Roscommon County Council

Lough Funshinagh Interim Flood Relief Scheme

Water Framework Directive Compliance Report

Reference:

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1. Introduction

1.1 Overview

The aim of the interim measures is to extract a sufficient volume of water from Lough Funshinagh so as to mitigate the predicted increase in level over the short term and to limit the peak water level to a level that will allow the flood risk at the properties around the lough to be successfully managed. This interim scheme is proposed prior to the development of a permanent scheme to manage flood risk in the vicinity of the lough.

To achieve this, the proposed interim scheme is to pump water from the lough for a period of up to 24 months. Pumping will be undertaken only when the water level in the lough is above 67.5mOD and at a flow rate not exceeding 300 litres/second (l/s).

The main elements of the proposed scheme consist of:

- Intake pump system (located within the lough)
- Intake compound
- Pipeline route from the lough to the Cross River
- Pipeline outfall at the Cross River.

This report presents the findings of the Water Framework Directive (WFD) (2000/60/EC) assessment of the potential impacts of the proposed scheme on the surrounding WFD waterbodies and WFD sensitive areas.

1.2 Report Aim

The purpose of this document is to assess compliance of the proposed scheme against the objectives of the WFD. The assessment can demonstrate WFD compliance by ensuring that proposed activities during construction, operation and decommissioning do not result in adverse effects to designated water bodies (or WFD sensitive areas). This document demonstrates that the proposed scheme will not jeopardise the potential for WFD water bodies to achieve good chemical or ecological status, whether already achieved or as a future objective.

The proposed scheme refers to the construction of an intake, intake compound, overground 2.5 km pipeline and outfall to the Cross river, to alleviate the flood risk posed from Lough Funshinagh. The aim of the proposed scheme is to lower, and then maintain, lough levels to reduce the risk of flooding on nearby residences and the Curraghboy village. The scheme would operate for up to two years, over two winter seasons (i.e. 2024/2025) and is proposed prior to the design and implementation of a permanent scheme. The pipeline would withdraw water from Lough Funshinagh and discharge water into the Cross River.

This report sets out the results of the WFD assessment and provides the competent authority, An Bord Pleanála, with the information necessary to undertake the necessary assessments and enable approval or otherwise of the proposed scheme.

2. WFD Assessment Methodology

2.1.1 Introduction

The following sections outline the legislation and guidelines considered, and the adopted methodology for defining the baseline environment and undertaking the WFD compliance assessment in terms of water quantity and quality. The requirements of the WFD are subtly different from those of EIA or assessments under the Habitats Directive in terms of the parameters and the level of detailed evaluation needed. Once the scope of assessments has been determined individually, there may be opportunities to explore synergies during data collection, assessment and public consultation before applying specific 'significance' tests under each individual Directive (JASPERS, 2018).

Assessments of relevance to this proposed scheme are as follows:

- EIA screening assessment under the EIA Directive 2014/52/EU
- Appropriate Assessment under Article 6(3) of the Habitats Directive 92/43/EEC.

2.1.2 Legislation, Planning Policy and Guidance

This WFD compliance assessment has been informed by the following legislation, policies, and published guidance:

2.1.2.1 Legislation

- Water Framework Directive (WFD) (2000/60/EC) (as amended)
- Groundwater Directive (2006/118/EC) (as amended)
- Habitats and Wild Fauna and Flora Directive (92/43/EEC) (as amended)
- Bathing Water Directive (rBWD) (2006/7/EC) (as amended)
- Nitrates Directive (91/676/EEC) (as amended)
- Environmental Quality Standards (EQS) Directive (2008/105/EC) (as amended)
- Priority Substances Directive (2008/105/EC) (as amended)
- European Communities (Water Policy) Regulation 2003 (S.I. 722 of 2003) (as amended)
- Schedule 5 of the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009), as amended
- EU Groundwater Regulations (S.I. 9/2010 (as amended)
- Arterial Drainage Act (1945) (as amended)
- Planning and Development Act (2000) (as amended); and
- Planning and Development (Amendment) (No.2) Regulations 2011 (S.I. No. 454 of 2011).

2.1.2.2 Planning Policies

Cycle 3 River Basin Management Plan (DHLG, 2024)

The WFD requires all Member States to protect and improve water quality in all waters so that we achieve good ecological status by 2015 or, at the latest, by 2027. It applies to rivers, lakes, groundwater, and transitional coastal waters. The Directive requires that management plans be prepared on a river basin basis and specifies a structured method for developing these plans. Ireland's river basin management planning process is based on a single national River Basin District, which is broken into 46 catchment management units (CMUs). The CMUs have been further broken down into 583 sub-catchments with waterbodies[1] within. Substantial background information for the plan and the most up to date information for the status of a waterbody is provided at www.catchments.ie. Information about the use and pressures on a waterbody is provided through specific Catchment and Sub-Catchment Assessments. The current condition of water resources is assessed against the standards and environmental objectives set out in the WFD.

The EU Habitats Directive places strict legal obligations on Ireland to ensure the protection, conservation and management of the habitats and species of conservation in all European Sites. An 'Appropriate Assessment' (AA) is necessary for a project which may have a likely significant effect on any European Site. The Habitats Directive has clear links to the WFD through the Register of Protected Areas, which includes Special Areas of Conservation (SAC) designated under the Habitats Directive, and Special Protection Areas (SPAs) designated under the Conservation of Wild Birds Directive (Directive 79/409/EEC as codified by Directive 2009/147/EC), collectively referred to as 'European Sites'. Many of the habitats and species listed for protection in both the Birds and Habitats Directives are water dependent. While maintenance and restoration of these features to favourable conservation status is the responsibility of the National Parks and Wildlife Service (NPWS), the EPA monitors the supporting water quality requirements for habitats and species using their assessed status under the third cycle River Basin Management Plan (RBMP).

The EPA has identified that diffuse emissions from the agricultural sector is the primarily source of the upward trend in excess levels of nutrients in water in Ireland. In addition, land and river channel alterations arising from agricultural activities are a significant pressure on the physical condition/hydromorphology of river channels. Irelands Common Agricultural Policy and the Nitrates Action Programme promote a sustainable agriculture model and the Good Agricultural Practice Regulations provide stricter requirements.

Peatland management influences the quantity and quality of water in a catchment. Appropriate habitat management combined with the restoration and rehabilitation of damaged and degraded peatlands can lead to improvements in the quality of water arising from peatland catchments. Maintaining and restoring peatlands will reduce carbon leaching, peat silt and ammonia losses; and vegetation of the surface of peat can slow the flow of water overland.

4th National Biodiversity Action Plan 2023-2030 (NPWS, 2023)

The National Biodiversity Action Plan outlines multiple actions meant to support the resilience and health of water ecosystems throughout Ireland. Outcome 2D: "*Biodiversity and ecosystem services in the marine and freshwater environment are conserved and restored*" has the most relevance for protection of water quality and ecosystems within the proposed scheme. Under this outcome are several targets and actions intended to achieve the outcome:

- By 2027, protection and restoration measures detailed in Ireland's third RBMP are implemented to ensure that our natural waters are sustainably managed, that freshwater resources are protected so that there is no further deterioration; and where required, Ireland's rivers, lakes and coastal water bodies are restored to at least good ecological status
- By 2027, optimised benefits in flood risk management planning and drainage schemes are in place

[1] A waterbody is an individual unit of a water feature used for monitoring and planning purposes.

- By 2026, Ireland is meeting all requirements for its transitional, coastal, and marine environment under the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD), thereby achieving and maintaining High or Good Ecological Status and Good Environmental Status, respectively; and
- By 2030, 300km of rivers are restored to a free-flowing state.

National Planning Framework (Project Ireland 2040)

Objective 57 of the National Planning Framework (NPF) (Project Ireland 2040) outlines ways to enhance water quality and resource management by:

- Ensuring flood risk management informs plan-making decisions by avoiding inappropriate development in areas at risk of flooding in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities (DEHLG and OPW 2009)
- Ensuring that River Basin Management Plan objectives are fully considered throughout the physical planning process; and
- Integrating sustainable water management solutions, such as Sustainable Urban Drainage (SuDS) principles, porous surfacing and green roofs, to create safe places.

Climate Action Plan 2024 (GoI, 2024)

The Climate Action Plan mentions that Ireland has observed significant impacts of climate change, including a consistent temperature rise over the past 120 years, reduced frost days, and shorter frost seasons. Sea levels have risen steadily since the early 1990s, and projections suggest decreased spring and summer rainfall alongside more frequent heavy precipitation events in winter and autumn. These shifts are anticipated to result in widespread direct and indirect adverse effects on Ireland. Foreseen impacts encompass heightened risks of groundwater, river, and coastal flooding, elevated coastal erosion, amplified strain on water resources and water purity, and alterations in wind velocities and storm pathways.

Although the Climate Action Plan lacks a designated water section, the measures affecting the water sector will be integrated within various related sections, including agriculture, land use, and adaptation. Under the policy measures for Ireland the anticipated climate change effects on Ireland's environment, society, and economic growth are projected to be extensive. These impacts encompass managed and natural ecosystems, water resources, agriculture and food security, the built environment, human health, and coastal areas. The most pressing risks Ireland faces from climate change predominantly revolve around alterations in extremes, such as floods, droughts, and storms. Policy measures are needed to address these risks.

According to the Climate Action Plan (CAP), the Water Resource and Flood Risk Management Sector is one of the Adaptation Sectors at the National Level and entails the following Sector Levels: Flood Risk Management, Water Quality, and Water Services Infrastructure.

County Roscommon Local Authority Climate Action Plan 2024-2029 (RCC, 2023)

The assessment identified river flooding and severe windstorm events currently posing the highest level of risk for County Roscommon, with river flood associated with damage to assets and infrastructure and potential for isolation of communities and vulnerable populations. The incidence of river flooding events is projected to increase, with associated impact severity rising from moderate to major. Nature-based solutions are promoted in relation to climate adaptation and mitigation. These need to be approached in a strategic way. The assessment of Lough Funshinagh in this Plan indicates that the lough has known threats and pressures for the SAC related to agricultural practices, direct interaction with species and populations through predator control and other direct land use practices. Mitigation measures are required to ensure no such impacts will affect the ecological integrity of the European site. The site is relatively unaffected by drainage and intensive agriculture, so its vegetation structure is unique. It contains rare species of bird and plant and probably also of invertebrates. Lough Funshinagh is classified as a turlough since it fluctuates to a significant extent every year and occasionally dries out entirely. However, in most years an extensive area of reed-filled water persists which provides excellent cover for wildfowl especially breeding species.

2.1.2.3 Guidance

Water Framework Directive: Project Assessment Checklist Tool (JASPERS, 2018)

Published methodologies for the assessment of plans or projects in relation to the WFD in Ireland are currently not available. This document provides background to the WFD and its implementation in EU Member States as well as summarising some of the relevant contents of CIS Guidance Document 36.

Irish Wetland Types – an identification guide and field survey manual (Irish Ramsar Wetlands Committee, 2018)

This is produced by the Irish Ramsar Wetlands Committee under the principles of the Ramsar Convention that predates European legislation under an international treaty. The Ramsar convention has an underlying focus on the biodiversity value of wetlands on a global scale, whilst recognising the livelihood and economic wellbeing benefits at a local scale. Subsequent to this the ecological importance of wetlands was recognised by the European Union under the EU Habitats and Birds Directives. The Irish Ramsar Wetlands Committee (IRWC) was set up by the Irish Government in 2010 and is co-hosted by the NPWS and the EPA.

River Hydromorphology Assessment Technique (RHAT) Training Manual-Version 2. (NIEA, 2014)

A detailed hydromorphology assessment will require a site walkover using the River Hydromorphology Assessment Technique (RHAT). The RHAT method was developed for WFD classification, but it also has other applications including assessing morphological pressures at a site or reach scale. The RHAT can be used as a tool to determine remedial/restoration work required to improve the river habitat as well as determine deviation from a "Natural" form. The RHAT concludes by defining a WFD Hydromorphological Status (i.e. Bad, Poor, Moderate, Good, High). This stage takes into consideration mitigation measures and is an iterative process whereby a mitigation measure can be assessed to determine the most appropriate for the proposed scheme.

Guidelines on procedures and treatment of geology, hydrology, and hydrogeology for National Road Schemes (NRA, 2009)

The primary objective of the Guidelines is to provide guidance on the assessment of geological, hydrological, and hydrogeological impacts during the planning and design of national road schemes in Ireland. The Guidelines are not mandatory but serve as a supplement to the National Roads Project Management Guidelines (NRPMG). The document includes a list of relevant impacts and constraints to be considered as well as maps to be included when determining the impact rating for geology, hydrology, and hydrogeology. Additionally, a matrix including criteria for rating impact significance at the EIA stage is included for each subject.

The Planning System and Flood Risk Management Guidelines for Planning Authorities (OPW and DEHLG, 2009)

In November 2009, the DEHLG and the OPW jointly published a Guidance Document for Planning Authorities entitled 'The Planning System and Flood Risk Management'. The Guidelines are issued under Section 28 of the Planning and Development Act 2000; and Planning Authorities and An Bord Pleanála are therefore required to implement these Guidelines in carrying out their functions under the Planning Acts.

The aim of the Guidelines is to ensure that flood risk is neither created nor increased by inappropriate development. The Guidelines require the planning system to avoid development in areas at risk of flooding, unless they can be justified on wider sustainability grounds, where the risk can be reduced or managed to an acceptable level. They require the adoption of a Sequential Approach (to Flood Risk Management) of Avoidance, Reduction, Justification and Mitigation and they require the incorporation of a Flood Risk Assessment into the process of making decisions on planning applications and planning appeals.

Fundamental to the Guidelines is the introduction of flood risk zoning and the classification of different types of development having regard to their vulnerability. The management of flood risk is now a key element of any development proposal in an area of potential flood risk and should therefore be addressed as early as possible in the site master planning stage.

Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016)

Inland Fisheries Ireland (IFI) provides guidance on the organisation of construction activities and crossing structures to prevent damage to aquatic and riparian habitats, pollution of waters, and interference with upstream and downstream movement of aquatic life during construction activities. These include guidance around the type of culverts and structures that should be used to reduce impact on the aquatic environment and proper planning to avoid discharge of construction materials into surface waters. IFI prefers clear span river and stream crossing structures whenever possible to avoid altering or moving existing watercourses; however, when this is not possible, planning should consider options which least disrupt the riparian zone and streambed.

Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas (DHLGH, 2022)

The Best Practice Interim Guidance Document a high-level guidance document demonstrating how urban areas can be planned and designed to address impacts related to the environment, climate change and flood risk through nature-based solutions for the management of rainwater and surface water runoff. The document has a distinct focus on planning and identifying opportunities where SuDS and nature-based solutions should be employed.

2.1.3 Scope of Assessment

To ensure compliance with the EU Water Framework Directive (2000/60/EC) (as amended), it is necessary to consider the elements of surface and groundwater systems. Ecological status of surface water is defined through assessment of ecological and chemical status. Ecological status relates to the biological quality elements supported by the physico-chemical elements and hydromorphology elements. Chemical status relates to the amount of priority substances, priority hazardous substances (i.e., listed in the EC Environmental Quality Standards Directive (2008/105/EC); transposed in Ireland by the European Communities Environmental Objectives (Surface Waters) Regulations 2009 S.I. No. 272/2009 (as amended)) and other pollutants in the aquatic environment.

All new developments in Ireland that may have an impact on the water environment are required to comply with objectives of the WFD, under the European Communities (Water Policy) Regulations 2003 S.I. No. 722/2003 (as amended). This includes ensuring that no changes occur that cause a deterioration of the ecological status of any water body, and that the development does not prevent the achievement of the future status objectives of any water body. Water body status deterioration can occur because of deterioration of any of the quality elements that make up the overall status (e.g. biological, physico-chemical, or hydromorphological elements for surface waters) even where this does not result in a lowering of overall water body status.

2.1.4 Summary of Data Sources

Data relating to water has been obtained from the following sources:

- WFD waterbodies, status and risk:
  - River Basin Management Plan (RBMP) for Ireland 2018 -2021, Cycle 2 (Department of Housing, Planning and Local Government, 2018); and associated Upper Shannon (26G) Catchment Summary
  - Draft RBMP for Ireland 2022-2027, Cycle 3 (Department of Housing, Planning and Local Government, 2023); and associated Upper Shannon (26G) Catchment Summary
  - EPA Unified GIS Application (https://gis.epa.ie/EPAMaps/ accessed July 2024) for Upper Shannon (26G) water quality and river ecological monitoring results
  - Water quality and Q-value temporal monitoring for Upper Shannon (26G) Catchment (https://www.catchments.ie/data accessed July 2024)
  - NPWS (2023) SAC and SPA Datasheets.
- Hydrology, hydromorphology and geohydrology:

- MWP, 2024. Lough Funshinagh Interim Pumping System. Engineering Report for RCC
  - Geological Survey Ireland (https://www.gsi.ie/en-ie/data-and-maps)
  - Map of Irish Wetlands (https://www.wetlandsurveys.ie/).
- Water quality:
  - EcoQuest Environmental. 2021. Lough Funshinagh Flood Management Works: Baseline Water Quality Monitoring Report for OPW
  - EcoQuest Environmental. 2021. Lough Funshinagh Flood Management Works: Quarterly Water Quality Monitoring Report for OPW.
- Biological and chemical water quality
  - Triturus. 2024. Aquatic baseline report for the Lough Funshinagh Interim Flood Relief Scheme.

2.1.5 Technical Assessment

2.1.5.1 Aquatic Baseline Assessment

Aquatic surveys were undertaken at seven locations within the Cross River in August 2024 (Triturus, 2024). The surveys informed a baseline assessment of the aquatic ecology including fisheries and water quality (biological and physiochemical), as well as other protected aquatic species and habitats in the footprint of the proposed scheme.

2.1.5.2 Water Quality Baseline Assessment

Baseline water quality samples were taken from both Lough Funshinagh and across seven locations within the Cross River in August 2024 (Triturus, 2024). One sample from the Cross River was taken upstream from the proposed scheme to act as a control. The remaining six sample locations within the watercourse were taken downstream of the proposed scheme.

2.1.5.3 Hydrology Impact Assessment

The assessment of potential changes in hydrological processes in watercourses affected by the proposed scheme is underpinned by hydrological modelling[11]. This detailed methodology is described in the MWP (2024) Lough Funshinagh Interim Pumping System – Engineering Report. The modelling has been undertaken to assess the potential impacts that the proposed scheme would have upon the hydrological function of Lough Funshinagh and the Cross River and has been used to inform the assessment and conclusions of this report. The assessment includes a review of available flow gauge data, estimations of the flow (m^3/s) during both high and low flow events with and without the proposed scheme (i.e. additional pumped water) and the flow discharge (m^3/s).

2.1.6 Consultation

Consultations were held between Inland Fisheries Ireland (IFI) and the NPWS during August 2024 regarding the proposed scheme. The NPWS have been made aware of the current proposed scheme since July 2024. Notably, while NPWS has been aware of the wider flooding issues at Lough Funshinagh prior to this specific proposal, these consultations have provided a platform for in-depth discussions and collaboration on the potential impacts and mitigation measures related to the proposed scheme.

2.1.6.1 Environmental Protection Agency

The EPA were contacted on the 7th August 2024. In response the authority responded that the EPA does not conduct monitoring in Lough Funshinagh. Guidance was provided as to the latest river status information of catchments.ie and Q-value data on epa.ie. Local Authority Waters Programme (LAWPRO) acts as a national shared service working on behalf of local authorities in coordinating of implementation of the Water Framework Directive. On the 25th July 2024 the local LAWPRO representative was consulted and whilst they indicated they had no statutory role in consultation, they were interested to support Roscommon County Council in any way.

2.1.6.2 *Inland Fisheries Ireland*

IFI was contacted requesting guidance regarding the waterbodies at Lough Funshinagh and the Cross River in relation to the proposed scheme. The purpose was to understand any potential concerns IFI might have about the proposed scheme and obtain advice on the design of the pump intake, screen, mesh sizes, outfall to the Cross River and any potential general impact on fisheries from the proposed scheme and mitigation which might be necessary to minimise or eliminate impacts. Additionally, Arup requested any available data for the Cross River and Lough Funshinagh to inform the relevant reports (AA, EcIA and WFD Assessment). In response to Arup's inquiry, IFI sent a letter on August 13th requesting further information, to which Arup provided a detailed response on August 16th.

2.1.6.3 *National Parks and Wildlife Service*

Relevant members of the NPWS Ecological Guidance and Advice Unit (EGAU), Development Applications Unit (DAU) and regional management/personnel were consulted regarding the proposed scheme. An online round-table meeting was held on August 22nd, during which NPWS representatives were presented with an overview of the proposed scheme, its design, relevant environmental and ecological baseline parameters, and the current findings of the associated environmental reports, including the AA, EcIA, EIA Screening and WFD Assessment.

3. STAGE 1: Screening

3.1 Proposed Scheme Design

The main elements of the proposed scheme consist of:

- Intake pump system (located within the lough)
- Intake compound
- Pipeline route from the lough to the Cross River
- Pipeline outfall at the Cross River.

3.1.1 Intake Pump System

The intake pump system consists of:

- Floating pump pontoon incorporating 2 No. high capacity hydraulically driven pumps housed in a floating container with integrated fish screens
- 2 No. hydraulic power units (HPUs) (located in the bunded intake compound) to power the pumps
- 4 No. 3,000L double skinned fuel tanks (located in the bunded intake compound; and
- Floating access pontoon to provide safe access to the pontoon and support the hydraulic hoses which link the pumps to the HPUs.

Refer to Figure 3.1 for the layout of the intake pump system.

The intake pump system will include a facility to alter the pump flow rate as necessary, refer to Section 3.3.2 *Pumping Controls*.

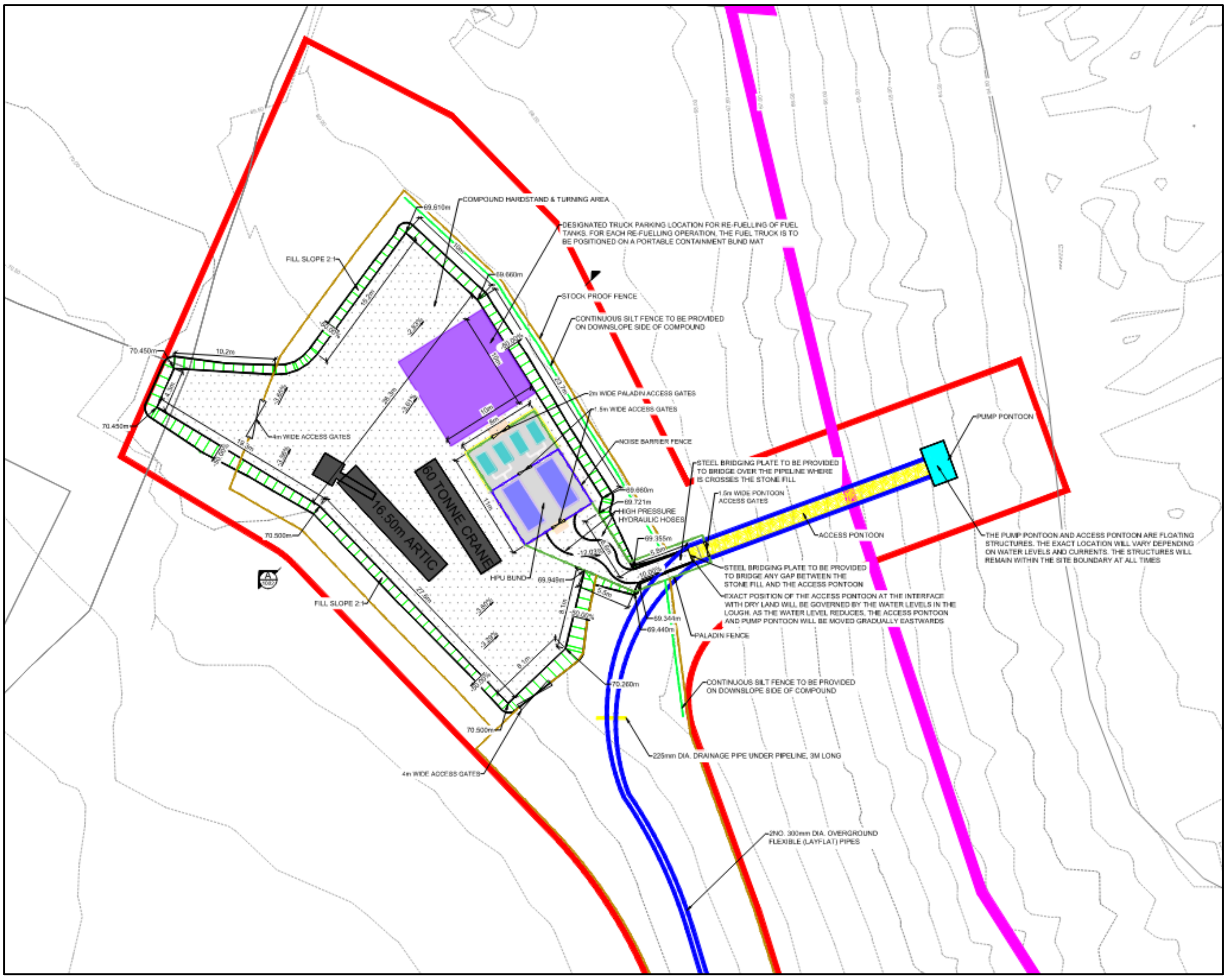

Figure 3.1 Proposed intake compound and pump layout. Source Dwg 24821-MWP-00-00-DR-C-1001 (MWP) | not to scale

3.1.1.1 Floating Pump Pontoon

The floating pump pontoon will consist of two submerged pumps enclosed in a container (2m x 1.2m x 4m), refer to Figure 3.2 from Drawing No. 24821-MWP-00-00-DR-C-1005 (MWP).

One vertical side of the container will be fitted with a $2m^2$ mesh fish screen with a maximum opening of 10 mm. The approach velocity of the water entering through the mesh screen will be a maximum of 150 mm/second, at a total flow rate of 300 litres/second. This will ensure that juvenile fish can swim away against the current and not get entrained on the mesh.

The container will float due to the buoyancy tanks fitted and will also be stabilised in position by four 100mm diameter poles with baseplates. As the poles are not for vertical support, minimal settlement of the poles into the ground is anticipated (less than 150 mm).

The pump pontoon will be accessible from land via the floating access pontoon.

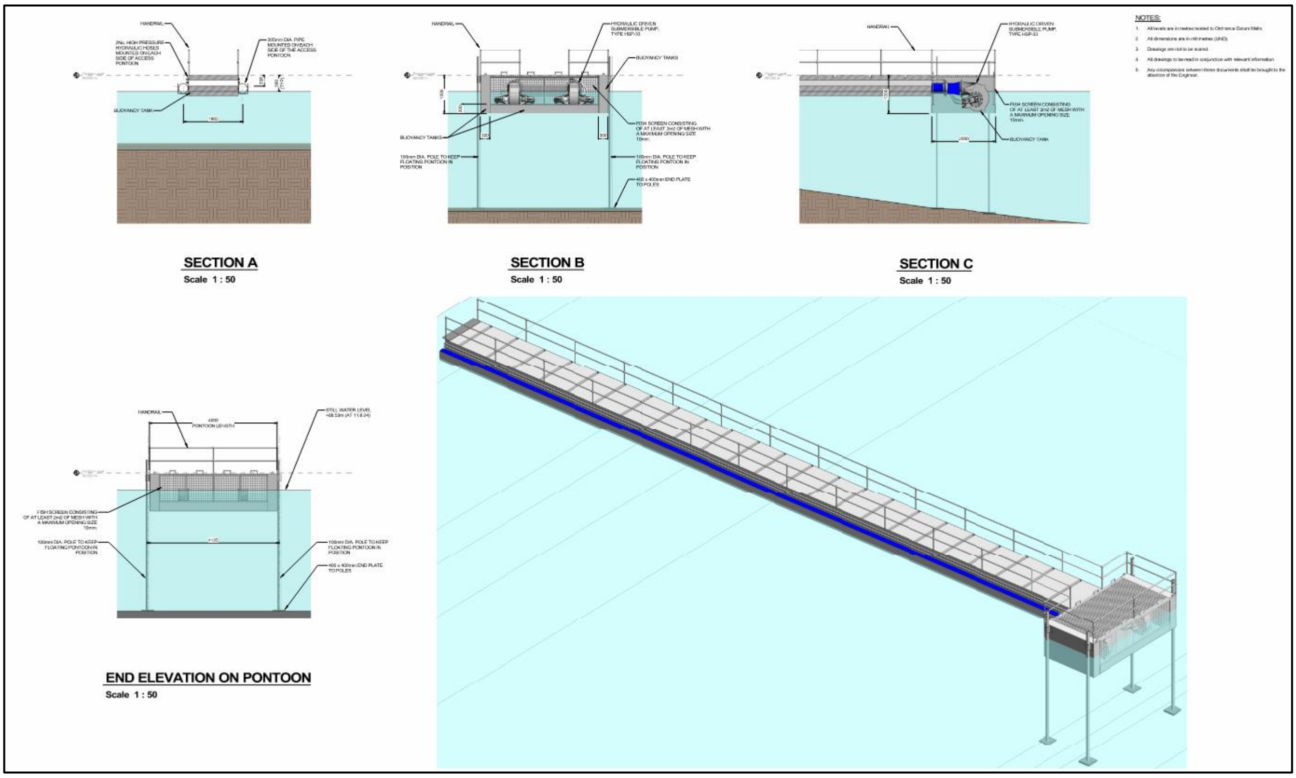

Figure 3.2 Design details of the pump pontoon (intake system). Source Dwg. 24821-MWP-00-00-DR-C-1005 (MWP) | not to scale

3.1.1.2 Floating Access Pontoon

The pump pontoon (and screen) will be accessible from land via a floating access pontoon, approximately 25.6 meters long that will extend from the lough edge, refer to Figure 3.3 below.

The access pontoon will support two pipes (305mm diameter each) mounted on either side of the pontoon that will run from the pump pontoon and will be jointed to the two 300mm diameter flexible ‘layflat’ pipelines.

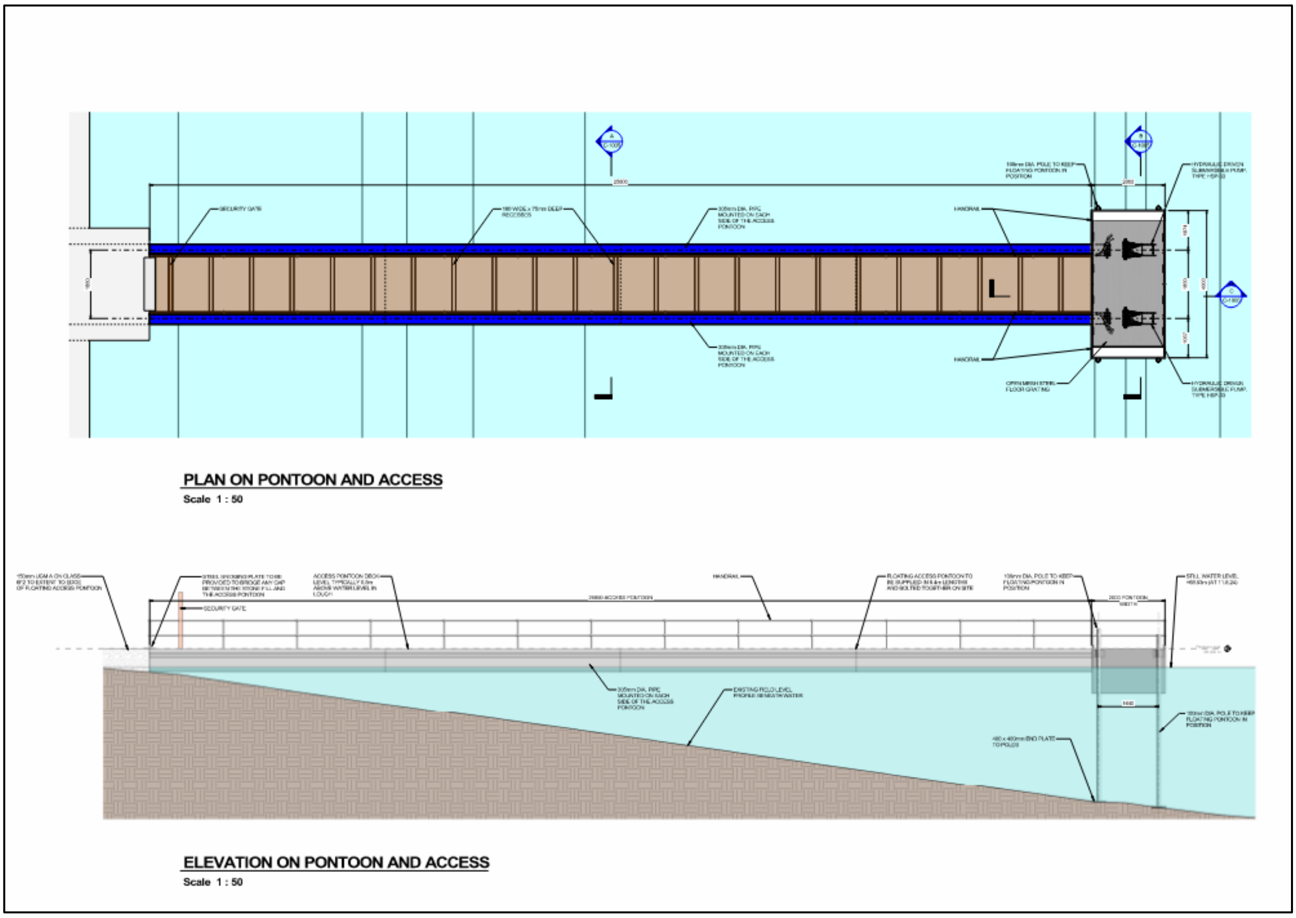

Figure 3.3 Configuration of the 2 pumps and floating pump pontoon. Source Dwg. 24821-MWP-00-00-DR-C-1004 (MWP) | not to scale

3.1.1.3 Pumping Rate and Pump Controls

The maximum flow rate has been selected taking consideration of the expected volume that needs to be removed from the lough in order to have a short-term meaningful beneficial impact and based on the flood risk assessment of the Cross River reach as well as with regard to the availability of the necessary high-capacity pumps.

Pumping will be undertaken only when the water level in the lough is above 67.5 mOD. As noted in the Engineering Report (Section 2.3, MWP 2024), the rationale for selecting a level of 67.50 mOD is that this is still above the pre-2016 "normal" maximum flood level indicated by the Lough Funshinagh Technical Subgroup (2024) and GSI (2016).

The two submersible pumps will operate in parallel with a total flow rate not exceeding 300 l/s.

The pump system together with the lake level and the flow in the Cross River will be monitored over the full duration of the scheme by Roscommon County Council.

3.1.2 Intake Compound

The overall area of the compound will be c 1,150 m^2. The intake compound is required to provide safe access for the delivery of the pump system components and to provide for safe and secure operation of the pumping system with appropriate protections in place to prevent contamination from a potential fuel spillage from the HPUs or storage tanks.

The intake compound consists of:

- 2 x 600kW hydraulic power units (HPUs)
- 4 x 3,000 litre double skinned fuel tanks, 2 for each HPU
- Concrete bund for HPUs and fuel tanks (11m x 8m) and secured with paladin fencing.

The intake compound will be located on private agricultural land located on the lough's edge. The design and location of the compound has been chosen to eliminate the risk of inundation of the tanks and pumping machinery (HPUs). The lowest elevation of the compound will be 69.22mOD. The compound will comprise a combination of a geotextile and geogrid placed directly on the grass over which a minimum thickness of 450mm of stone will be placed as the compound base to ensure all plant and machinery will be above the peak flood height of March 2024 (69.37mOD), refer to Figure 3.4 below.

In addition, the two 600kW hydraulic pumping units (HPUs) and four 3,000 litre diesel storage tanks will be located within a concrete bund with a minimum finished floor elevation of 70.50mOD. The HPUs will each be placed on concrete plinths within the concrete bund, refer to Figure 3.5 below.

The HPU model to be employed will be a D600/A4VSO500 manufactured by Holland Special Pumps. Each unit measures approximately 4m x 1.8m x 2.35m. The units are diesel powered with a fuel tank capacity of 100 litres housed within the HPU unit.

The HPUs will be connected to the pumps by two hydraulic hoses each via the access pontoon, refer to Figure 3.4 below.

The HPU sound level produced per unit is approximately 76dBA at 7 meters. To provide noise mitigation a 4m high solid noise barrier will surround the HPUs, with an acoustically absorptive material facing the power packs.

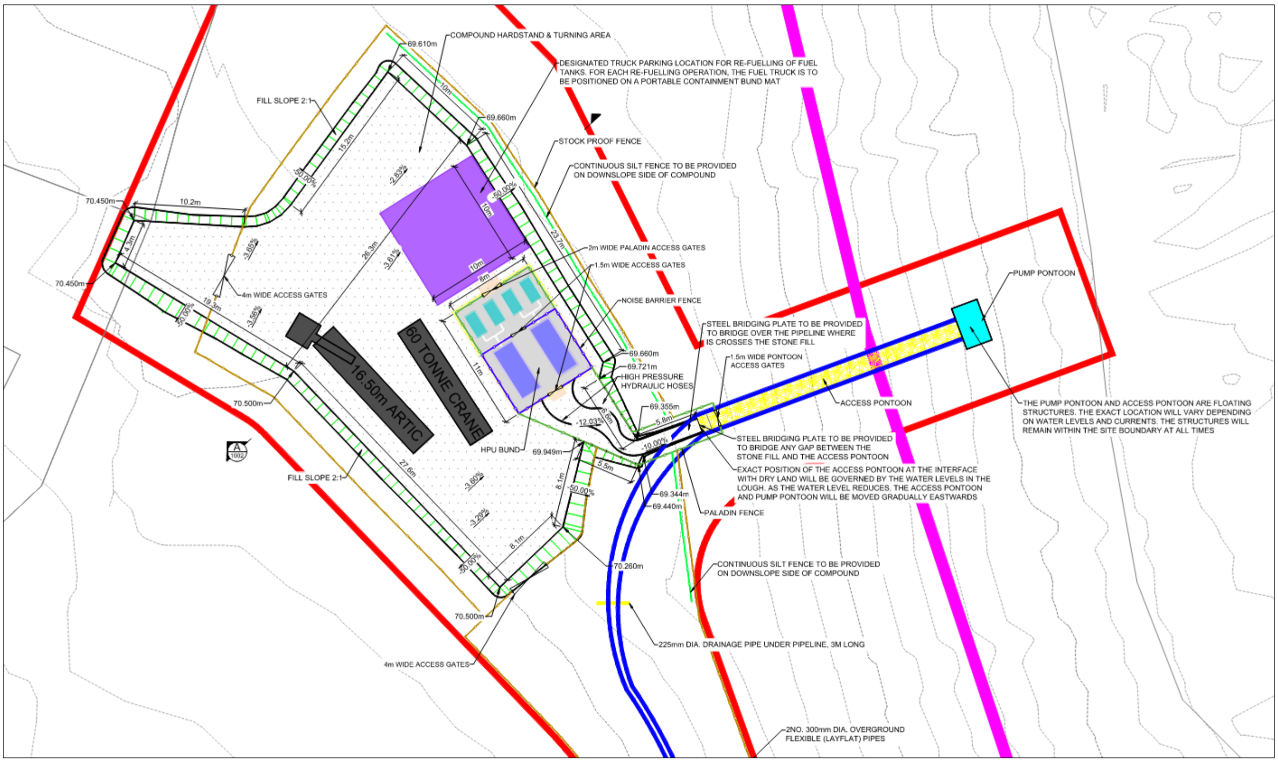

Figure 3.4 Intake compound, floating access pontoon and pump pontoon. Source Dwg. 24821-MWP-00-00-DR-C-1001 (MWP) | not to scale

3.1.2.1 Concrete Bund

As outlined above, both the HPUs and the four fuel tanks will be located within a reinforced concrete bund (11m x 8m base) with upstand walls to contain any fuel in the case of a spillage or leak. All fuel tanks are double skinned and in addition the bund will provide at least 110% storage capacity for 2 No. fuel tanks (i.e. 6,600 litres) plus an additional allowance for 75mm of rainfall accumulation.

The finished floor level of the concrete bund will be 70.58 mOD, reducing to 70.50 mOD at the sump to allow for rainwater accumulation, refer to Figure 3.5 below. The sump will be provided at the lowest corner of the bund to enable rainwater to be pumped out at regular intervals during the operational phase. The upstand walls also serve as a wheel stop to prevent vehicles accidentally impacting the fuel tanks during turning manoeuvres.

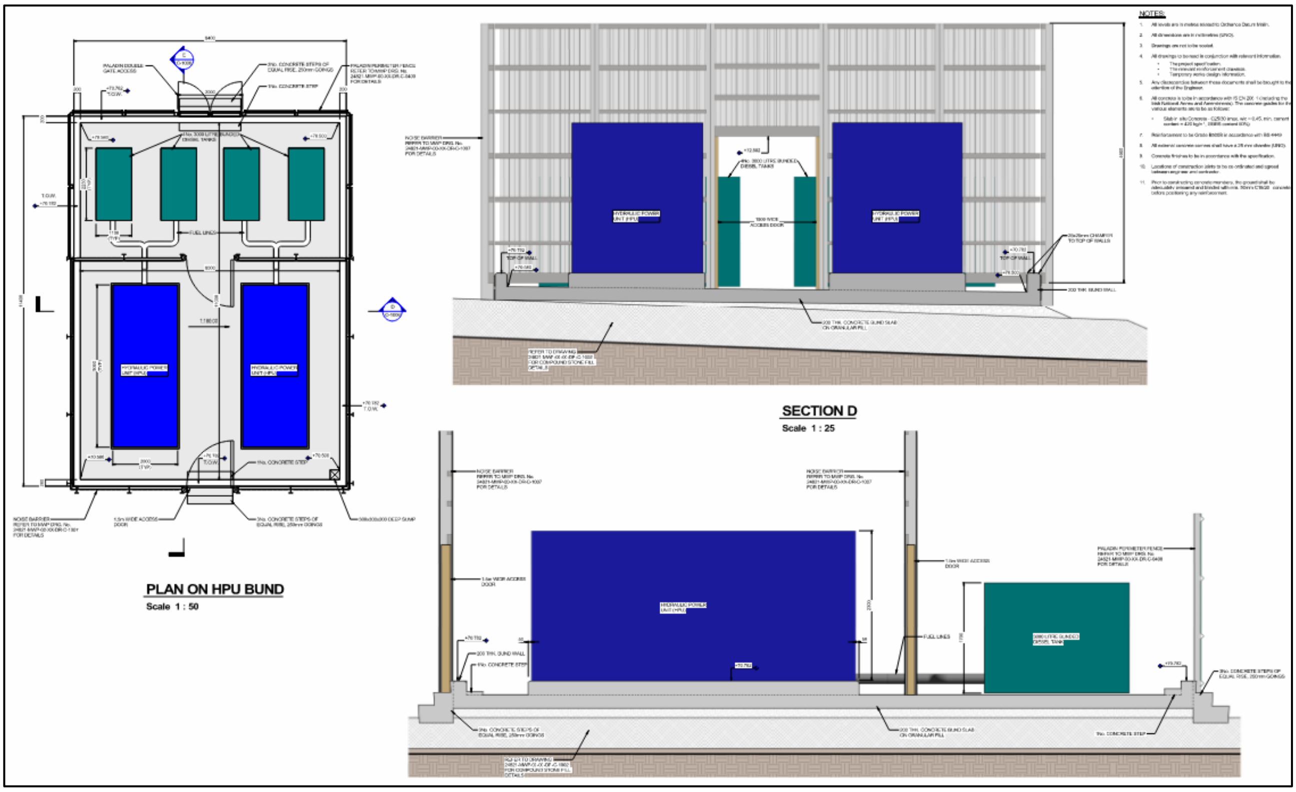

Figure 3.5 Configuration of concrete bund containing 4 no. fuel tanks and 2 no. HPUs. Source Dwg. 24821-MWP-00-00-DR-C-1006 (MWP) | not to scale

3.1.2.2 Compound Base

The compound base will be made up of a minimum thickness of 450mm stone hardstand area suitable for vehicular traffic, including loading/unloading of delivery vehicles and fuel trucks. The total footprint of the hardstand area will be c. 1150 m^2. The hardstand area is sized to provide for safe truck turning within the compound. During construction the articulated delivery lorry (16.5m long) and 60 tonne crane used to deliver and place the plant into position will utilise the hardstand area within the compound, refer to Figure 3.5 above.

3.1.2.3 Fencing and Security

A stock proof fence will be installed around the perimeter of the compound. An agricultural access gate (Figure 3.6) will be provided at the northern end of the compound to facilitate access. An additional gate will be provided at the southern end of the compound to enable the landowner to access the agricultural lands to the south.

For security and safety reasons, a paladin fence will be erected to secure the perimeter of the HPU/tank bund and access point to the floating access pontoon.

Access for the landowner to their lands will be maintained at all times.

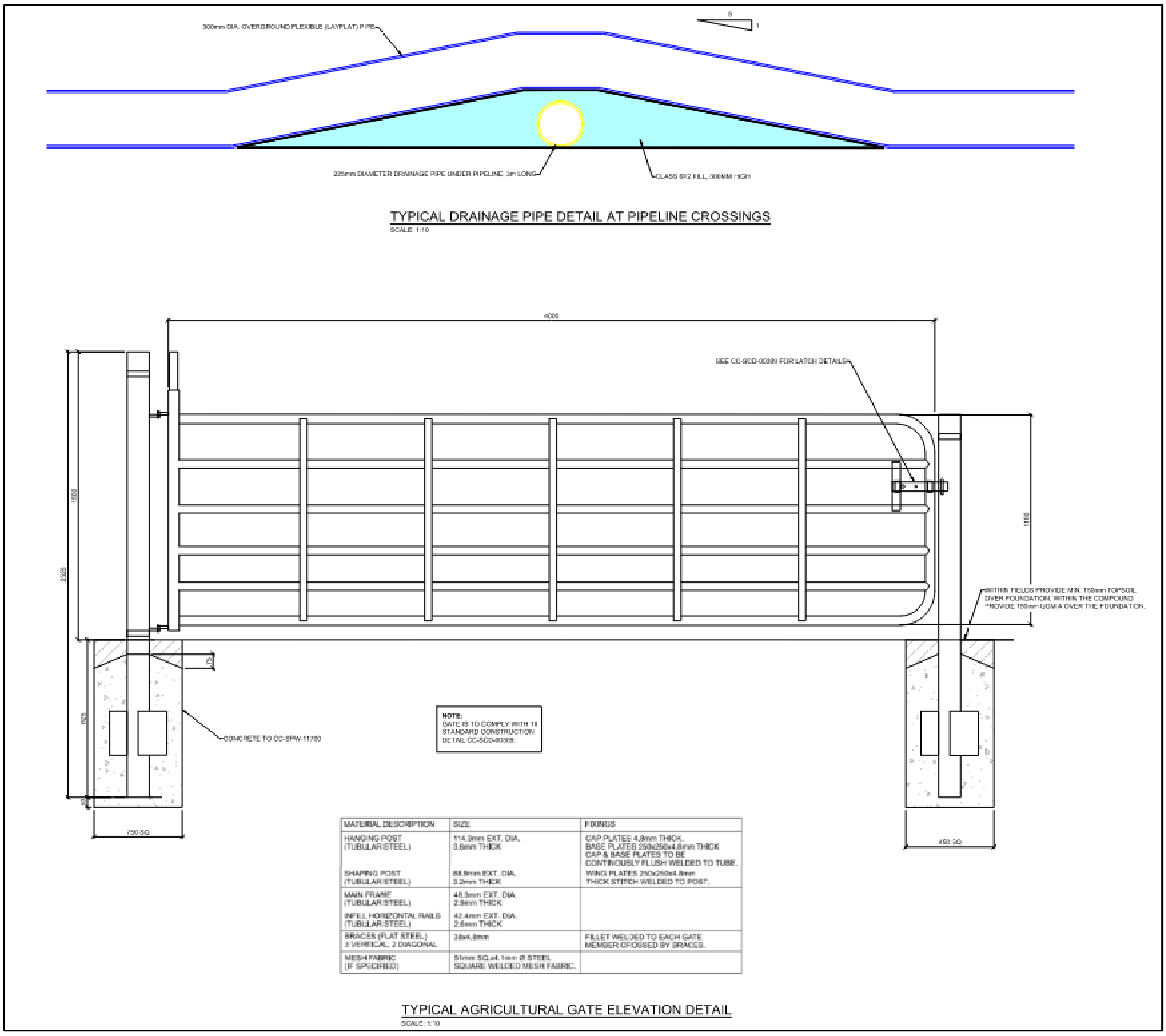

Figure 3.6 Agricultural gate design. Source Dwg. 24821-MWP-00-00-DR-C-0404 (MWP) | not to scale.

3.1.3 Pipeline Route to the Cross River

The purpose of the pipeline is to convey the water from the pump intake system to the outfall at the Cross River. The route of the pipe has been selected so that it runs along property boundaries for the majority of its length as this will minimise disruption to landowners.

The total length of the pipeline will be 2.7 km:

- From the pump pontoon to the 2 No. 300mm diameter flexible pipes – c. 0.25 km
- From the 2 No. 300mm diameter flexible pipes to the PE ribbed pipe – 2.13 km
- From PE ribbed pipe to outfall at the Cross River (500mm diameter PE ribbed pipe) – 0.32 km.

The pipe between the pump intake system and PE ribbed pipe will consist of two parallel 300 mm diameter flexible pipes covering a length of c.2 km from the intake system to a point 160 m south of the L2013 road and will comprise 50 m to 200 m lengths (typically 200m) of flexible pipe. These flexi pipe lengths will be jointed using bolted collars and placed on the ground and will operate under pressure with full bore flow. At full capacity each flexible pipe will weigh 77kg per meter length. The pipeline will cross 10 existing hedgerows/ fences and at each crossing a 5 m gap will be cleared.

At the transition point south of the L2013, the flexible pipes will be connected via a manifold to a single PE ribbed pipe 500 mm in diameter (c.320 m long) which will terminate at the outfall to the Cross River.

The PE ribbed pipe will operate under gravity flow and will flow half full at a velocity of c.4.10 metres/second when the pumps are discharging at a rate of 300 litres/second.

The PE ribbed pipe will consist of lengths varying between 5m and 12 m of jointed pipe laid directly on the ground and will operate under gravity along the downhill approach to the outfall which has a gradient of approximately 3%. At full capacity the PE pipe will weigh 109kg per meter length. Settlement is not likely to exceed 50 mm for flexi pipe and the PE ribbed pipe.

Due to badger activity in the field where the PE ribbed pipe will be placed, a provision will be made for badgers to cross the PE ribbed pipe by constructing a ramp over the pipe.

Sections of pipe will also be provided through the fencing to facilitate movement of badgers in the area across the stock proof fencing.

3.1.3.1 Fencing

The pipeline route will where possible be located parallel and adjacent to property boundaries and existing fencing and hedgerows to minimise the disruption to landowners. The route will be fenced off with wooden post and wire fencing to prevent livestock and people from interfering with the pipeline. The fencing will provide a clearway of 5 m to 7 m wide to allow for a vehicle to access the pipeline route for routine inspections.

All fencing will be removed on completion of the pumping works.

The pipeline will be inspected daily to check for leaks or damage.

3.1.3.2 Road Crossings

The pipes will run overground throughout except at road crossings, which will be required at three locations:

- Private access road adjacent to the R362 road
- R362 regional road
- L2013 local road.

These road crossings will consist of two 600 mm diameter PE ribbed carrier pipes laid under the road, through which the pair of flexible pipes can be routed. These will be installed by open excavation followed by backfilling of the trench and reinstatement of the road. A short section of open excavation will remain on both sides of each crossing. The existing hedgerow will be removed on both sides of the road over a width of approximately 5m.

The pipeline will be installed in two segments such that only partial road closure will be required for up to two days at each public road crossing location. One lane of traffic will be kept open to maintain traffic flow.

3.1.4 Outfall

The outfall at the Cross River has been designed to prevent potential erosion of the riverbanks and bed. The outfall consists of the following key features (Figure 3.7 below):

- A geotextile layer will cover the riverbed and extend up both the sides of the riverbanks
- Rock armour will be used to hold the geotextile in position, prevent erosion and dissipate energy from the pipeline
- A diffuser tee fitted will be fitted at the end of the PE ribbed pipe to dissipate energy and distribute the flow over a larger area of riverbank. The tee will have a series of 36 no. 80 mm diameter holes drilled at 120 mm spacing on the side opposite to the PE ribbed outfall pipe
- Rock armour will be built up around the ends of the diffuser tee to further dissipate the energy from water discharging from the ends of the tee

- A 1.60 metre width of the riverbed will be covered with natural flag stones to hold the geotextile in place and to allow unhindered fish passage, as recommended by Inland Fisheries Ireland. The top of the flags will have an exposed aggregate finish. The leading edge and tail edge flags at the upstream and downstream interfaces with the existing riverbed will be level with the existing riverbed to avoid localised erosion.

At the outfall location, as detailed above, a geotextile layer will cover the riverbed and extend up the side of the riverbanks on both sides to protect the integrity of the riverbed from potential erosion from the outflow. The central part of the riverbed will remain free from rock armour so as not to impede fish passage. The geotextile will extend over a length of 10m, centred on the outflow location (5m upstream and 5m downstream of outflow).

Natural flag stones with an exposed aggregate finish will be placed over a 1.6m width of the riverbed with the leading edge and tail edge of the flags at the upstream and downstream interfaces placed level with the existing riverbed to avoid localised erosion.

The geotextile will be held in place by rock armour which consists of 200 kg rocks approximately 0.5 m in diameter. The types of rock used will be strong, inert rock, free from cracks/ joints to ensure the rock will not break down and affect the river environment.

The water from the outfall pipe will run onto the rock armour on the north (left) bank and this will dissipate the energy of the flow and allow it to enter the river in a controlled manner without causing erosion. Due to the significant depth of the channel, the diffuser tee will remain well above the water level in the river when pumping is being carried out.

The geotextiles, flags and rock armour will remain in place for the duration of the interim scheme. The geotextiles, flags and rock armour will be removed on the completion of the scheme.

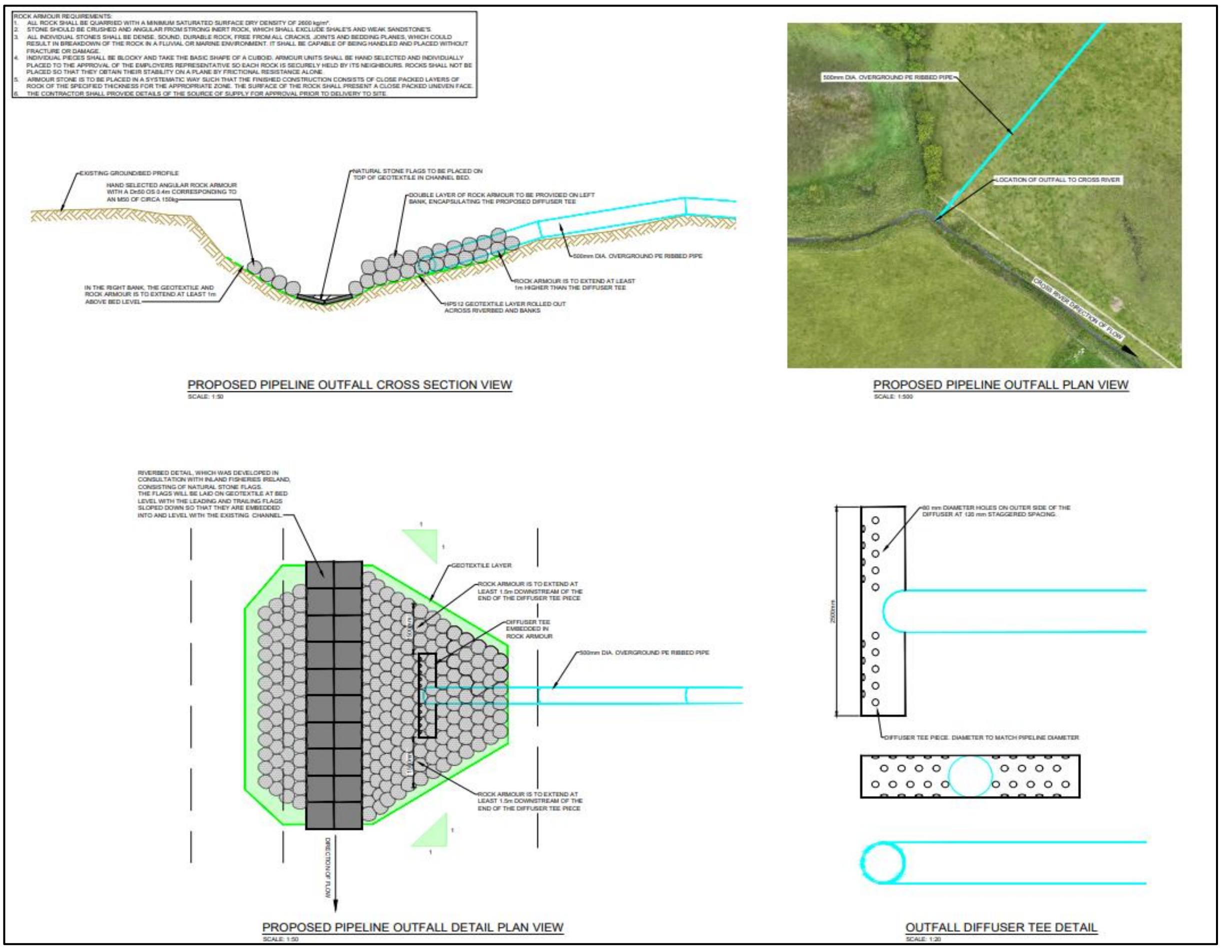

Figure 3.7 Outfall design. Source Dwg. No. 24821-MWP-00-00-DR-C-1003 (MWP) | not to scale

3.2 Construction of the Proposed Works

This section describes the works required to construct, install and commission the proposed scheme.

3.2.1 Phasing of works

Some works may be carried out concurrently where possible however the overall phasing of the works will likely be as follows:

- Construction of the intake compound
- Installation of the pump intake system i.e. HPUs, pump pontoon and floating access pontoon
- Laying of pipeline along the pipeline route including road crossings and fencing
- Installation of outfall; and
- Equipment installation and setup.

It is anticipated that the construction works will take approximately one month to complete. It is expected that the civil works will be completed in 3-4 weeks and that the installation and setting up of equipment will take one week.

3.2.2 Intake Compound

The compound will be constructed without excavating the existing ground. A combination of geogrid and geotextile will be placed over the vegetation on the existing surface within the footprint of the compound. A minimum thickness of 450mm of imported stone (Class 6F or similar) will be placed on top of the geogrid and geotextile. The total footprint of the hardstand area at the will be c. 1,150 m^2.

A site inspection by the design engineering team and landowner knowledge of the land have determined the ground conditions to be suitable for the size and nature of compound designed for the proposed scheme.

Intake Compound

The construction of the intake compound will involve the following sequence:

- The appointed contractor will mark out the line of the proposed compound using a GPS / total station
- A layer of geogrid / geotextile will be rolled out by hand along the line of the proposed compound
- The stone aggregate used to construct the compound will be imported from a local quarry using trucks. The trucks will reverse tip the stone onto the geogrid / geotextile and an excavator will be used to spread the stone before compaction. Compaction of the stone material will be completed using the Transport Infrastructure Ireland (TII) Specification for Roadworks. This is typically completed in layers with the use of a vibratory roller or similar
- The compound will be constructed with a minimum crossfall of 3% to ensure that water can flow off the surfaces and to reduce the risk of rutting / potholes occurring
- Surface water runoff from the compound will be discharged directly over the edge of the stone embankment and a continuous silt fence will be constructed on the downslope side to capture any sediment that may run off the surfaces
- The timber posts in the stockproof fence will be driven into the existing soil without any excavation.

Concrete Bund

- A concrete bund measuring 11m x 8m will be constructed inside the compound to support the HPUs and fuel tanks and to contain any fuel in the event of a spillage. The slab will be cast directly onto the imported stone used to construct the compound. The slab will include reinforcement to prevent leakage. The upstand walls will be cast in-situ using conventional formwork
- The acoustic barrier, 4m in height, will be fixed directly to the HPU bund upstand walls or slab

- The paladin fence posts will be secured to concrete blocks (Kelley Blocks or equivalent) so as to avoid disturbance of the underlying ground. Refer to the drawing in Figure 3.8 for details of fences.

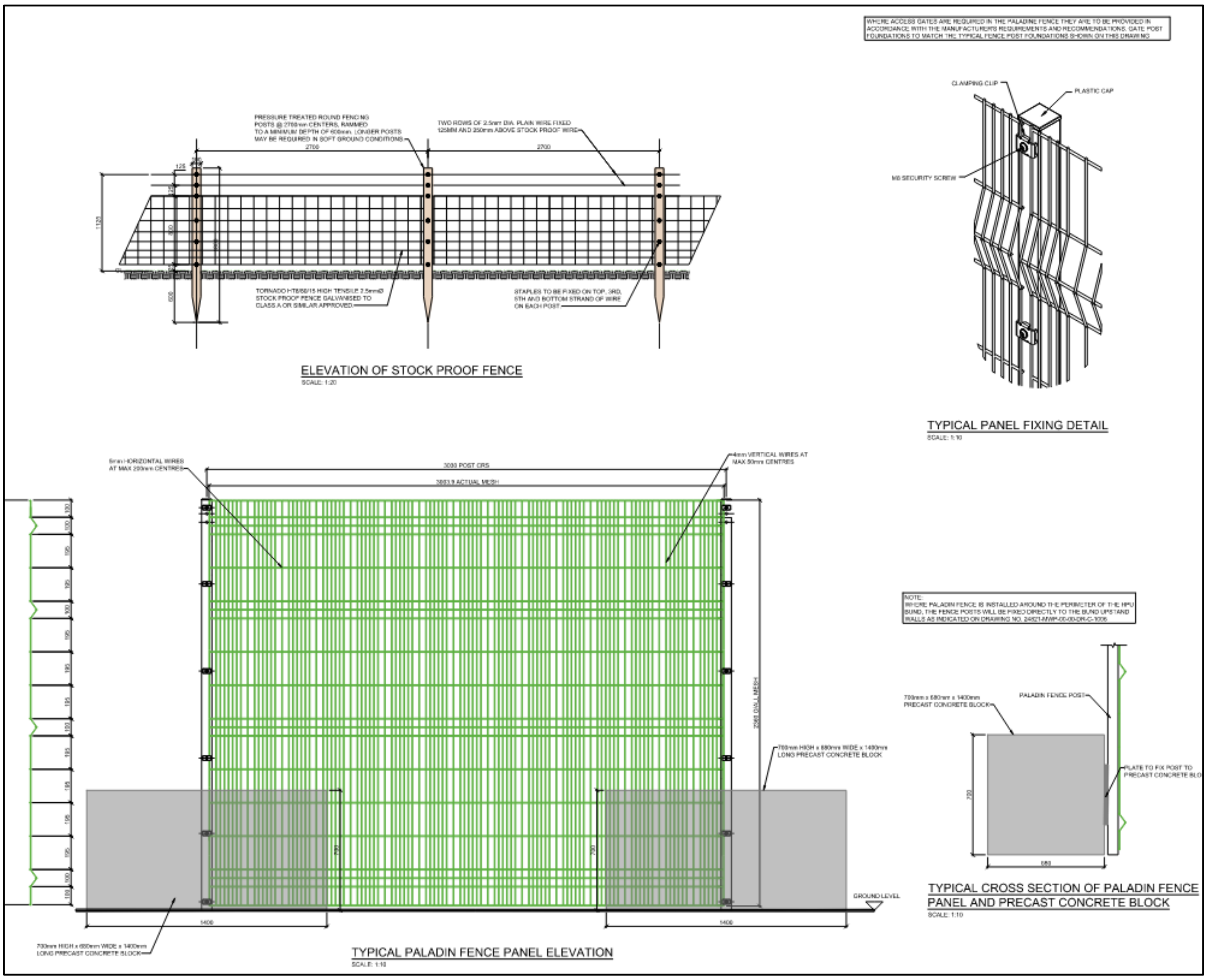

Figure 3.8 Design detail of paladin fence installation. Source Dwg. 24821-MWP-00-00-DR-C-0403 (MWP) | not to scale

3.2.3 Pump Intake System

The construction of the pump intake system will involve the following sequence:

- The pump pontoon and access pontoons will be manufactured in the Netherlands and will be transported to site on an articulated truck. The HPUs and fuel tanks will also be transported from the Netherlands on an articulated truck. The trucks will deliver all these components to the intake compound
- A 60-tonne mobile crane will be used to lift the pump pontoon (with the pumps already installed within it) from the truck in the compound to the lough. The pump pontoon will be floated into its final position and held in place horizontally using 4 no. spud legs (100 mm diameter) fixed with end plates, which will rest on the ground beneath the water. A small boat will be in the water to assist with positioning
- The same crane will lift the HPUs and fuel tanks into position within the HPU bund
- The floating access pontoons will be transported to the site in 5 no. 6.4m lengths. Each section will be lifted into position in the lough using the crane and bolted together
- The hydraulic hoses and 2 no. c.300 mm diameter pipes will be mounted on the sides of the floating pontoons using brackets
- The fuel tanks will be filled with diesel using a fuel truck

- The pump system will be tested and, after installing the remainder of the pipeline, it will be commissioned.

3.2.4 Pipeline Route to the Cross River

Laying of Pipeline

Vegetation clearance will be required where the pipes must cross ditches however only space for the two pipes will be required and these locations will be replanted on removal of the temporary pipeline. Similarly, it may be necessary to cut through concrete walls or dismantle stone walls to allow the pipeline through such boundaries. All such boundaries will be reinstated once the pipeline is removed.

The construction of the pipeline will involve the following sequence:

- The flexible layflat hose and PE ribbed pipe system will be supplied from the Netherlands and will be transported to site on articulated lorries
- The layflat hose will be supplied in 50 m to 200 m lengths (typically 200 m) and will be housed in a container for transport. The container will be lifted off the trucks and onto a flatbed trailer which will be attached to a tractor or excavator. The tractor or excavator will drive along the route of the pipeline and deploy the hose directly onto the ground surface. The final positioning of the hose will be done by hand
- The pipeline will need to pass through a number of field boundary fences/hedgerows, as shown on the engineering report drawings (24821-MWP-00-00-DR-C-0100, 24821-MWP-00-00-DR-C-0101, 24821-MWP-00-00-DR-C-0102, 24821-MWP-00-00-DR-C-0103). At each location, the existing boundary fence/hedgerows will be removed over a width of 5 m which is required to allow both the pipeline and a tractor/excavator to pass through
- Cross drains consisting of HDPE drainage pipes will be laid directly on the ground beneath the layflat hose at appropriate intervals to maintain the existing drainage regime on the site. This approach eliminates the need to excavate new drainage channels or alter the existing flow regime
- The PE ribbed pipeline will be supplied in lengths varying between 5 m and 12 m and will be connected using rigid joints. The pipe sections will be loaded from the articulated lorry to a flatbed trailer attached to a tractor or excavator. The tractor or excavator will drive along the route of the PE ribbed pipe and will be followed by an excavator which will be used to lift the pipes from the trailer to the required position on the ground
- Due to the existing surface condition, which has a number of localised humps and depressions, the line of the 500mm diameter PE ribbed rigid pipe will be smoothened out. This will be achieved using an excavator to compact and level out any localised humps/depressions. The maximum depth change will be 150mm which is less that the depth of influence in conventional agricultural tilling
- The layflat flexible pipe will be connected to the PE ribbed pipe using a bespoke fabricated manifold section
- A provision will be made for badgers to cross the PE ribbed pipe by installing ‘Badger Gates’ in the fencing. This consists of sections 300mm diameter pipe placed through and perpendicular to the wire fencing to allow badgers to travel through.

Fencing Installation

A stock proof fence will be provided both sides of the pipeline along the full length of the route and will incorporate timber posts which will be driven into the existing soil without any excavation. The stock-proof fence will consist of wooden post and wire fencing. Refer to Figure 3.8.

Road Crossings

There will be two public road crossings along the route (the R362 and L2013) and one crossing of a private road. A shallow trench will be excavated across each road and a concrete pipe installed through which the flexible pipes will subsequently be pulled. It is anticipated that the trenching works will take up to two days for each installation and one lane of traffic will be kept open to maintain traffic flow. It is known that an existing Uisce Éireann watermain and a fibre optic cable are present in the roads.

The construction of road crossings will involve the following sequence:

- On the public roads, in order to allow traffic to continue to use the roads, the pipe will be installed in two segments such that at least one traffic lane remains open at all times
- Prior to undertaking any works, a CAT scan will be undertaken to identify any services in the road
- An 1800 mm wide trench will be excavated across the road to accommodate 2 no. 600 mm diameter HDPE carrier pipes. The overall trench depth will be approximately 2,000 mm to provide sufficient cover to the pipe and to ensure that the existing services can be avoided
- The HDPE carrier pipe will be positioned onto a 100 mm thick layer of pipe bedding material placed at the bottom of the trench. Once the carrier pipe is in position the trench will be backfilled and the road will be reinstated
- The existing hedgerow will be removed on both sides of the road over a width of approximately 3 m. These will be reinstated following installation of the carrier pipes
- At each side of the road, the trench will extend past the pipe into the field and will be sloped upwards to meeting the existing field level as shown
- Figure 3.9 and Figure 3.10. A handrail will be erected around the trench in the field
- The flexible pipes will be placed through the carrier pipe.

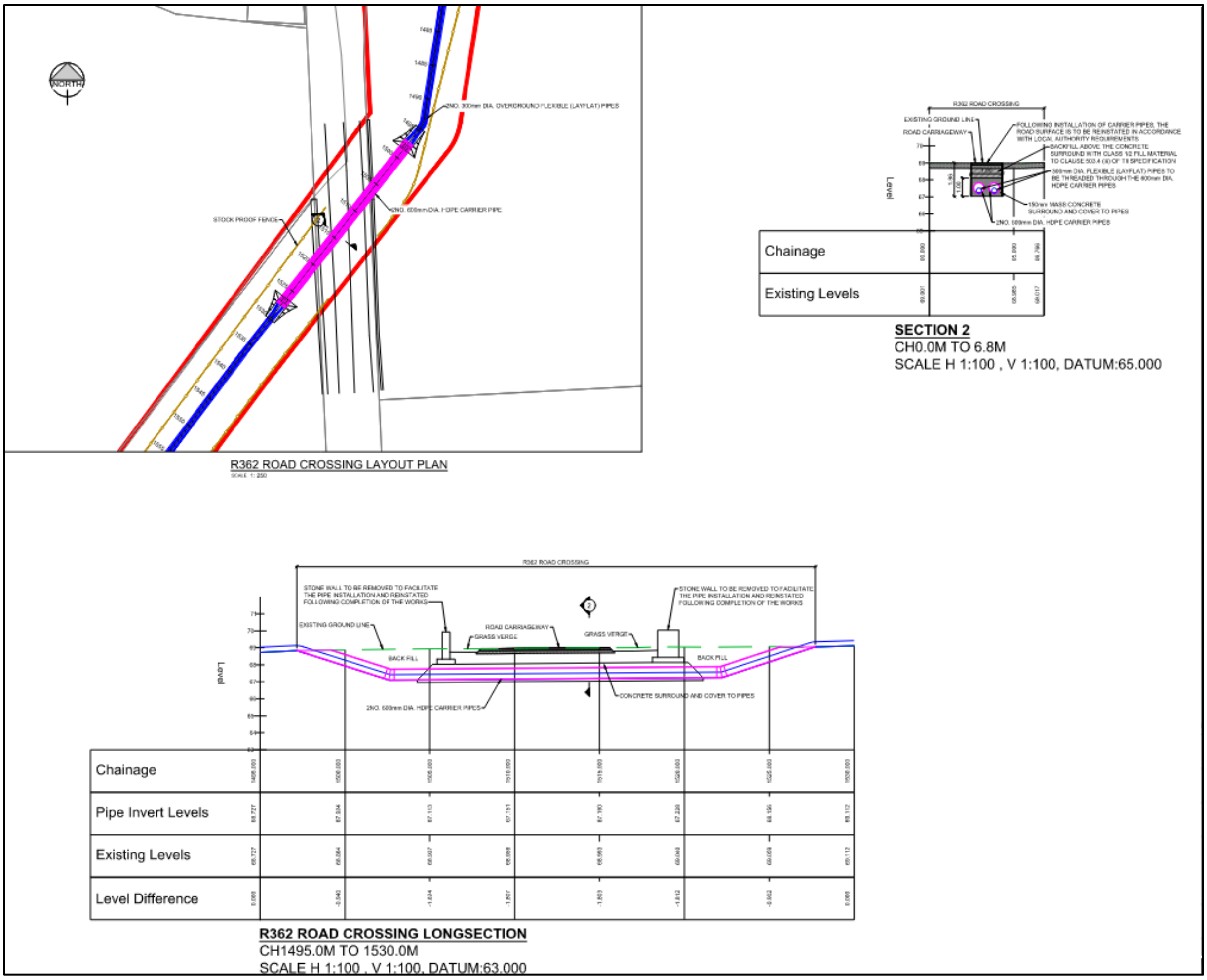

Figure 3.9 Proposed R362 road crossing detail. Source Dwg. 24821-MWP-00-00-DR-C-0401 (MWP) | not to scale

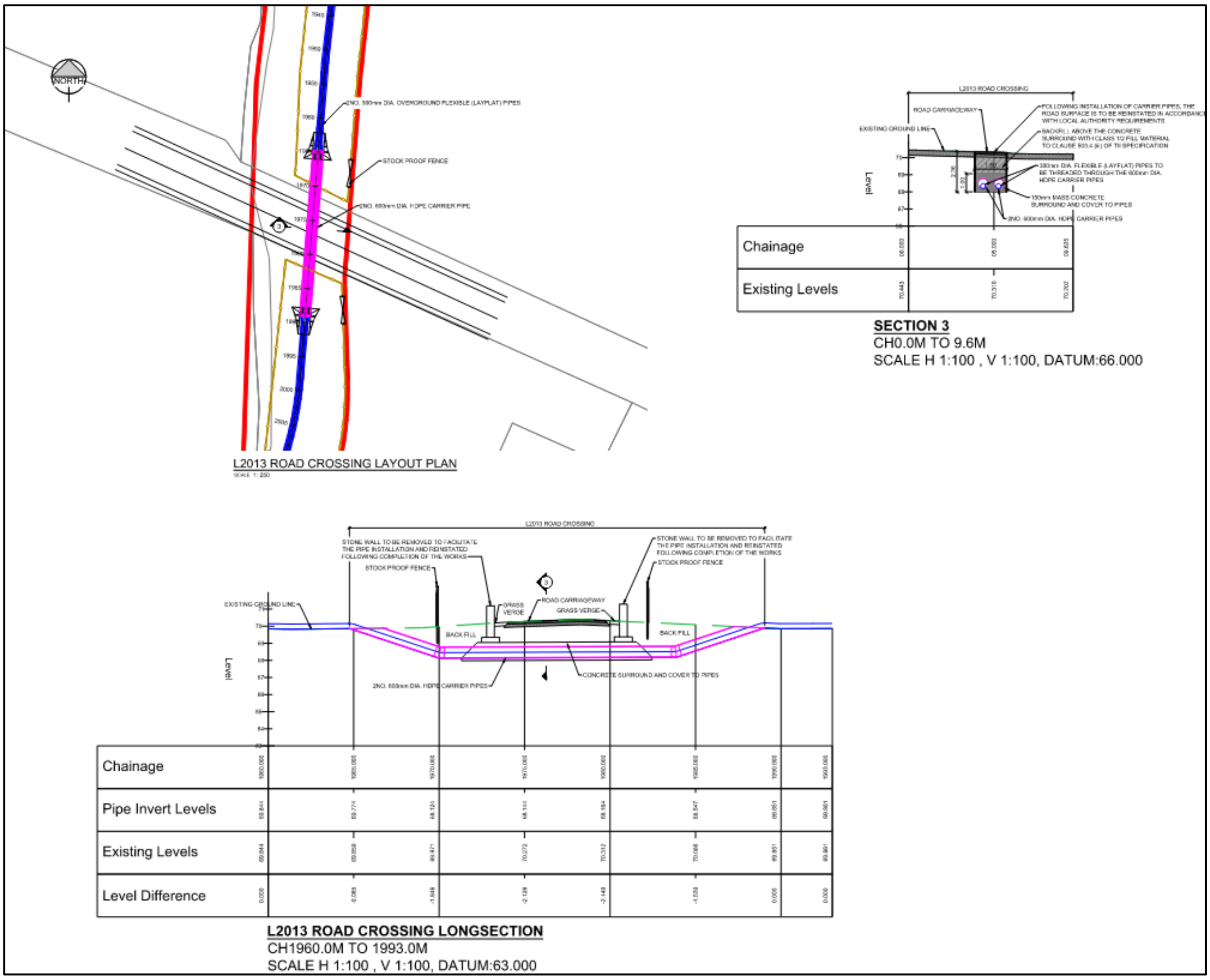

Figure 3.10 Proposed L2013 road crossing detail. Source Dwg. 24821-MWP-00-00-DR-C-0402 (MWP) | not to scale

3.2.5 Outfall

No excavation works or vegetation removal will be required at the outfall location.

The construction of the outfall will involve the following sequence:

- The geotextile will be supplied in a roll and transported to the outfall location by an excavator
- The rock armour and natural flag stones will be transported to the outfall location using a tipper truck or tracked dumper
- As noted on drawing 24821-MWP-00-00-DR-C-1003:
  - All rock shall be quarried with a minimum saturated surface dry density of 2600 kg/m³
  - Stone should be crushed and angular from strong inert rock, which shall exclude shales and weak sandstones
  - All individual stones shall be dense, sound, durable rock, free from all cracks, joints and bedding planes, which could result in breakdown of the rock in a fluvial or marine environment. It shall be capable of being handled and placed without fracture or damage
  - Individual pieces shall be blocky and take the basic shape of a cuboid. Armour units shall be hand selected and individually placed to the approval of the Employers Representative so each rock is securely held by its neighbours. Rocks shall not be placed so that they obtain their stability on a plane by frictional resistance alone

- Armour stone is to be placed in a systematic way such that the finished construction consists of close packed layers of rock of the specified thickness for the appropriate zone. The surface of the rock shall present a close packed uneven face
- The contractor shall provide details of the source of supply for approval prior to delivery to site.

- The geotextile will be rolled out across the full width of the channel from top of bank to top of bank
- An excavator will be used to systematically position rock armour and natural flag stones onto the geotextile, starting at the bottom and working upwards to ensure stability is maintained. The finished construction consists of close packed layers of rock of the specified thickness for the appropriate zone
- The PE ribbed pipe will be laid as far as the top of the channel bank using the method outlined in the previous sub-section. The pipe will be mitre cut and jointed to another pipe section by fusion welding a coupler so that the jointed section will be oriented downwards following the riverbank gradient
- The diffuser tee will have been prefabricated and will be fixed to the end of the pipe with a rigid joint
- Additional rock armour will be placed around the ends of the diffuser tee to ensure that water discharging from the ends must flow around and through the rock armour before entering the river.

3.2.6 Service Diversions

Services will potentially be encountered during the road crossing works. As noted above in Section 0, the overall trench depth will be approximately 2,000 mm to provide sufficient cover to the pipe and to ensure that the existing services can be avoided.

3.2.7 Traffic Management

As noted in Section 0, traffic management measures will be required during the installation of the pipeline under the public roads. One lane of traffic on the public roads will be maintained at all times.

3.2.8 Environmental Management During Construction

General

A construction environmental management plan (CEMP) has been prepared and will be updated throughout the duration of the proposed scheme. The CEMP is included as part of an information pack for the proposed scheme

Every effort will be made to ensure that any detrimental environmental effects will be avoided, prevented or reduced during the construction phase of this project.

The CEMP comprises all of the construction mitigation measures, which are set out in this report and the following reports submitted with the statutory approval application:

- Screening for Appropriate Assessment (AA) and Natura Impact Statement (NIS) Report
- Ecological Impact Assessment Report
- Archaeological Impact Assessment Report
- Water Framework Directive Assessment.

The CEMP will be updated by RCC with any additional measures which are required by the statutory consent conditions and will be provided to the appointed contractor.

Implementation of the CEMP will ensure disruption and nuisance are kept to a minimum. The plan will have regard to the guidance contained in the handbook published by Construction Industry Research and Information Association (CIRIA) in the UK, Environmental Good Practice on Site Guide, 4th Edition (CIRIA 2015).

Waste Arising

All waste arisings during construction will be managed in accordance with the waste hierarchy, in compliance with the provisions of the Waste Management Acts, 1996, as amended, and to contribute to achieving the objectives set out in the Waste Action Plan for a Circular Economy (DECC, 2020).

3.2.9 Landowner and Community Liaison

Roscommon County Council (RCC) will coordinate communications and liaise with affected landowners and the local community during all phases of the proposed scheme. RCC will liaise with residents and the general community during the construction phase to ensure that any disturbance is kept to a minimum and to ensure that all anticipated nuisances are minimised, and that the construction activity will have the lowest possible impacts on the residents and other properties.

3.2.10 Construction Management

RCC will have a construction management team on site for the duration of the construction phase. This team will supervise the construction of the scheme including monitoring the contractors' performance to ensure that the proposed construction phase mitigation measures are implemented, and that construction impacts, and nuisance are minimised.

3.2.11 Construction Safety

All contractors and subcontractors must progress their works with reasonable skill, care and diligence and, at all times, proactively manage the works in a manner most likely to ensure the safety, health and welfare of those carrying out construction works, pedestrians, road users and other interacting stakeholders. Measures related to construction health and safety are detailed in the CEMP.

A Project Supervisor Design Process (PSDP) has been appointed by RCC.

RCC will appoint the Project Supervisor Construction Stage (PSCS) for the construction stage of the project to manage and co-ordinate health and safety matters during the construction stage. The PSCS will be appointed before the construction work begins and remains in that position until all construction work on the project is completed.

3.3 Operations & Maintenance Activities

RCC will appoint an operations contractor to oversee all operations and maintenance activities.

3.3.1 Maintenance Activities

During the operation of the proposed scheme, the following maintenance activities will be required:

- Daily inspection of pumps and fish screen
- Daily inspection of pipeline route and fencing
- Daily inspection of outfall location
- Regular refuelling
- Periodic service of pumps and HPUs
- Weekly check of compound drainage; and
- Daily emptying of rainwater from dry sump.

The pump intake screen will be inspected daily to ensure proper operation of the pumps and to check for any blockages or damage to the fish screens. If the fish screens become blocked, they can be cleared by an operative who can safely reach the screens from the access walkways as required.

3.3.2 Pumping Controls and Monitoring

3.3.2.1 Pumping Duration

It is anticipated that the pumps will operate 24 hours a day at a combined flow rate not exceeding 300 l/s, as necessary to meet the scheme objectives for a period of up to 24 months.

Pumping will also depend on the flow rates of the Cross River which will be continuously monitored. Pumping will be reduced/halted as needed to eliminate any risk of downstream flooding of the Cross River.

3.3.2.2 Monitoring

The following aspects of the proposed scheme will be continuously monitored by RCC and data will be accessible remotely:

- The level of Lough Funshinagh
- Pumping rate of the HPUs; and
- Flow rate of the Cross River.

Currently, hourly readings of the lough's water level are being recorded and monitored daily by GSI[2]. Lake levels will be monitored daily as it is expected that the change in lake level as a result of pumping will be relatively slow.

The pumping control system will be remotely monitored by RCC and if required the pumping flow rates will be adjusted or shut off. The pumping controls will not be automatically regulated based on monitoring data.

The flow in the Cross River will be monitored at three locations by OPW hydrometric gauges at 15-minute intervals for the duration of the interim scheme. One location is an existing EPA flow gauge, Summerhill Station (26221), located approximately 13.7 km downstream from the pipeline outfall.

An additional two hydrometric gauges will be installed and operated by the OPW, one at Curraghboy approximately 0.9 km downstream of the pipeline outfall and one at Atteagh approximately 5.2 km downstream of the pipeline outfall.

The Cross River flow rate will be monitored continuously to assess if the trigger flows have been reached. The details of trigger flows are provided in the MWP engineering report. Regional flood warnings will be checked daily.

OPW installations of hydrometric gauges

Two new hydrometric gauges will be installed and operated by the OPW under its own statutory powers, at Curraghboy & Atteagh, Co. Roscommon. Both gauges will be installed on the left bank of the Cross River upstream of the adjacent road bridges. All installation works will be undertaken by the OPW according to their standard procedures (e.g. Activity Risk Assessments, Safe Operating Procedures Preliminary, Safety & Health Plan, and Job Safety Plans.). All installation works will be supervised on site by a OPW Project Supervisor Construction Stage following agreement and planning of works prepared by the OPW Project Supervisor Design Process.

OPW Installation Methodology

The installation of the hydrometric gauges will follow the methodology set by the OPW:

- The location of the station enclosure plinth will be scanned with a Cable Avoidance Tool prior to any excavation taking place
- A small excavation (maximum depth of 0.15m) will be required to facilitate the construction of the concrete plinth (~0.6 m^2)

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[2]Available at: https://gwlevel.ie/?place=00011_001_tl_gs

- A prefabricated timber shutter (~ 0.8 x 0.8 x 0.15m) will be positioned and pinned where the concrete plinth is to be cast. The shutter will then be lined with polythene on the base and sides to prevent any cement paste from escaping. Sandbags to be positioned on the riverside of the shutter to contain any residual spillage

- Concrete will be transported from the designated mixing location via barrow on a route protected with polythene. Approximately 0.1m^3 of concrete will be required for the plinth. The concrete is then placed, screed and finished with a steel trowel. Once the concrete is cured shutters are removed

- A staff gauge (~1.2 m high) will be attached to the existing rock armour (Curraghboy) or bridge abutment (Atteagh) using proprietary fittings and mechanical fixings. The staff board itself will be 150 x 44 mm untreated timber with staff plates fitted using stainless steel screws or galvanized nails

- The sensor ducting will be extended the river channel and connected the station

- A solar panel will be installed to provide power to the station

- Once all installation works are completed, a final check will be carried out to ensure any excess materials or equipment are removed off site.

3.3.2.3 OPW Maintenance and Calibration

The gauges transmit the data every 15 minutes to a central server that is available to the public to view on OPW's waterlevel.ie. The gauges are typically visited on a six-weekly cycle by a regional team consisting of a Technician and Driver. This team is assigned to the station and carries out all maintenance and calibration duties at the site.

3.3.3 Intake Compound

3.3.3.1 Fuel Storage Tanks

A maintenance contractor will be appointed by RCC who will oversee the maintenance of all aspects of the pumping operation.

It is anticipated that the four fuel storage tanks will need to be refilled every fourth day with a fuel tanker making deliveries to the compound. The following maintenance activities will be required during the operational phase at the intake compound:

- **Refuelling**- The hydraulic pumps will each have a running time of about 100 hours on full fuel tanks therefore refuelling will be required every fourth day while pumping is ongoing. This will involve a fuel tanker driving into the Intake Compound and delivering fuel to the tanks which are located within the bunds. Appropriate mitigation measures to manage spill risks are detailed in Section 3.3.5.2 and the CEMP.

- **Emptying of rainwater** - Rainwater from the HPU bund will need to be emptied daily by pumping the rainwater from a dry sump using a light duty puddle pump and discharging the water in a distributed manner onto the grassed surface at a location where the buffer distance is at least 15m to the lough edge.

- **HPU Service** - The HPUs will need to be serviced every 500 running hours. A typical service will consist of changing filters and oil. A spill kit will be used to ensure that any spillage is contained.

- **Drainage inspection** - The local drainage around the compound and the silt fence on the downslope side of the compound will be checked once per week to ensure adequate function and that there are no signs of blockage.

3.3.4 Pipeline Route

The entire pipeline route will be visually inspected every day by driving the route to identify any signs of damage or distress to the pipeline and to ensure all stock proof fencing remains intact.

The Cross River outfall will be inspected once per day. The purpose of the inspection will be to ensure that the diffuser is working properly and is not blocked, to ensure the rock armour and geotextile has not become dislodged or unstable. The pumps will be shut down immediately in the unlikely event that there is a concern with regard to the integrity of the outfall.

3.3.5 Environmental Management and Monitoring

3.3.5.1 Water Quality Monitoring

A specialist contractor will be appointed by RCC to carry out monthly water quality sampling of the Lough Funshinagh and the Cross River.

A water quality monitoring programme is planned for both Lough Funshinagh and the Cross River for the duration of the interim scheme.

3.3.5.2 Refuelling

Refuelling will take place at the intake compound with the truck parked over a portable PVC containment bund mat. This is designed for use under vehicles and shall act as a containment system to catch any spills which may occur during refuelling. The mat is manufactured from 900gsm PVC-coated hydrocarbon and shall be placed on top of a geotextile layer.

The following measures will be in place during refuelling operations to mitigate the risk of accidental spills:

- Refuelling shall take place with the vehicle parked over a portable PVC containment bund mat. This is designed for use under vehicles and shall act as a containment system to catch any spills which may occur during refuelling. The mat is manufactured from 900gsm PVC-coated hydrocarbon and shall be placed on top of a geotextile layer
- Only designated trained and competent operatives will be authorised carry out refuelling operations
- Spill kits will be kept on site in case of accidental spillages and all designated operatives will be trained in using them
- Fuel tanks will only be filled from transportation tankers under the use of automatic shut off overfill protection
- The fuel tanks shall not be left unattended during refuelling
- Oil booms will be kept on site to deal with any accidental spillage
- Strict procedures for fuel tank and plant inspection, maintenance and repairs shall be detailed in the contractor's method statements and construction machinery shall be checked for leaks before arrival on site
- The plant refuelling procedures described above shall be detailed in the contractor's method statements.

3.3.5.3 Spill Management

A spill kit will be available at the intake compound in case of leaks and spills. All operational staff will be trained on how to use spill kits. In the event of a spill incident, immediate action will be taken to identify and stop the source of the spill.

The appointed operations contractor will be immediately given information on the location, type, and extent of the spill so that they can take appropriate action. If possible, efforts will be made to clean up as much as possible using the spill control materials. The disposal of any used spill control material will be done using a fully licensed waste contractor with the appropriate permits so that further contamination is limited.

3.3.5.4 Waste Arising

Waste may be generated during the operation of the proposed scheme as a result of the screens being cleared and the maintenance of the hydraulic pumping units (old filters, used hydraulic filters etc.).

The provision of appropriate waste management at each working area and regular collections as per the existing arrangements on site.

3.4 Decommissioning

3.4.1 Pump Intake System

Decommissioning of the pump intake system will involve the following:

- The pumps will be shut down and disconnected from the pipeline and hydraulic hoses
- A 60-tonne mobile crane will be used to lift the pump pontoon (with the pumps inside) from the lough to an articulated truck parked in the intake compound. A small boat will be in the water to assist
- The floating access pontoons will be dismantled (unbolted) and lifted from the edge of the lough to a truck parked in compound using the 60 Tonne crane
- The same crane will lift the HPUs and fuel tanks onto the truck.

3.4.2 Intake Compound

Decommissioning of the intake compound will involve the following sequence:

- The stock proof fence and paladin fence will be taken up and loaded onto a flatbed truck for reuse
- The concrete HPU bund will be demolished using an excavator with a rock breaker and removed to a licensed facility
- The Class 6F stone (compound) as well as the geogrid / geotextile used to construct the compound will be taken up and brought to a licensed facility. A reuse for the stone aggregate will be sought where possible following confirmation of acceptability
- The ground beneath the footprint of the compound will be rotovated and tilled to reinstate the area to agricultural usage, similar to the surrounding lands.

3.4.3 Pipeline Route

Decommissioning of the pipeline will involve complete removal of all rigid PE pipe and flexible ‘layflat’ pipe.

3.4.3.1 Road Crossing

Decommissioning of the road crossings will involve the following sequence:

- The HDPE carrier pipes will remain in place after the pipeline has been removed
- Each end of the pipe will be blocked by filling in the trench at the ends. The redundant pipe beneath the road will not be of concern
- The existing hedgerow which was removed will be replanted using native hedge species and/ or walls/ fences will be restored.

3.4.4 Outfall

Decommissioning of the outfall will involve the following sequence:

- The PE ribbed pipe and diffuser tee will have been removed in conjunction with the remainder of the pipeline
- The rock armour and natural flag stones will be carefully removed from the surface of the geotextile using an excavator and placed into a tipper truck or tracked dumper
- The geotextile will be pulled across the river and removed by hand without entering the water.

3.4.5 Waste Arising

All waste arising will be managed in accordance with the waste hierarchy, in compliance with the provisions of the Waste Management Act, 1996, as amended, and to contribute to achieving the objectives set out in the Waste Action Plan for a Circular Economy (DECC, 2020).

Opportunities for reuse of materials, by-products and wastes will be sought throughout the decommissioning phase. Where possible, metal, timber, glass and other recyclable material will be segregated and removed off site to a permitted / licensed facility for recycling.

The contractor appointed for the decommissioning of the scheme will record the quantity in tonnes and types of waste and materials leaving the site. The name, address and authorisation details of all facilities and locations to which waste and materials are delivered will be recorded along with the quantity of waste in tonnes delivered to each facility. Records will show the type of material, specifying those that are recovered, recycled, and disposed of. The relevant appropriate waste authorisation will be in place for all facilities that wastes are delivered to (i.e., EPA Licence, Waste Facility Permit or Certificate of Registration).

The following are the expected wastes to be generated during the decommissioning phase:

- Concrete from HPU bund and Paladin post bases to be removed to a licensed facility
- Geotextiles/ geogrid to be taken to licensed facility and reused following confirmation of acceptability
- Stone aggregate to be taken to licensed facility and reused following confirmation of acceptability
- Fencing (posts, wire and paladin) to be gather for re-use
- Rock amour to be taken to licensed facility
- Pipeline to be gather and re-used where possible.

3.4.6 Nature of any Associated Demolition Works

No demolition works are associated with the proposed scheme. Limited ground works and excavations are required (restricted to the road crossings).

3.5 WFD Waterbodies

3.5.1 Surface waterbodies

Lough Funshinagh is located within the WFD catchment of 26G: Upper Shannon and Shannon(Upper)_SC_100 subcatchment (Figure 3.11). The 26G catchment area is 383km^2 and covers an area from Athlone to Shannonbridge. The catchment is characterised by flat topography underlain by karst features and poorly draining soils. Groundwater is closely connected to surface water in the headwaters. Lough Funshinagh is located north of Curraghboy in a karstified part of the catchment. Although there is no surface outflow channel, underground flow has been identified through dye tracing, discharging to the Cross River near Brideswell (Drew and Burke, 1996).

The Cross River occurs within the 42.7km^2 WFD river waterbody (Table 3.1). It is a lowland river that originates from groundwater springs about 2.8km south of Lough Funshinagh and flows for 20km before joining the Shannon River. The Shannon River drains from Lough Ree into 26G through Athlone, before being joined by the Cross River from the west. Continuing south, the Shannon is then joined from the east by the Cloonbonny and Boor Rivers, before being joined from the west by a series of small tributaries, the largest of which is the Ballydangan River. The Shannon flows out of the catchment at Shannonbridge. There are five WFD river waterbodies within 26G_2 Shannon (Upper)_SC_100 sub-catchment that are hydrologically connected to the proposed scheme (Table 3.1).

Table 3.1 WFD river waterbodies hydrologically connected to the proposed scheme (source: EPA)

Code	Name	Area (km^2)	Type
IE_SH_26C100060	CROSS (ROSSCOMMON)_010	42.7	River waterbody
IE_SH_26C100200	CROSS (ROSSCOMMON)_020	37.4	River waterbody
IE_SH_26C100300	CROSS (ROSSCOMMON)_030	6.5	River waterbody
IE_SH_26D100400	CROSS (ROSCOMMON)_040	13.9	River waterbody
IE_SH_26S021800	SHANNON (Upper)_120	108.9	River waterbody

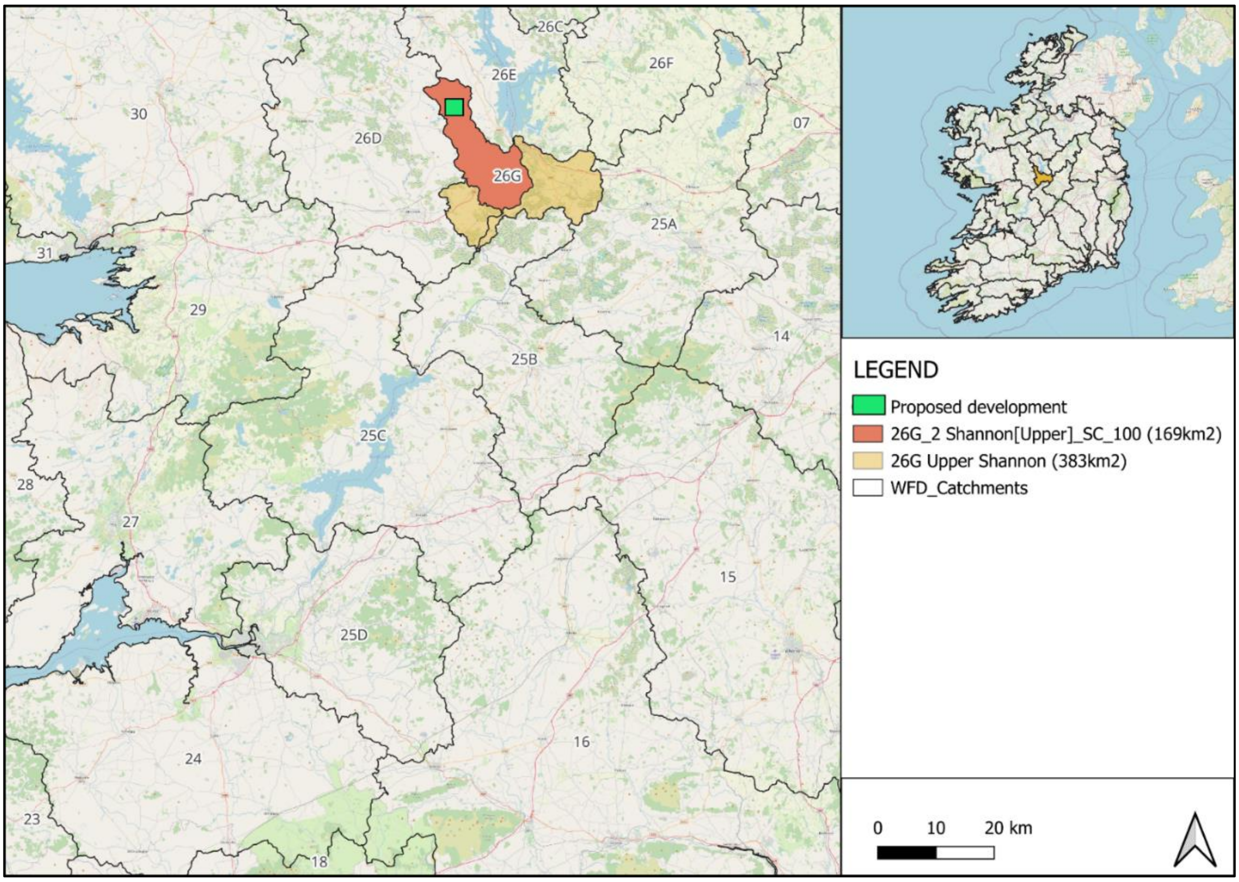


Figure 3.11 Location of proposed scheme within the 26G Upper Shannon WFD catchment and 26G_2 WFD subcatchment (source: EPA)

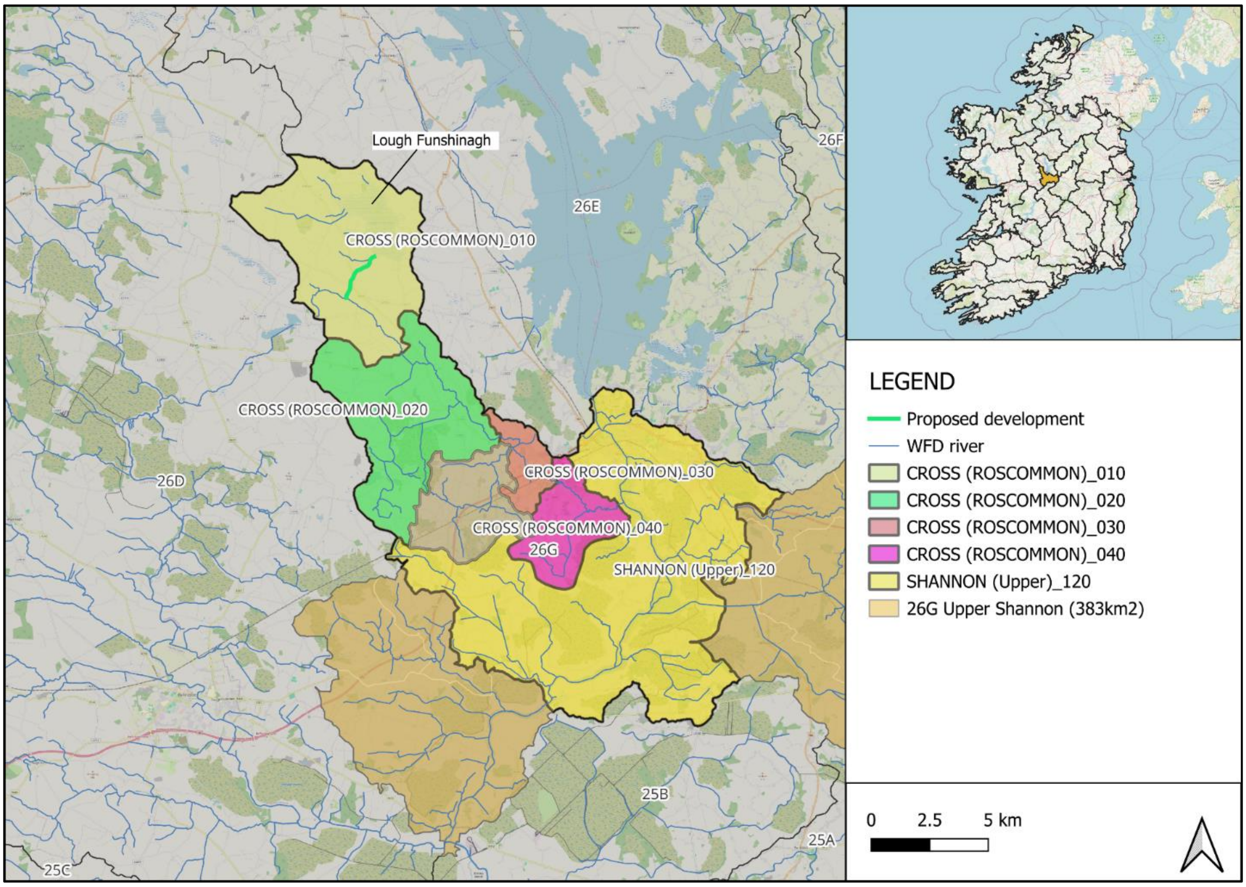


Figure 3.12 Location of proposed scheme within the 26G Upper Shannon WFD catchment and 26G_2 WFD subcatchment (source: EPA)

3.5.2 Groundwater waterbodies

Under the WFD, the regional hydrogeology has been assessed using the GSI groundwater viewer and EPA data viewer indicating that the underlying WFD groundwater body is Funshinagh (IE_SH_G_091) (Table 3.2).

Table 3.2 WFD groundwater bodies hydrologically connected to the proposed scheme (source: EPA)

Code	Name	Description	Area (km^2)	Type
IE_SH_G_091	Funshinagh	Karstic	565.28	Groundwater body

The Funshinagh groundwater body predominately comprises Dinantian Pure Bedded Limestones which are a Regionally Important karstified bedrock aquifer dominated by conduit flow. According to the GSI[3] groundwater body description, within this type of highly permeable aquifer the groundwater flows through enlarged conduits and fractures which are well connected and widespread. The bedrock is devoid of intergranular flow as the groundwater flows within the fractures and conduits resulting in highly variable aquifer permeability and transmissivity. Groundwater velocities are relatively rapid indicating sizable conduits are present within the aquifer. High yielding springs in the region further indicate the significant capacity for the groundwater network to transmit high volumes of water and the regional scale of the groundwater flow network. Flow paths can be several kilometres in length. The presence of a groundwater dominated system is indicated by the lack of surface water features (e.g. rivers and streams) on the ground surface.

[3] GSI (2003) Funshinagh GWB: Summary of Initial Characterisation, available: https://gsi.geodata.gov.ie/downloads/Groundwater/Reports/GWB/FunshinaghGWB.pdf, [accessed August 2024]

The karstified bedrock is evidenced by numerous karst landforms including springs, swallow holes, turloughs and enclosed depressions. These features indicate places where significant karstification of the bedrock has occurred and where there is likely to be significant water bearing conduits or fractures. Point recharge can occur at these karst features, although diffuse recharge also occurs across the GWB as the rainfall percolates through the subsoil.

The regional groundwater flow direction is towards Lough Ree[5], however local variations in the groundwater flow direction exist due to the karstified nature of the bedrock. Groundwater gradients are relatively low across the region and may not reflect the topography. Furthermore, due to the karstified nature of the bedrock the groundwater catchment boundaries may not reflect the surface water catchment boundaries.

The isolated pockets of Dinantian Pure Unbedded Limestones are classified as Locally Important aquifers where the bedrock is moderately productive only in local zones. This type of bedrock is less susceptible to karstification and therefore the permeabilities are lower than in the karstic aquifer.

3.5.3 Hydrologically Connected Protected Areas

3.5.3.1 Areas Designated as Drinking Waters

There is one groundwater body designated for drinking water hydrologically connected to the proposed scheme (Table 3.3).

Table 3.3 Areas Designated as Drinking Waters with a hydrological connection to the proposed scheme (source: EPA)

Code	Name	Type	Protected area type
IE_SH_G_091	Funshinagh	GWB	Article 7 for Drinking Water

3.5.3.2 Economically Significant Aquatic Species

None in the vicinity.

3.5.3.3 Areas Designated as Bathing Waters

None in the vicinity.

3.5.3.4 Nutrient Sensitive Waters

There is one nutrient sensitive area that is hydrologically connected to the proposed scheme (Table 3.4). Three protected areas are within the same catchment as the proposed scheme.

Table 3.4 Nutrient Sensitive Areas with a hydrological connection to the proposed scheme (source: EPA)

Code	Protected area	Catchment
IERI_SH_2010_0002	Shannon (River)	26G

3.5.3.5 Protected Areas

There are eight protected areas that are hydrologically connected to the proposed scheme (Table 3.5). Four protected areas are within the same catchment as the proposed scheme.

Table 3.5 Protected Areas with a hydrological connection to the proposed scheme (source: EPA)

Code	Protected area	Catchment
IE0000611	The Lough Funshinagh SAC	26G
IE0002337	Crosswood Bog SAC	26G
IE0004096	The Middle Shannon Callows SPA	26G
IE0000216	River Shannon Callows SAC	26G
IE0004077	River Shannon and River Fergus Estuaries SPA	25B
IE0004058	Lough Derg (Shannon) SPA	25C

Code	Protected area	Catchment
IE0002241	Lough Derg, North-east Shore SAC	25C
IE0002165	Lower River Shannon SAC	25D

3.6 Current Pressures on WFD Waterbodies

3.6.1 Surface Waterbody Status

The WFD status of the surface water bodies show that none of the WFD river waterbodies are reaching their goal of ‘good’ status by 2027 or earlier (Table 3.6). CROSS_010 has improved from Poor to Moderate, CROSS_020 and _030 have declined in status. The others have stayed the same. All are therefore considered ‘at risk’ waterbodies. Hydromorphology is the top significant pressure, with agriculture being significant in the upper catchment and peat drainage and extraction and urban wastewater becoming a significant pressure in the lower catchment.

Table 3.6 Surface Water WFD Status (source: WFD cycle 3)

Code	Name	WFD status			Significant issue	Significant pressure
		2010-15	2013-18	2016-21		
IE_SH_26C100060	CROSS (ROSSCOMMON) _010	Poor	Poor	Moderate	Morphological	Agriculture
					Nutrients	Hydromorphology
IE_SH_26C100200	CROSS (ROSSCOMMON) _020	Good	Good	Moderate	Sediment	Hydromorphology
					Morphological	
					Nutrients	
					Organic	
IE_SH_26C100300	CROSS (ROSSCOMMON) _030	Good	Moderate	Moderate	Sediment	Hydromorphology
					Morphological	Agriculture
					Nutrients	Urban wastewater
					Organic	
IE_SH_26D100400	CROSS (ROSCOMMON)_ 040	Moderate	Moderate	Moderate	Hydrological	Hydromorphology
					Morphological	Peat drainage and extraction
					Nutrients	
IE_SH_26S021800	SHANNON (Upper)_120	Poor	Poor	Poor	Hydrological	Hydromorphology
					Morphological	Peat drainage and extraction
					Nutrients	

3.6.2 Groundwater Body Status

The WFD status for the groundwater bodies within the proposed scheme is ‘good’ and ‘not at risk’ (Table 3.7).

Table 3.7 EPA WFD Groundwater Body status and risk (source: EPA WFD cycle 3)

European Code	Water Feature	WFD Status		WFD Risk
		2013-18	2016-2021	
IE_SH_G_091	Funshinagh ground waterbody	Good	Good	Not at risk

3.6.3 EPA Water Quality Monitoring

There are 6 EPA biological river quality monitoring sites[4] along the Cross River (with two monitoring sites being associated with tributaries) (Table 3.8). The biological quality of these sites indicate that the Cross River is strongly influenced by groundwater in its upper reaches downstream of Lough Funshinagh, which results in typically low dissolved oxygen saturation for a river. Although there were improvements to good quality in the middle reaches a decline was reached at the confluence with the River Shannon.

Table 3.8 Biological quality rating of river waterbodies in 26G_2 (Source: catchment.ie)

Code	Stream Name / WFD Name	Station code	1984	1987	1992	1996	1999	2002	2006	2009	2011	2014	2017	2020	2023
IE_SH_26C 100060	CROSS (ROSSCOMM ON)_010	RS26C100060				4	4	3-4	3-4	3		3	3	3-4	3-4
IE_SH_26C 100200	CROSS (ROSSCOMM ON)_020	RS26C100070							3		4				
IE_SH_26C 100200	CROSS (ROSSCOMM ON)_020	RS26C100100	4	4	4-5	4	3-4	4							
IE_SH_26C 100200	CROSS (ROSSCOMM ON)_020	RS26C100200	4	4	3-4	4	4	4	3-4	3-4	4	4	4	3-4	4
IE_SH_26C 100300	CROSS (ROSSCOMM ON)_030	RS26C100300	4	4	3	3	3	3	3-4	3-4	4	4	3-4	3-4	4
IE_SH_26D 100400	CROSS (ROSCOMMO N)_040	RS26C100400	4	4	4	4		4		4	3	3-4	3-4	3-4	3

The water quality status of the WFD river waterbodies under the third RBMP indicated that the water quality status of the WFD water bodies reaches a 'good' status in the middle WFD waterbodies but reduces to moderate and poor in the lower WFD waterbodies (Table 3.9). The upper waterbody had a 'poor' water quality status.

Table 3.9 Water quality status of river waterbodies in 26G_2 (Source: catchment.ie)

Code	Stream Name / WFD Name	2007-09	2010-12	2010-15
IE_SH_26C100060	CROSS (ROSSCOMMON)_010	Poor	Unassigned	Poor
IE_SH_26C100200	CROSS (ROSSCOMMON)_020	Moderate	Good	Good
IE_SH_26C100300	CROSS (ROSSCOMMON)_030	Moderate	Good	Good
IE_SH_26D100400	CROSS (ROSCOMMON)_040	Moderate	Poor	Moderate
IE_SH_26S021800	SHANNON (Upper)_120	Poor	Poor	Poor

3.7 Cause-and-effect mechanisms on WFD Waterbodies

The compliance assessment for cause-and-effect mechanisms on the surface WFD waterbodies indicates that the proposed scheme has possible direct and indirect effects on the hydromorphological/ physico-chemical supporting elements, biological quality elements and chemical status of four WFD river water bodies (Table 3.10).

[4] The EPA assigns biological river quality (biotic index) ratings from Q5 to Q1 based on the relative proportion of pollution sensitive to tolerant macroinvertebrates. Q5 reflects a satisfactory condition with unpolluted water, whilst Q2 reflects an unsatisfactory condition with serious water pollution.

Table 3.10 Compliance assessment cause-and-effect mechanisms (River waterbodies)

		IE_SH_26C100060		IE_SH_26C100200		IE_SH_26C100300		IE_SH_26D100400	
	WFD elements	Direct effect	Indirect effect	Direct effect	Indirect effect	Direct effect	Indirect effect	Direct effect	Indirect effect
Hydromorphological supporting element	Hydrology: quantity and dynamics of flow	Yes	Yes	No	Yes	No	Yes	No	Yes
	Hydrology: connection to groundwaters	No	Yes	No	Yes	No	Yes	No	Yes
	River continuity	Yes	Yes	No	No	No	No	No	No
	Morphology: river depth and width	No	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Morphology: river bed structure, substrate	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Morphology: riparian zone structure	No	Yes	No	No	No	No	No	No
Physico-chemical supporting elements	Thermal conditions	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Oxygenation	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Salinity	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Acidification	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Nutrient conditions	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Specific synthetic pollutants	No	No	No	Uncertain	No	Uncertain	No	Uncertain
	Specific non-synthetic pollutants	No	No	No	No	No	No	No	No
Biological quality elements	Phytoplankton	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Macrophytes and phytobenthos	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Benthic invertebrate fauna	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
	Fish fauna	Yes	Yes	No	Uncertain	No	Uncertain	No	Uncertain
Chemical status	Priority substances	No	Yes	No	No	No	No	No	No
	Priority hazardous	No	Yes	No	No	No	No	No	No

		IE_SH_26C100060		IE_SH_26C100200		IE_SH_26C100300		IE_SH_26D100400	
	WFD elements	**Direct effect**	**Indirect effect**	**Direct effect**	**Indirect effect**	**Direct effect**	**Indirect effect**	**Direct effect**	**Indirect effect**
EU protected areas	IE0000611	Yes	Yes	No	No	No	No	No	No
	IE0002337	No	Yes	No	No	No	No	No	No
	IE0004096	No	Yes	No	No	No	No	No	No
	IE0000216	No	Yes	No	No	No	No	No	No
	IE0004077	No	Yes	No	No	No	No	No	No
	IE0004058	No	Yes	No	No	No	No	No	No
	IE0002241	No	Yes	No	No	No	No	No	No
	IE0002165	No	Yes	No	No	No	No	No	No

There could be an indirect effect on one WFD groundwater body connected to the proposed scheme (Table 3.11).

Table 3.11 Compliance assessment cause-and-effect mechanisms (Groundwater bodies)

		IE_SH_G_091	
	WFD elements	Direct effect	Indirect effect
Groundwater quantitative status	Available groundwater resource	No	Uncertain
	Groundwater dependent surface water bodies	Yes	Yes
	Groundwater dependent terrestrial ecosystems	Yes	Yes
	Saline or other intrusions	No	No
Groundwater chemical status		No	No
EU protected areas	IE0000611	No	Uncertain
	IE_SH_G_091	No	No

4. STAGE 2: Scoping

Based on the Stage 1 assessment four WFD river water bodies, one WFD groundwater body and eight protected areas were screened in for Stage 2 assessment (Table 4.1). Each of these waterbodies and protected areas with a potential causal mechanism, or where there is uncertainty about whether status would be affected for any of the elements, were assessed for whether the effect will be temporary[5], insignificant in the context of the waterbody, and whether there are no potential in-combination effects. River waterbodies and hydrologically connected protected areas were assessed in Table 4.2 and Table 4.3; and groundwater bodies were assessed in Table 4.4.

Table 4.1 WFD compliance assessment of cause-and-effect mechanisms for WFD river, ground waterbodies and protected areas

European Code	Description	Screened In/Out	Reason
IE_SH_26C100060	CROSS (ROSSCOMMON)_010	In	Possible direct and indirect causal effect on Hydromorphological supporting element; Physico-chemical supporting elements; Biological quality elements and Chemical status.
IE_SH_26C100200	CROSS (ROSSCOMMON)_020	In	Possible direct and indirect causal effect on Hydromorphological supporting element; Physico-chemical supporting elements and Biological quality elements.
IE_SH_26C100300	CROSS (ROSSCOMMON)_030	In	Possible direct and indirect causal effect on Hydromorphological supporting element; Physico-chemical supporting elements and Biological quality elements.
IE_SH_26D100400	CROSS (ROSCOMMON)_040	In	Possible direct and indirect causal effect on Hydromorphological supporting element; Physico-chemical supporting elements and Biological quality elements.

[5] 'Short' and 'long' periods of time are not defined in the Common Implementation Strategy (CIS) guidance although it is noted that monitoring frequency for the element in question can serve as an indication. A 'temporary' effect on the status of an element can be defined when an element in question will recover within monitoring period, or if the effect is associated with construction or establishment and recovery is expected with no permanent adverse consequences and no further deterioration is expected.

European Code	Description	Screened In/Out	Reason
IE_SH_G_091	Funshinagh	In	Possible direct and indirect causal effect on groundwater quantitative status.
IE0000611	The Lough Funshinagh SAC	In	Possible direct and indirect causal effect on SAC.
IE0004096	The Middle Shannon Callows SPA	In	Possible indirect causal effect on SPA.
IE0000216	River Shannon Callows SAC	In	Possible indirect causal effect on SAC.
IE0004077	River Shannon and River Fergus Estuaries SPA	In	Possible indirect causal effect on SPA.
IE0004058	Lough Derg (Shannon) SPA	In	Possible indirect causal effect on SPA.
IE0002241	Lough Derg, North-east Shore SAC	In	Possible indirect causal effect on SAC.
IE0002165	Lower River Shannon SAC	In	Possible indirect causal effect on SAC.

Table 4.2 WFD compliance assessment scoping table (Rivers)

		IE_SH_26C100060			IE_SH_26C100200			IE_SH_26C100300			IE_SH_26D100400		
	WFD elements	Temporary effect [6]	Insignificant effect [7]	No in-combination effects	Temporary effect	Insignificant effect	No in-combination effects	Temporary effect	Insignificant effect	No in-combination effects	Temporary effect	Insignificant effect	No in-combination effects
Hydro-morphological supporting element	Hydrology: quantity and dynamics of flow	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Hydrology: connection to groundwaters	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	River continuity	Yes	Yes	Yes	Not assessed as proposed development will have no direct or indirect effect.			Not assessed as proposed development will have no direct or indirect effect.			Not assessed as proposed development will have no direct or indirect effect.		
	Morphology: river depth and width	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Morphology: river bed structure, substrate	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Morphology: riparian zone structure	Yes	Yes	Yes	Not assessed as proposed development will have no direct or indirect effect.			Not assessed as proposed development will have no direct or indirect effect.			Not assessed as proposed development will have no direct or indirect effect.		
Physico-chemical supporting elements	Thermal conditions	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Oxygenation	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Salinity	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Acidification	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Nutrient conditions	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Specific synthetic pollutants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Specific non-synthetic pollutants	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biological quality elements	Phytoplankton	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Macrophytes and phytobenthos	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
	Benthic invertebrate fauna	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes

[6] The periods of time relate to the monitoring period of the WFD element and should consider whether the element in question will recover within the monitoring period

[7] Insignificance in the context of the waterbody spatial scale

	WFD elements	IE_SH_26C100060 Temporary effect [6]	IE_SH_26C100060 Insignificant effect [7]	IE_SH_26C100060 No in-combination effects	IE_SH_26C100200 Temporary effect	IE_SH_26C100200 Insignificant effect	IE_SH_26C100200 No in-combination effects	IE_SH_26C100300 Temporary effect	IE_SH_26C100300 Insignificant effect	IE_SH_26C100300 No in-combination effects	IE_SH_26D100400 Temporary effect	IE_SH_26D100400 Insignificant effect	IE_SH_26D100400 No in-combination effects
	Fish fauna	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Chemical status	Priority substances	Yes	Yes	Yes	Not assessed as proposed development will have no direct or indirect effect.			Not assessed as proposed development will have no direct or indirect effect.			Not assessed as proposed development will have no direct or indirect effect.		

Table 4.3 WFD compliance assessment scoping table (Hydrologically connected protected areas)

		Description	Qualifying interests	Conservation objectives (related to WFD)	Could the status of EU protected areas be compromised?
EU protected areas	IE0000611	Lough Funshinagh SAC	Turloughs [3180] Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation [3270]	To maintain the favourable conservation condition of Turloughs* in Lough Funshinagh SAC, which is defined by attributes and targets related to the WFD: Area stable at c.378.3ha or increasing, subject to natural processes. Maintain appropriate natural hydrological regime necessary to support the natural structure and functioning of the habitat. Maintain appropriate water quality to support the natural structure and functioning of the habitat. To maintain the favourable conservation condition of Rivers with muddy banks with *Chenopodion rubri p.p.* and *Bidention p.p.* vegetation in Lough Funshinagh SAC, which is defined by attributes and targets related to the WFD: Area stable, subject to natural fluctuations. Maintain appropriate natural hydrological regime necessary to support the natural structure and functioning of the habitat. Maintain appropriate water quality to support the natural structure and functioning of the habitat.	Habitat area, habitat distribution, hydrological regime and water quality of both 3180 and 3270 could be compromised.
	IE0004096	The Middle Shannon Callows SPA	Whooper Swan (Cygnus cygnus) [A038] Wigeon (Anas penelope) [A050]	To maintain the favourable conservation condition of qualifying interests in Middle Shannon Callows SPA, which is defined by attributes and targets related to the WFD: Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target.	Habitat linked to hydrology in upper parts of the SPA could be compromised.

		Description	Qualifying interests	Conservation objectives (related to WFD)	Could the status of EU protected areas be compromised?
			Corncrake (Crex crex) [A122] Golden Plover (Pluvialis apricaria) [A140] Lapwing (Vanellus vanellus) [A142] Black-tailed Godwit (Limosa limosa) [A156] Black-headed Gull (Chroicocephalus ridibundus) [A179] Wetland and Waterbirds [A999]	Sufficient number of locations, area and availability of suitable roosting habitat to support the population target. No significant loss to wetland habitat within the SPA, other than that occurring from natural patterns of variation. No significant impact on the quality or functioning of the wetland habitat within the SPA, other than that occurring from natural patterns of variation.	
	IE0000216	River Shannon Callows SAC	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410] Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis) [6510] Alkaline fens [7230] Limestone pavements [8240] Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0] Lutra lutra (Otter) [1355]	To maintain the favourable conservation condition of Alkaline fens in River Shannon Callows SAC, which is defined by attributes and targets related to the WFD: Maintain, or restore where necessary, appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat. Maintain, or restore where necessary, as close as possible to natural or semi-natural drainage conditions. Maintain appropriate water quality, particularly pH and nutrient levels, to support the natural structure and functioning of the habitat. To maintain the favourable conservation condition of Alluvial forests with *Alnus glutinosa* and Fraxinus excelsior (*Alno-Padion, Alnion incanae, Salicion albae*)* in River Shannon Callows SAC, which is defined by attributes and targets related to the WFD: Appropriate hydrological regime necessary for maintenance of alluvial vegetation. To maintain the favourable conservation condition of Otter (*Lutra lutra*) in River Shannon Callows SAC, which is defined by attributes and targets related to the WFD: No significant decline (freshwater habitat). Length mapped and calculated as 146.7km	Habitat linked to hydrology in upper parts of the SAC could be compromised.
	IE0004077	River Shannon and River Fergus Estuaries SPA	Various	Habitat and hydrology attributes.	Unlikely due to spatial distance of hydrological connection is more than 100km away.

		Description	Qualifying interests	Conservation objectives (related to WFD)	Could the status of EU protected areas be compromised?
	IE0004058	Lough Derg (Shannon) SPA	Various	Habitat and hydrology attributes.	Unlikely due to spatial distance of hydrological connection is more than 50km away.
	IE0002241	Lough Derg, North-east Shore SAC	Various	Habitat and hydrology attributes.	Unlikely due to spatial distance of hydrological connection is more than 50km away.
	IE0002165	Lower River Shannon SAC	Various	Habitat and hydrology attributes.	Unlikely due to spatial distance of hydrological connection is more than 100km away.

Table 4.4 WFD compliance assessment scoping table (Groundwater body)

		IE_SH_G_091		
	WFD elements	Temporary effect [8]	Insignificant effect[9]	No in-combination effects
Groundwater quantitative status	Available groundwater resource	Yes	Yes	Yes
	Groundwater dependent surface water bodies	Yes	Yes	Yes
	Groundwater dependent terrestrial ecosystems	Yes	Yes	Yes
Groundwater chemical status		Yes	Yes	Yes

[8] The periods of time relate to the monitoring period of the WFD element and should consider whether the element in question will recover within the monitoring period

[9] Insignificance in the context of the waterbody spatial scale

5. STAGE 3: Detailed Assessment

The WFD river water body **IE_SH_26C100060, IE_SH_26C100200, IE_SH_26C100300** and **IE_SH_26D100400** (i.e. Cross River) required a Stage 3 detailed assessment to determine the significance of the effect of the discharge of water to the Cross River on the following elements:

- Morphology: river depth and width; river bed structure
- Hydrology: quantity and dynamics of flow
- Physico-chemical supporting elements: Thermal conditions; Oxygenation; Salinity; Acidification; Nutrient conditions; and
- Biological quality elements: Phytoplankton; Macrophytes and phytobenthos; Benthic invertebrate fauna; Fish fauna.

The **IE0000611**, **IE0004096** and **IE0000216** required a Stage 3 detailed assessment to determine the significance of effect of the discharge of water to the Cross River on the conservation objectives relating to habitat, water quality and hydrological regime.

The detailed assessment is aligned with the locations of the Aquatic Assessment and water quality sampling that was undertaken in August 2024 (i.e. Sites 1-7). This allowed for the baseline habitat and biological quality of the Cross River to be assessed alongside predictions on the hydrological and morphological impact of the proposed scheme.

5.1 WFD river water bodies

5.1.1 Hydromorphology

5.1.1.1 Catchment scale controls

The Cross River lies within the Shannon River catchment area, which is the largest in Ireland at more than 18,000km^2 (Figure 5.1). The Shannon River, with a length of 260km, drains central Ireland from the Cuilagh mountains towards the Shannon Estuary in Limerick. The area is mainly rural agricultural landuse although many EU protected sites depend on the surface and groundwater.

The Cross River has a length of approximately 20km, rising from groundwater springs at 65mOD about 2.8km south-west of Lough Funshinagh and discharging into the Shannon River at 32mOD about 2.5km south of Athlone (Figure 5.2 and Figure 5.3). The catchment area of the Cross River at its outlet is 108km^2 and the catchment area above the proposed outfall is 4.17km^2 (MWP, 2024). The topography of the Cross River catchment is dominated by quaternary deposits of till derived from limestone and presents as a karstified bedrock. Evidence of numerous karst landforms including springs, swallow holes, turloughs and enclosed depressions indicate places where significant karstification of the bedrock has occurred and where there is likely to be significant water bearing conduits or fractures. It is likely that baseflow is predominantly groundwater driven, particularly in the upper catchment.

Along the length of the Cross River the bedrock geology is predominantly Visean Limestone, consisting of undifferentiated limestones. This underlies a quaternary sediment layer, primarily of alluvium with areas of gravels derived from limestone, peat and till derived from limestone (Figure 5.4). The cut-over raised peat underlies the Cross River at four locations (Figure 5.5). The presence of wetlands in the catchment indicates the complex surface water, groundwater and sediment dynamics to the Cross River.

The Cross River has a bed gradient of 0.1% (Figure 5.6), with the upper channel being steeper at a gradient of about 0.3% compared to the lower channel at a gradient of about 0.07%. Both are low gradients, but there is a slight steepness to the upper channel.

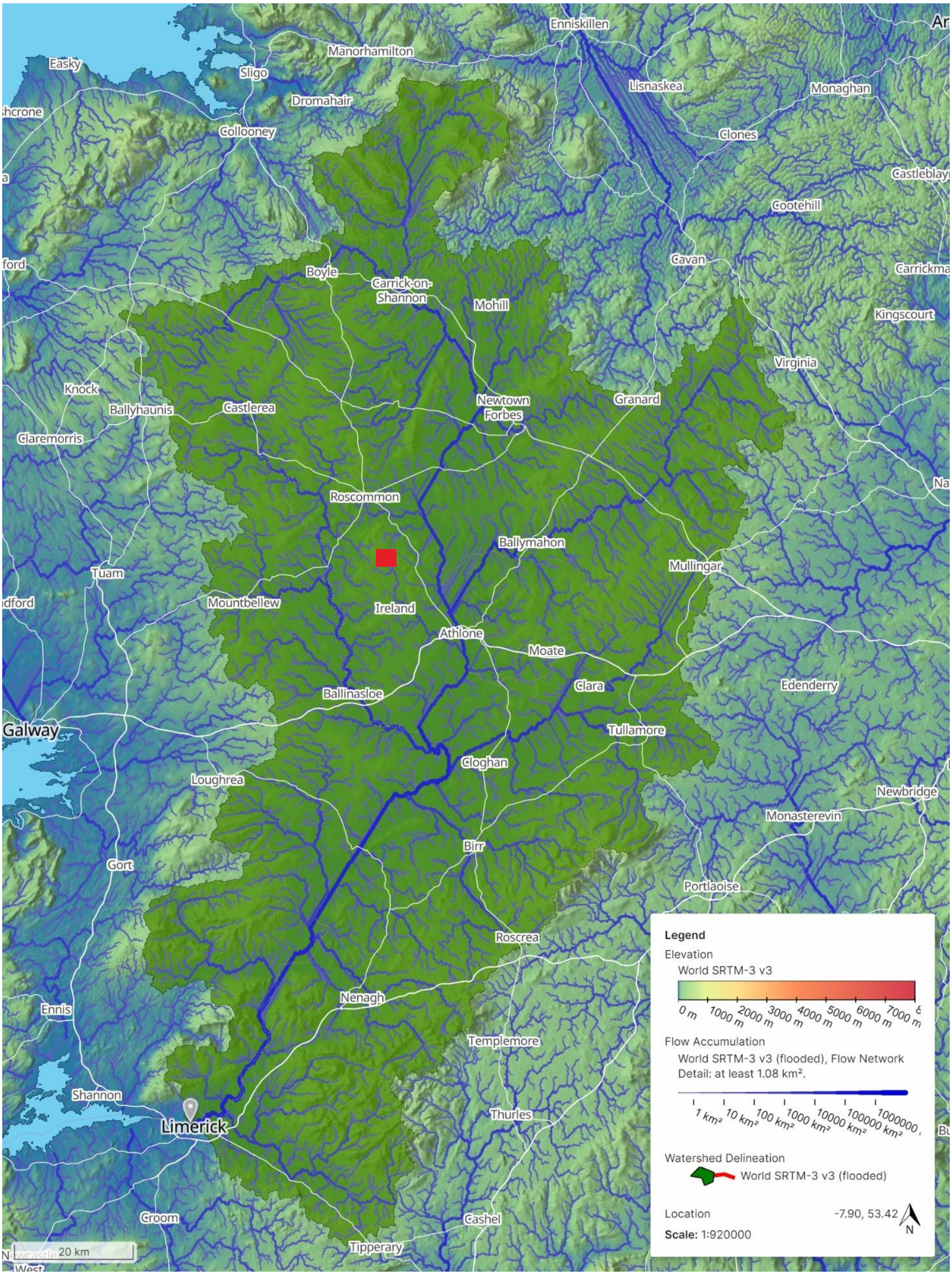


Figure 5.1 Surface water drainage of Shannon River, with proposed scheme identified within the red block (Source: Scalgo, 2024)

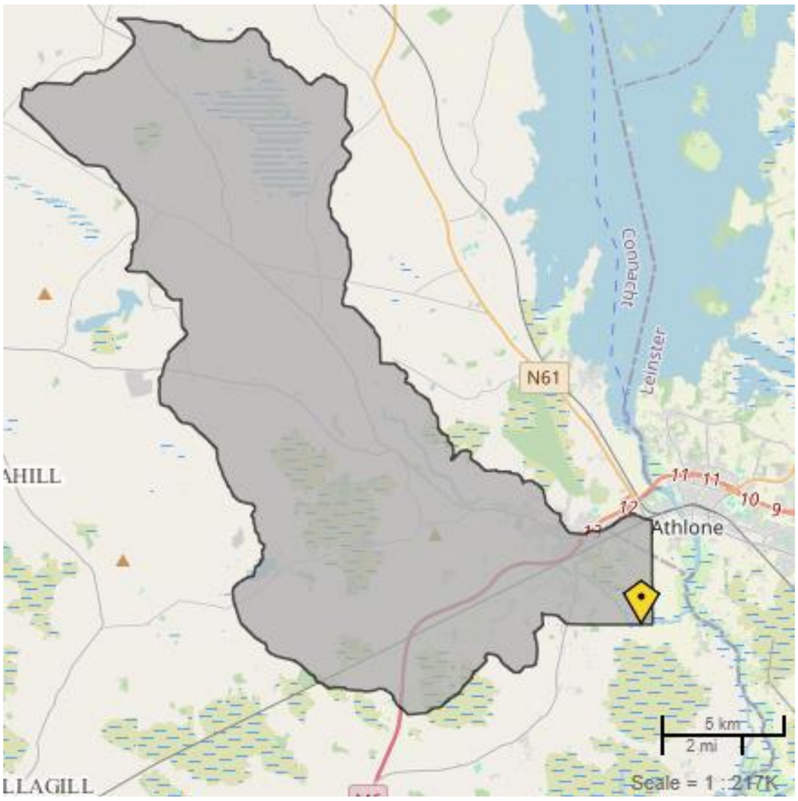


Figure 5.2 Surface water drainage of Cross River (MWP, 2024) | not to scale

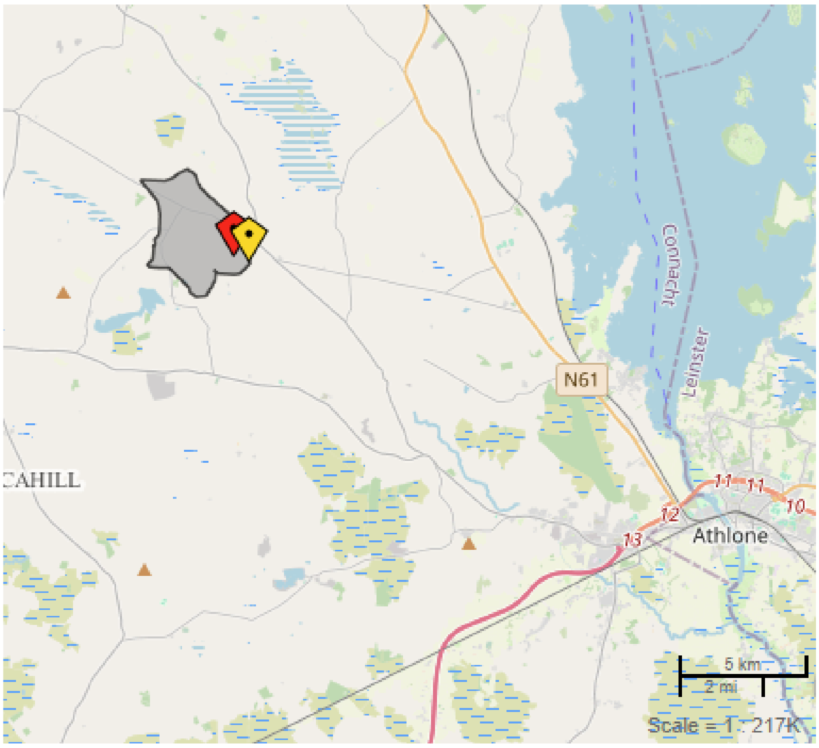


Figure 5.3 Surface water catchment area of the proposed outfall point on Cross River (MWP, 2024) | not to scale

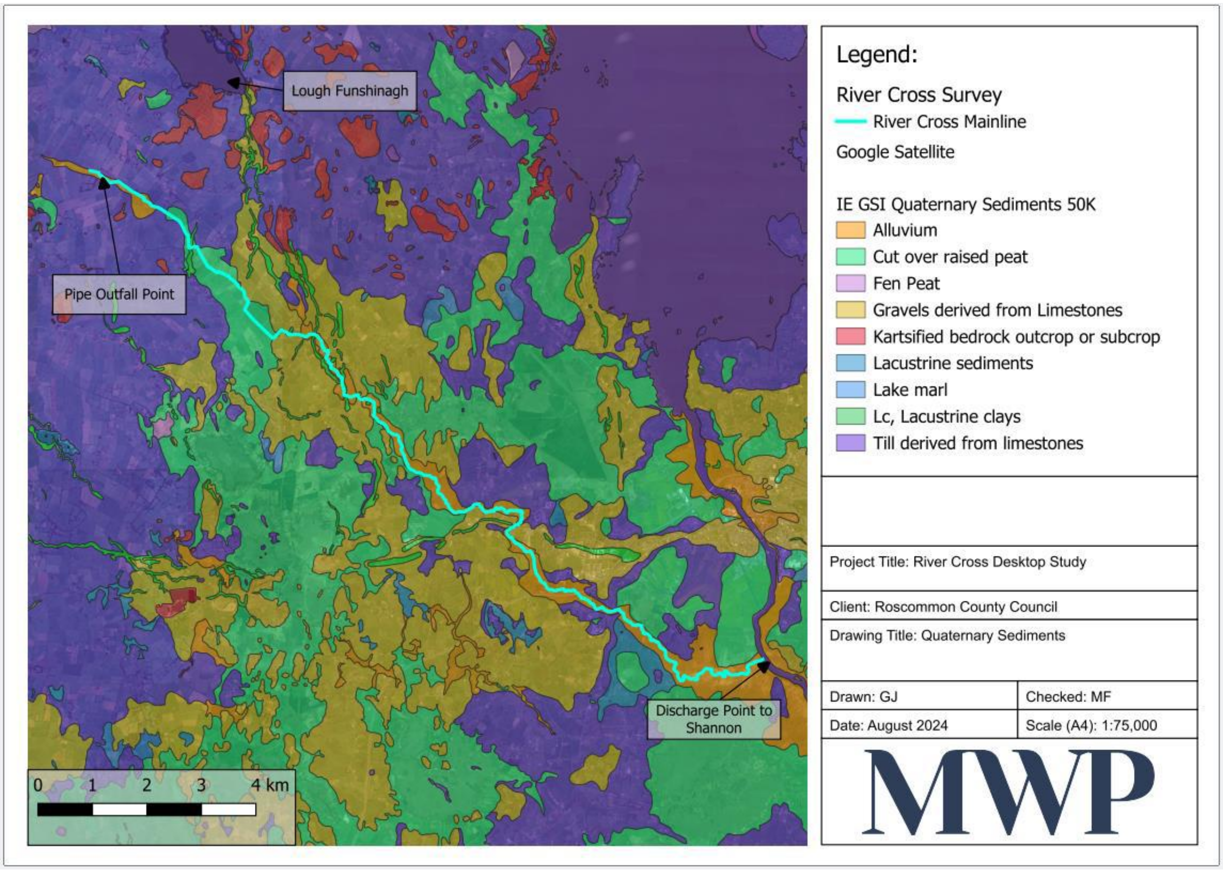


Figure 5.4 Quaternary sediments underlaying Cross River (MWP, 2024)

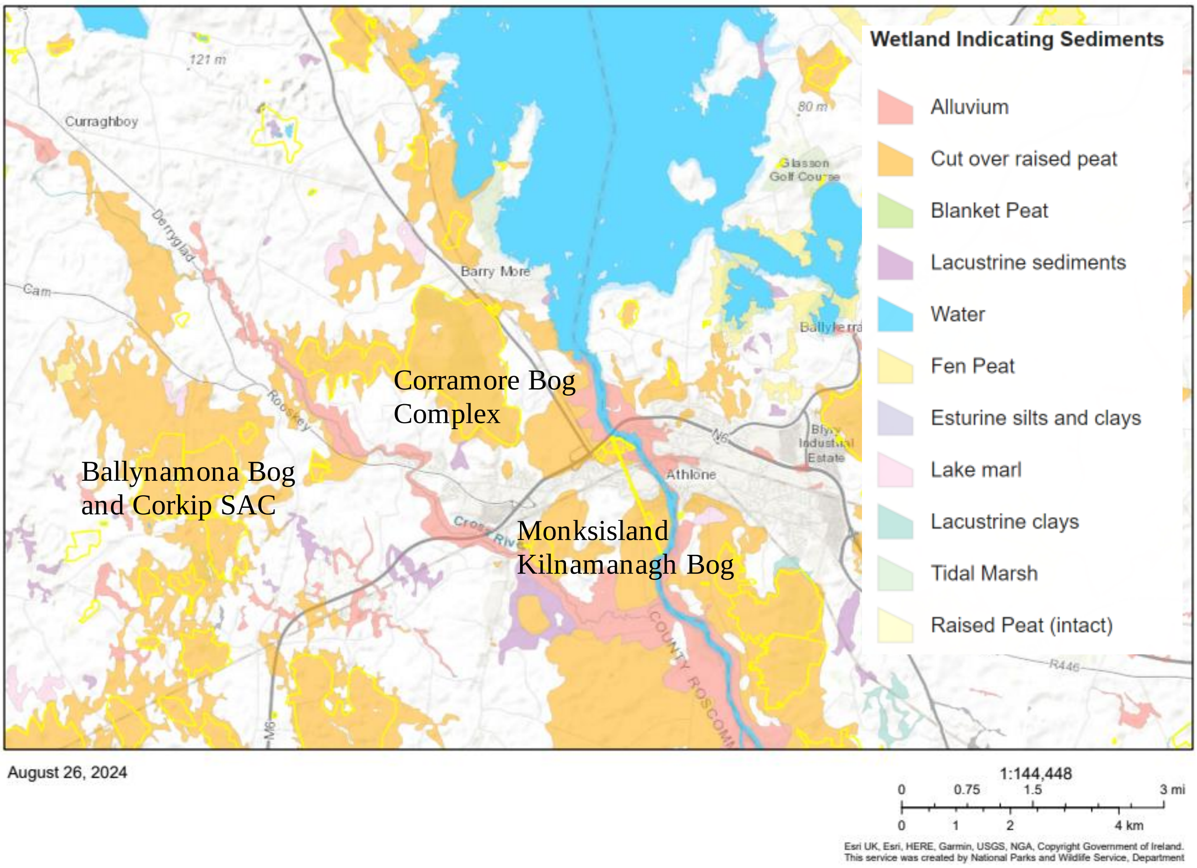


Figure 5.5 Wetlands within Roscommon County, with alluvian broadly following the river route (Map of Irish Wetlands, 2024)

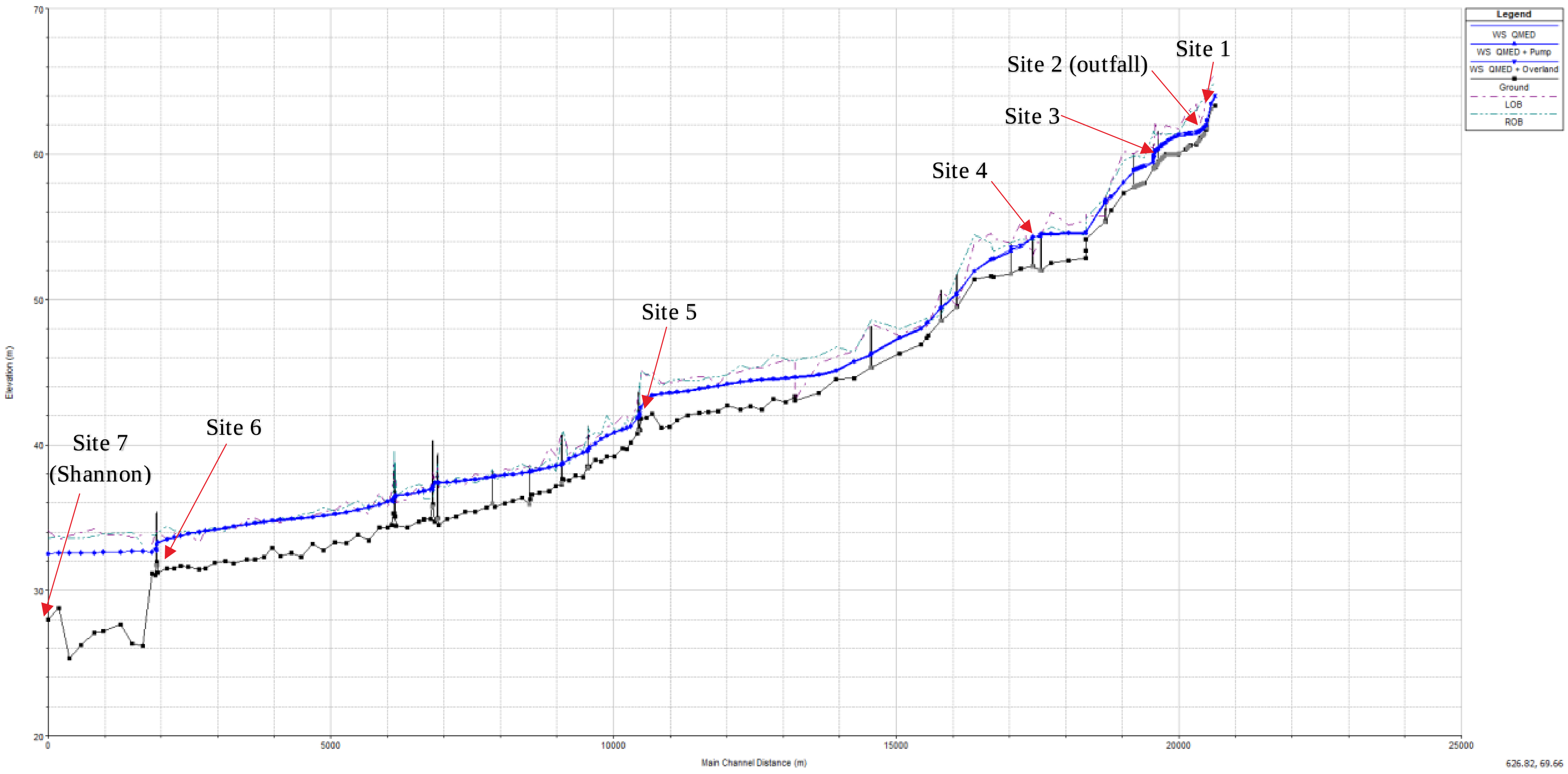


Figure 5.6 Longitudinal section of Cross River with Qmed and with pumped flows, proposed outfall location at 2050m distance (MWP, 2024)

5.1.1.2 Stream power

The current erosive power for the Cross River was assessed at the outfall location within the Cross River through a stream power analysis (MWP, 2024). The current stream power for natural flow and stream power with natural and the proposed pumped flow were below the 35W/m^2 high energy threshold for erosion for the outfall location and mid-point (Brookes, 1987) (Table 5.2). Further downstream the energy threshold is high under natural flow. The additional pumped flow does not change this energy threshold significantly.

Table 5.1 Stream power analysis of pumped flow on Cross River (MWP, 2024)

Sample Site	Energy Slope (%)	Current potential energy expenditure (W/m2)	Potential energy expenditure with proposed pumping (W/m2)	Change in potential energy expenditure with proposed pumping (W/m2)
Site 2	0.4	18.96	28.50	9.5
Site 5	0.01	4.7	5.1	0.4
Site 6	0.06	50.4	48.6	1.8
Site 7	0.1	82.5	85.5	3

5.1.1.3 Human impacts

Maps from 1829-1834 (6 inch maps from Geohive) indicate that the Cross River has been artificially straightened and re-sectioned for agricultural purposes (Figure 5.8). The cut-over bogs have also been drained for agriculture. By confining the river its natural lateral and longitudinal connectivity has been gradually reduced, which has impacted the flow of water and sediments to downstream habitats as well as to surrounding peatlands. As water and sediment is such an important driver of the creation of habitats in this area it is likely that surrounding ecosystems have been impacted by the confounding losses.

Figure 5.7 Map of the length of Cross River in (1829-1834) (MWP, 2024)

5.1.1.4 River habitat survey

In August 2024 an Aquatic Assessment (Triturus, 2024) and additional hydromorphology site assessment informed the assessment of the river habitat for the Cross River (Appendix A). Sites 1-7 related to the Aquatic Assessment and Sites A-E related to the hydromorphology site assessment (Figure 5.8, Figure 5.9). The assessments indicate that the Cross River is a historically modified lowland limestone watercourse (FW2: Fossit, 2000). The upper reaches have been extensively modified (historically straightened and deepened), resulting in a channel with typically poor hydromorphology. Siltation and eutrophication pressures from adjoining agricultural land are a threat to biological water quality (refer to Section 5.1.3). Relatively low summer flows and natural bed calcification further reduced the quality of aquatic habitats in the upper reaches. However, water flows and volumes increased significantly between survey sites Site 4 and Site 5. This, coupled with the retention of more natural characteristics in the middle and lower reaches (albeit still often deepened) resulted in better quality aquatic habitats which supported a number of high conservation value aquatic species (refer to Section 5.1.4).

Site assessment using the River Hydromorphology Assessment Technique (RHAT) methodology (NIEA[10], 2014) suggests the river typology for the upper reaches of the Cross River (i.e. above site 3) is 'pool riffle glide'. This morphology is characterised by low to moderate gradient channel beds. Sediment is predominantly gravel, with patches of cobbles and sand. Flow types are made up of riffle sections interspersed with pools and glides. The lower reaches of the Cross River are 'lowland meandering', which is characterised by low to no gradient lowland streams with smooth flow and fine substrates.

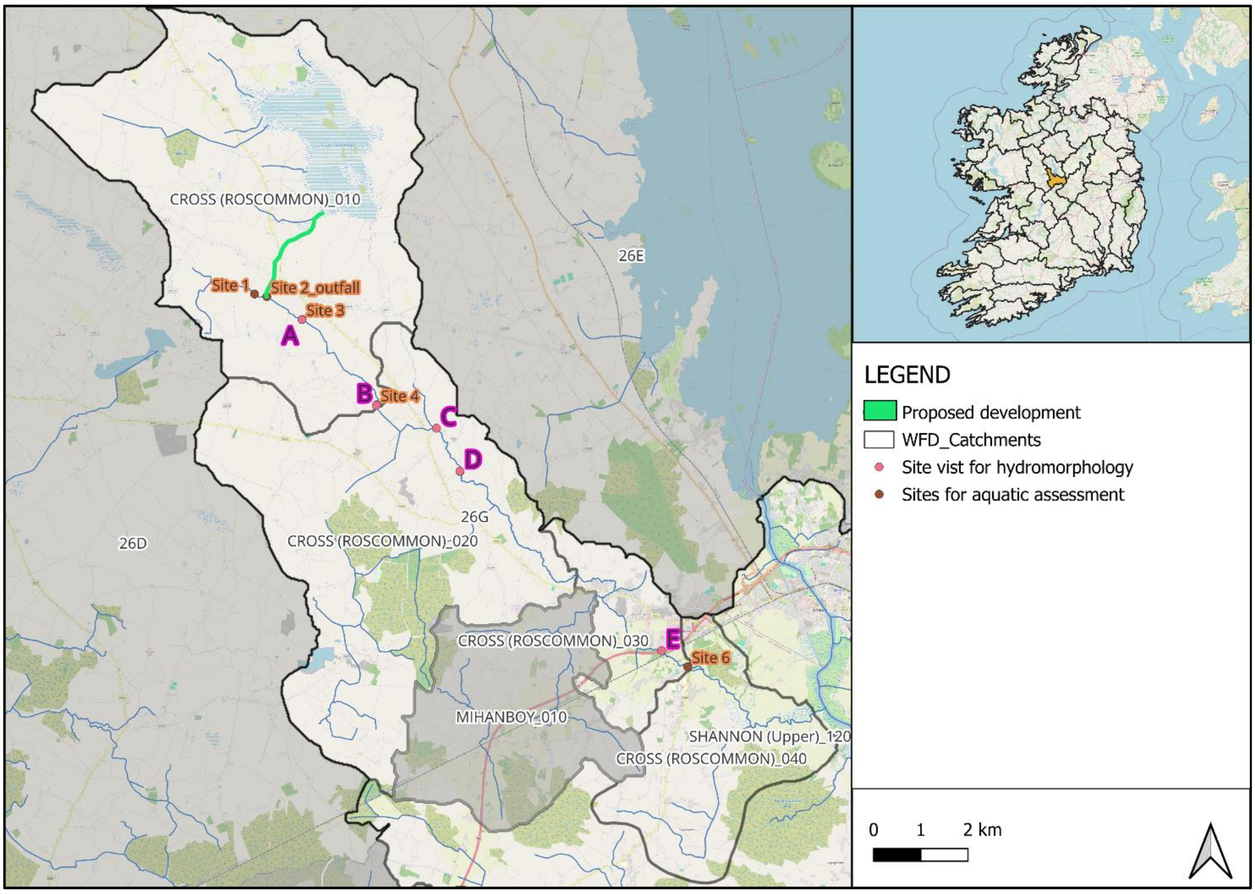


Figure 5.8 Site walkover for hydromorphology and aquatic surveys from the upstream (site1) to downstream (site7) reaches of the Cross River


Site 1: 250m upstream of proposed outfall location, channel is modfied into trapezoidal shape with heavily scrubbed banks. Substrata were dominated by mixed gravels and cobble.

[10] River Hydromorphology Assessment Technique (RHAT) Training Manual-Version 2. (NIEA, 2014)

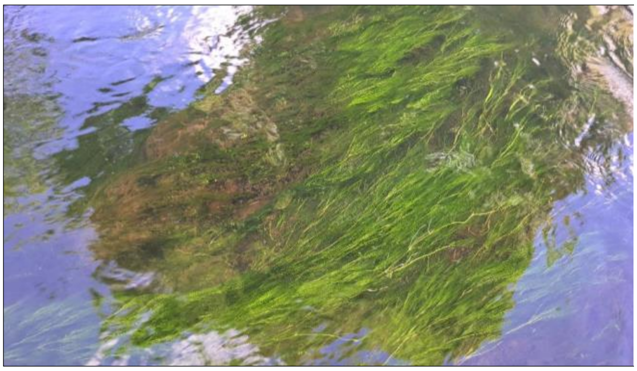

Site 2: At proposed outfall location, channel is modfied into trapezoidal shape with steep banks ncroached by terrestrial and herbaceous scrub. Substrata were dominated by fine and medium gravels with frequent small cobble


Site 3 / Site A: 900m downstream of proposed outfall location, near local road. Channel is deepened and locally straightened, with bank modifications and revetment in vicinty of bridge (box culvert). Substrate dominated by heavily calcified cobble and boulder with localised mixed gravel and sands.


Site 4 / Site B: Site at a farm access track. Channel extensively deepened historically and locally straightened along the road. The substrata were dominated by deep silt with a high clay fraction.


C: Site just above site 5 indicating increased flow volume compared to upstream, floating aquatic plants and mixed substrate.


Site 5 / Site D: At Millnagh Mill. Channel deepened historically with some local straightening in vicinity of mill. The substrata were dominated by heavily compacted/calcified cobble and abundant boulder.

Site 6: Channel has been deepened with bank revetment. Filamentous algal and floc cover was moderate, indicating enrichment.

Site 7: Site 250m above Shannon River confluence. Channel has been deepened historically but not straightened with low-lying clay banks adjoined by extensive flood plains. The substrata were dominated by deep silt with scattered compacted/bedded boulder and cobble, mostly confined to the bridge apron.

Figure 5.9 Site walkover photographs from the upstream (Site 1) to downstream (Site 7) reaches of the Cross River, indicating the channel/banks and substrate condition.

5.1.2 Geohydrology and Hydrology

Smaller tributaries and groundwater springs contribute to natural flow downstream of CROSS (ROSSCOMMON)_010. The groundwater connection to Lough Funshinagh is explained in more detail in Section 5.2.1.

5.1.2.1 Hydrological analysis

A hydrological analysis was conducted for the Cross River using the continuous flow records at Summerhill (Station 26221) from 2001 to present (MWP, 2024). The gauge is located approximately 15.3 km downstream of the proposed pipe outfall site and 4.7 km upstream of the River Shannon. The assessment considered cross sections across the Cross River, starting at a point upstream of the proposed outfall. The catchment area above the proposed outfall is 4.7km^2 (Figure 5.3).

The characteristics of the Cross River are reflected in the nodes selected for high and low flow analysis of the river (Table 5.2). These are also representative of the aquatic assessment site locations (Site 1-7).

Table 5.2 Characteristics of nodes at proposed outfall location and at confluence with Shannon River

Cross-section	Sample Site	Description	Catchment area (km2)	Chainage (m)	Water depth (m)	Freeboard to bank (m)
134	Site 2	At proposed outfall	4.17	0	0.357	2.07
8	Site 7	At Shannon River	107.96	19000	2.25	0.36

5.1.2.2 High flow analysis

A high flow analysis for the Cross River was estimated along the 20km length, with adjustments made for the influence of the Shannon River at the downstream outlet (Table 5.3). The analysis indicated that pumped flow into the Cross River would increase water levels by approximately 110mm at the outfall location (i.e. Site 2). As the freeboard to bank is 2.07m the channel can accommodate this increase. At the outlet to the Shannon River (i.e. Site 7) the water level with the influence of the Shannon River and without the influence of the Shannon River will have no notable change due to the pumped flow. The change in flow velocity with pumped flow is negligible for most of the Cross River.

Table 5.3 Impact of proposed pumping on peak flow, flow velocity, water depth and freeboard for Cross River

Sample Site	Current Peak flow (m3/s)	Peak flow with proposed pumped flow (m3/s)	Current flow velocity (m/s)	Flow velocity with proposed pumped flow (m/s)	Increase of water depth with pumped flow (m)	Increase of freeboard to bank with pumped flow (m)
Site 2	0.53	0.83	0.62	0.65	0.112	0.11
Site 5	3.26	3.56	0.39	0.42	0.04	0.04
Site 6	8.06	8.36	0.52	0.53	0.03	0.03
Site 7	8.15	8.45	0.65	0.65	0.04	0.03

5.1.2.3 Low flow analysis

A low flow analysis for the Cross River was estimated along the 20km length, with adjustments made for the influence of Shannon River (both Qmed and Q95). With the addition of the proposed pumped flow, the most significant difference in flow and velocity is observed at the outfall location (i.e. Site 2), with this difference becoming less substantial further downstream (Table 5.4). At Site 2, the addition of the proposed pumped flow corresponds to an increase in water depth of 0.141m for a 95%ile low flow and 0.101m in for the 50%ile low flow. At Site 7 the addition of the proposed pumped flow corresponds to a significantly smaller increase in water depth of 0.022m for a 95%ile low flow and 0.047m for the 50%ile low flow. Including the Shannon low flows had no significant effect on flows.

Table 5.4 Impact of proposed pumping on flow rate and flow velocity at 95th percentile low flow for Cross River, with Shannon River influence considered

Sample Site	Current Q95 low flow (l/s)	Q95 low flow with Shannon[11] & proposed pumped flow (l/s)	Current Q95 low flow velocity (m/s)	Q95 low flow velocity with Shannon & proposed pumped flow (m/s)
Site 1	12.2	312.2	0.48	1.15
Site 2	112	412	0.4	0.62
Site 5	190	490	0.83	1.01
Site 6	290	590	0.10	0.16
Site 7	300	600	0.06	0.12

Table 5.5 Impact of proposed pumping on flow rate and flow velocity at 50th percentile low flow for Cross River

Sample Site	Current Q50 low flow (l/s)	Q50 low flow with proposed pumped flow (l/s)	Current Q50 low flow velocity (m/s)	Q50 low flow velocity with proposed pumped flow (m/s)
Site 1	60	360	0.70	1.19
Site 2	440	740	0.63	0.70
Site 5	660	960	0.60	0.53
Site 6	1230	1530	0.25	0.28
Site 7	1290	1590	0.28	0.31

[11] Additional of Qmed or Q95ile Shannon flow had the same values for flow and flow velocity

5.1.3 Water Quality and Biological Limits

In order to analyse the water quality in the Cross River, the EPA water quality database was used (Appendix B). In general, most stations have data for several water quality parameters that extend from 2007 to 2024, with samples being taken once a month. Assessment of the EPA water quality monitoring data for the Cross River indicated that CROSS (ROSSCOMMON)_010 waterbody is not well represented (Figure 5.10). Monitoring stations further downstream such as RS26C100100, RS26C100200, RS26C100300 and RS26C100400 had more samples over longer periods. In general, most stations have data that extends from 2007 or 2010 to 2024, with samples being taken once a month.

A trend analysis of these stations was conducted and supplemented by samples collected on the 12th of August 2024 (i.e. Site 1-7) in the Cross River as well as with water quality monitoring at Lough Funshinagh[12] (i.e. SW1-2) (Figure 5.11). The water quality parameters were assessed to determine current trends in water quality for the Cross River against Directive Standards (Table 5.6) and a 'Waste Assimilative Capacity' assessment (Appendix C) was conducted to determine the capacity of the river to assimilate additional nutrients from the transfer of water from Lough Funshinagh.

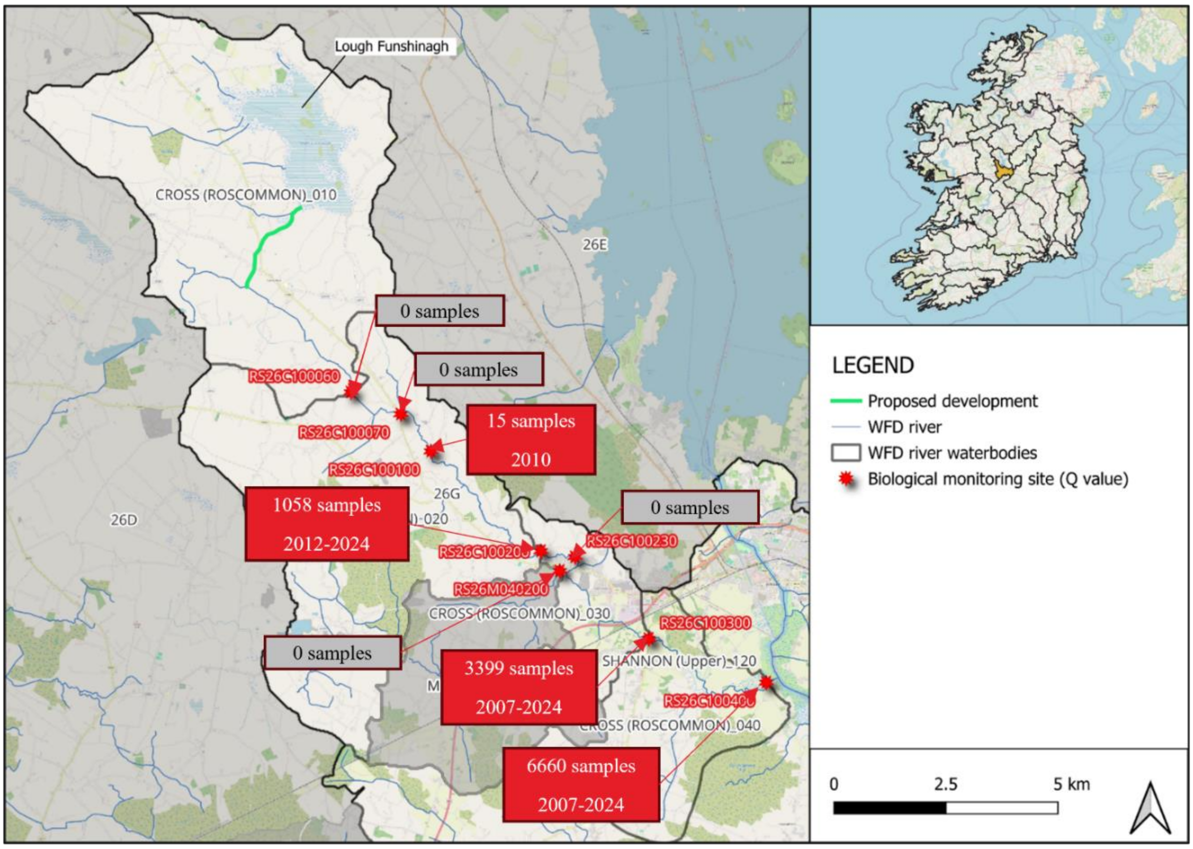


Figure 5.10 Location of EPA water quality monitoring stations in relation to the proposed scheme

[12] Water quality monitoring on behalf of the Office of Public Works as part of the Lough Funshinagh Flood Management Works led by the OPW in 2023. Lough Funshinagh, Lough Cup (a turlough approximately 700m south east of Lough Funshinagh) and unnamed stream entering Lough Funshinagh were monitored as part of monitoring plan.

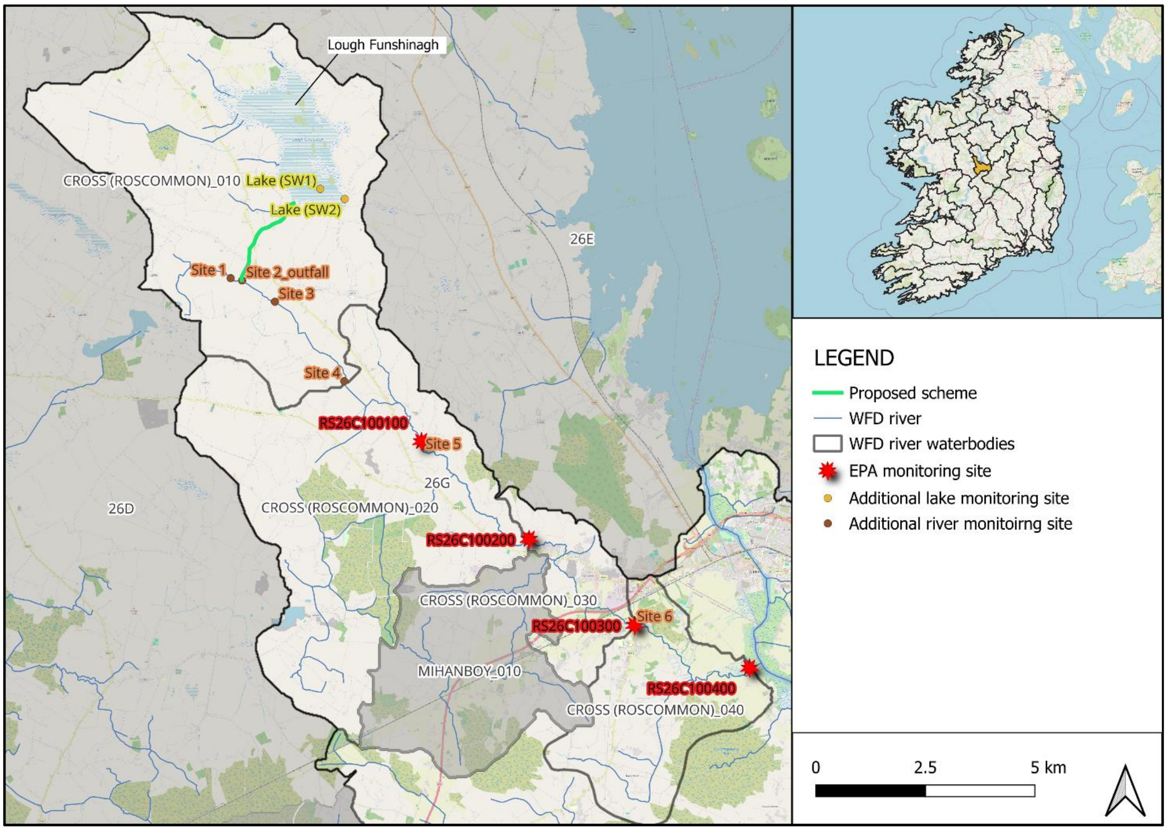


Figure 5.11 Location of additional river and lake water quality monitoring samples; and select EPA water quality monitoring stations in relation to the proposed scheme

Table 5.6 Relevant standards and regulations applicable to water quality assessment

Water Quality Parameter	Salmonid Water Regulation[13]	Drinking Water Regulations[14]	Surface Water Regulations[15]			Unit
	As per the above regulation	As per the above regulation	As per the above regulation			
			High Status	Good Status	Moderate Status	
Temperature	21.5 °C (10 °C from November to April)	N.V.	Not greater than a 1.5°C rise in ambient temperature outside the mixing zone.			°C
pH	6 - 9	6.5-9.5	4.5 - 9, Water hardness ≤ 100 mg/1 CaCO3 6 - 9, Water hardness >100 mg/1 CaCO3			pH Units
Total Ammonia (as N)	0.02	0.3	0.04	0.065	N.V	mg/l
Total Residual Chlorine	0.005	N.V.	N.V.	N.V.	N.V.	mg/l
Conductivity	N.V.	2500	N.V.	N.V.	N.V.	µs/cm-1 at 20 °C
Sodium Na	N.V.	200	N.V.	N.V.	N.V.	mg/l
Manganese Mn	N.V.	0.05	N.V.	N.V.	N.V.	mg/l
Chloride Cl	N.V.	250	N.V.	N.V.	N.V.	mg/l
Fluoride F	N.V.	N.V.	0.5	0.5	0.5	mg/l
Sulphate SO4	N.V.	250	N.V.	N.V.	N.V.	mg/l
Nitrate (as N) NO3	N.V.	50	N.V.	N.V.	N.V.	mg/l
Nitrite (as N) NO2	0.05	0.5	N.V.	N.V.	N.V.	mg/l
Boron B	N.V.	1	N.V.	N.V.	N.V.	mg/l
Chlorides (as Cl-)	N.V.	250	N.V.	N.V.	N.V.	mg/l
Copper	N.V.	2	0.005	N.V.	N.V.	mg/l
Suspended Solids	25	Acceptable to consumers and no abnormal change	N.V.	N.V.	N.V.	mg/l

[13] S.I. No. 293/1988

[14] S.I. No. 122/2014 and S.I. No. 464/2017

[15] S.I. No. 272/2009 and S.I. No. 77/2019

Water Quality Parameter	Salmonid Water Regulation[13]	Drinking Water Regulations[14]	Surface Water Regulations[15]			Unit
	As per the above regulation	As per the above regulation	As per the above regulation			
			High Status	Good Status	Moderate Status	
Zinc	0.03 to 0.5 *depending on the water hardness	N.V.	8 or 50 or 100 ug/l * depending on the water harness			mg/l
BOD5	5	N.V.	1.3	1.5	N.V.	mg/l
Iron	N.V.	0.2	N.V.	N.V.	N.V.	mg/l
Selenium	N.V.	10	N.V.	N.V.	N.V.	mg/l
Orthoposhpates as P. MRP	N.V.	N.V.	0.025	0.035	N.V.	mg/l

5.1.3.1 Thermal conditions

It is expected that lake water will have a higher temperature than river water therefore thermal condition is an important parameter to monitor. Water temperature is one of the main abiotic factors affecting the structure and functioning of aquatic ecosystems and its alteration can have important effects on biological communities, it might affect the organisms' behaviour, growth, survival and disease resistance[16]. Fish response to increasing temperature will vary according to their thermal tolerances and life stage; however, a negative response is expected for cold-water species[17].

Average annual surface water temperatures recorded in the Cross River ranged from between 13-13.7°C in summer months (April to September) and 8.4-8.9°C in winter months (October to March), when it is proposed for water to be pumped from Lough Funshinagh to the Cross River (Figure 5.12). The average water temperatures recorded in stations RS26C100200, RS26C100300 and RS26C100400 are similar, with a variation of 0.39°C (Figure 5.13). Thermal conditions increase further downstream.

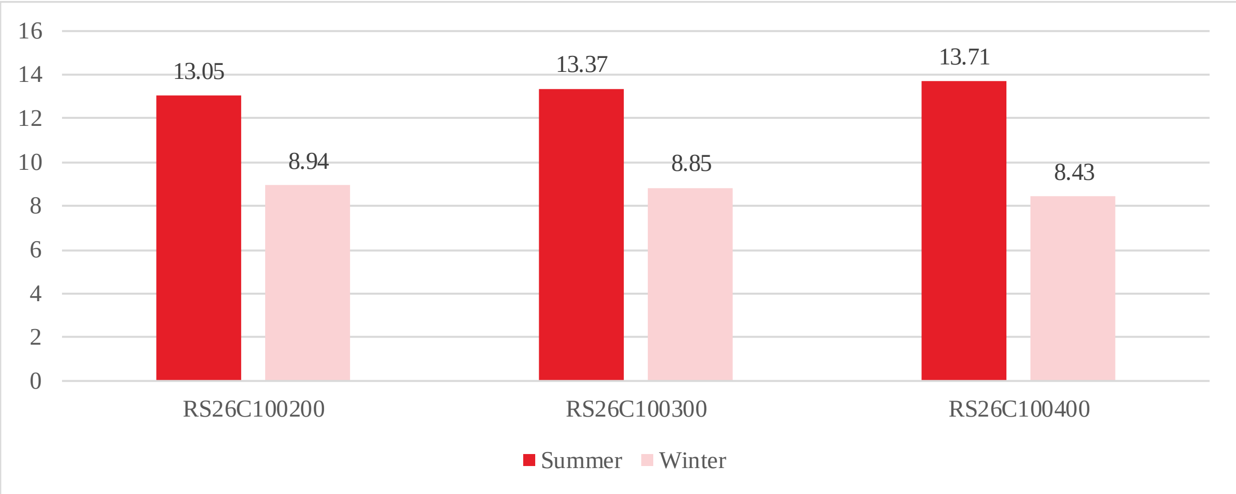


Figure 5.12 Average seasonal temperature at select EPA water quality stations for Cross River (EPA, 2024)

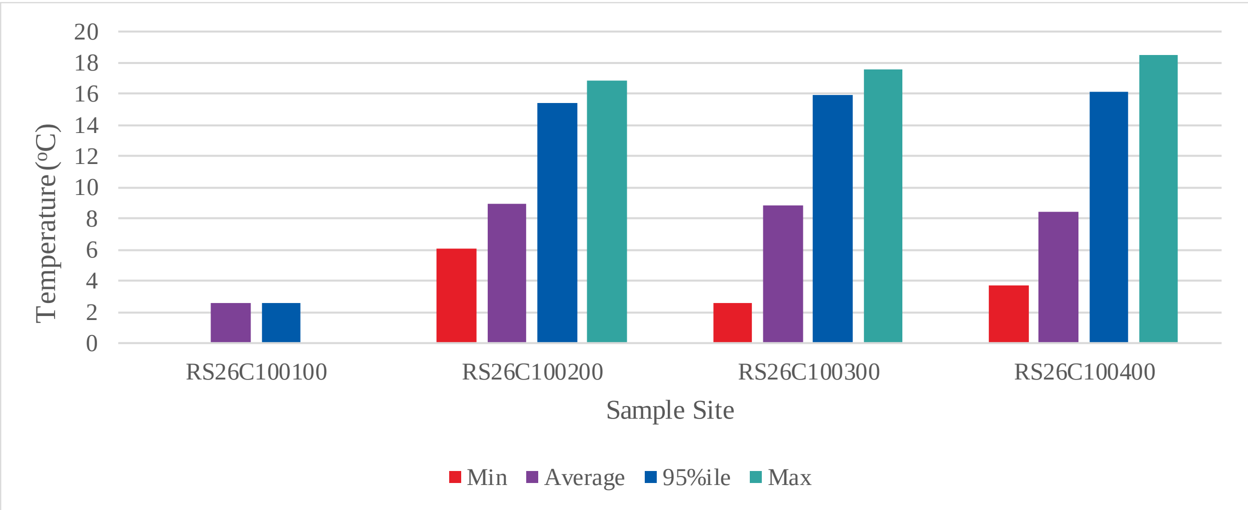


Figure 5.13 Minimum, maximum and average temperature at select EPA water quality stations for Cross River (EPA, 2024)

[16] Biological reviews, 2022. Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10088029/pdf/BRV-98-191.pdf,

[17] Inland Fisheries Ireland, 2018. Climate change mitigation research programme. Salmonids in hot water, Summer 2018. IFI/2019/1-4465

5.1.3.2 *Oxygenation conditions*

Oxygenation conditions were assessed through Dissolved Oxygen (DO), Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD). The trends from the EPA dataset were assessed as were the baseline sampling results. Water temperature affects DO concentrations in a river or waterbody, DO generally increases as the water temperature decreases[18]. The flow rate of a river, stream or turbulence in a lake can also impact upon the DO concentration. Rapidly moving water tends to contain higher DO concentrations whereas stagnant water typically contains lower DO concentrations. BOD is a parameter used to describe the level of oxygen concentration in water bodies. BOD is a measure of the amount of oxygen that aerobic microorganisms need to decompose organic substances in a water sample over a five-day period in the dark at 20 °C, expressed in O_2/litre. COD is another method of estimating the theoretical oxygen demand.

Assessment of the EPA dataset indicated that DO concentrations ranged from between 13.25 mg/l RS26C100300 to 4 mg/l at RS26C100400. The DO concentration in stations RS26C100300 and RS26C100400 present an increasing trend from 2007 to 2024 while the DO concentration in RS26C100200 shows a decreasing tendency from 2012 to 2024. The BOD ranges from 0.36 mg/l in RS26C100300 to 8.7 mg/l in the same station (Figure 5.14). Station RS26C100300 BOD surpasses the moderately polluted rivers upper limit and reaches 8.7mg/l, this datapoint was extracted in 2024. COD values are not present in the EPA database.

The baseline samples (Figure 5.15) show lower BOD concentrations when compared to the average EPA datapoints from the 4 stations. BOD levels were low (≤1.1mg O_2/l) with all sites meeting the high status threshold of ≤1.3mg O_2/l as set out under the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77/2019). The baseline samples COD concentrations are smaller than the maximum UWWTD threshold of below 125mg O_2/l. The baseline samples DO concentrations were within acceptable limits for salmonids.

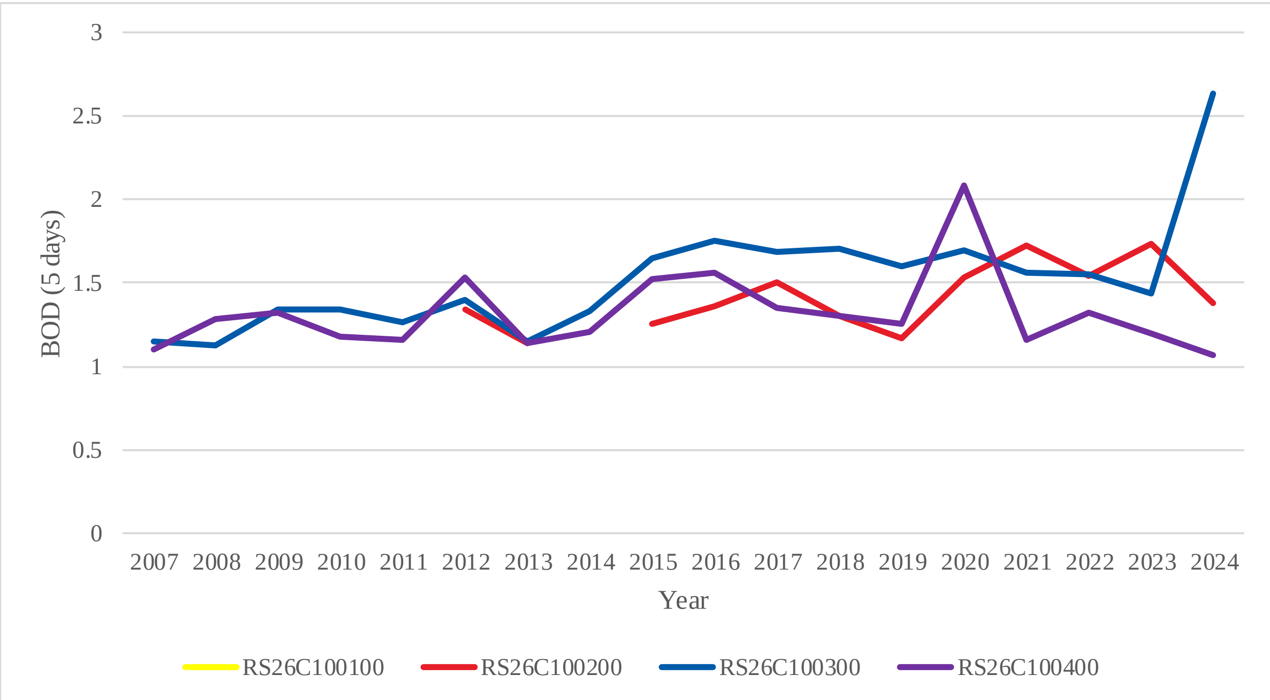


Figure 5.14 Average annual BOD at select EPA water quality stations for Cross River (EPA, 2024)

[18] USGS, 2018. https://www.usgs.gov/special-topics/water-science-school/science/dissolved-oxygen-and-water

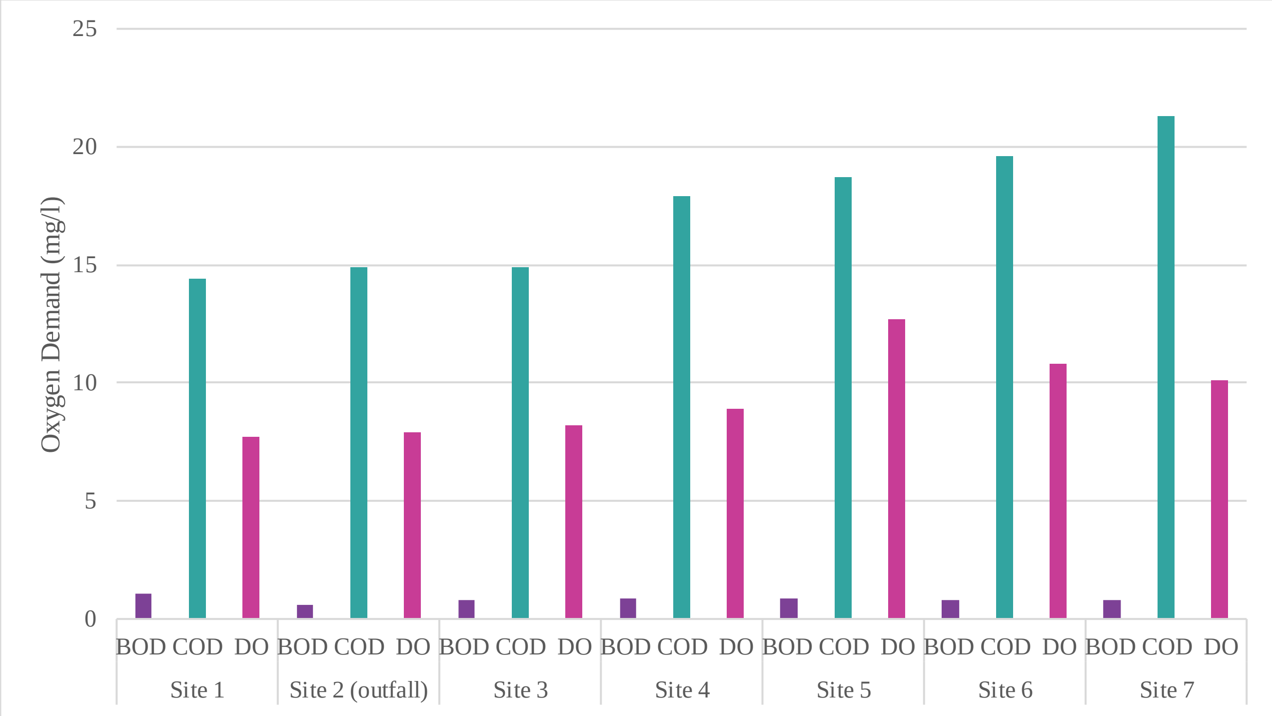


Figure 5.15 Baseline oxygenation conditions in Cross River[19][20]

5.1.3.3 Salinity

Electrical conductivity is a measure of the ability of an aqueous solution to carry an electrical current. Conductivity is useful as a general measure of water quality. Each water body tends to have a relatively constant range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements. Significant changes to electrical conductivity can indicate that unknown pollutants have entered the waterbody and that further detailed laboratory analysis on a range of parameters is warranted.

There are no nationally recognised screening limits for electrical conductivity in surface waters. The drinking water criteria of 2,500 µS/cm has been included in the analysis for comparison purposes only although this relates to treated drinking water. Electrical conductivity in a lake or river can be quite variable, and still within natural levels that will not cause any harm. Typical natural background values within a river can vary between 100 – 2000 µS/cm.

The data distribution from the EPA does not allow a determination of a range of conductivity in the river at the different measurement stations: RS26C100200 only has one data point in 2015, and stations RS26C100300 and RS26C100400 only have more than three data points a year in 2015. The recorded electrical conductivity results at each sample location ranged from between 266 µS/cm in RS26C100400 in 2018 to 609 µS/cm in the same station in 2009. The conductivity at the 2024 sample sites were also within an acceptable range within the river and lake (Table 5.7). Lough Funshinagh had a lower conductivity than the river samples.

[19] According to UWWTD, the COD in the wastewater discharge must remain below 125mg/l O2. Conversely, a minimum reduction of 75% needs to be achieved.; biochemical oxygen demand (BOD) needs to be reduced to 25mg/l O2 or a minimum reduction of 70-90% needs to be achieved.

[20] According to European Communities (Quality of Salmonid Waters) Regulations, 1988, S.I. No 293.1988 Dissolved Oxygen (DO) levels acceptable limit for salmonids is >6mg/l.

Table 5.7 Salinity of Cross River considering EC Directive 98/83/EC[21]

Sample site	Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges
RS26C100100	Conductivity @20°C	uS/cm	-	-	-	-	0	None
RS26C100200	Conductivity @20°C	uS/cm	-	-	545	545	1	2015
RS26C100300	Conductivity @20°C	uS/cm	582	452	524.8	576.5939	15	2014-2015
RS26C100400	Conductivity @20°C	uS/cm	609	266	515.73	566.7744	22	2007-2009 2014-2015

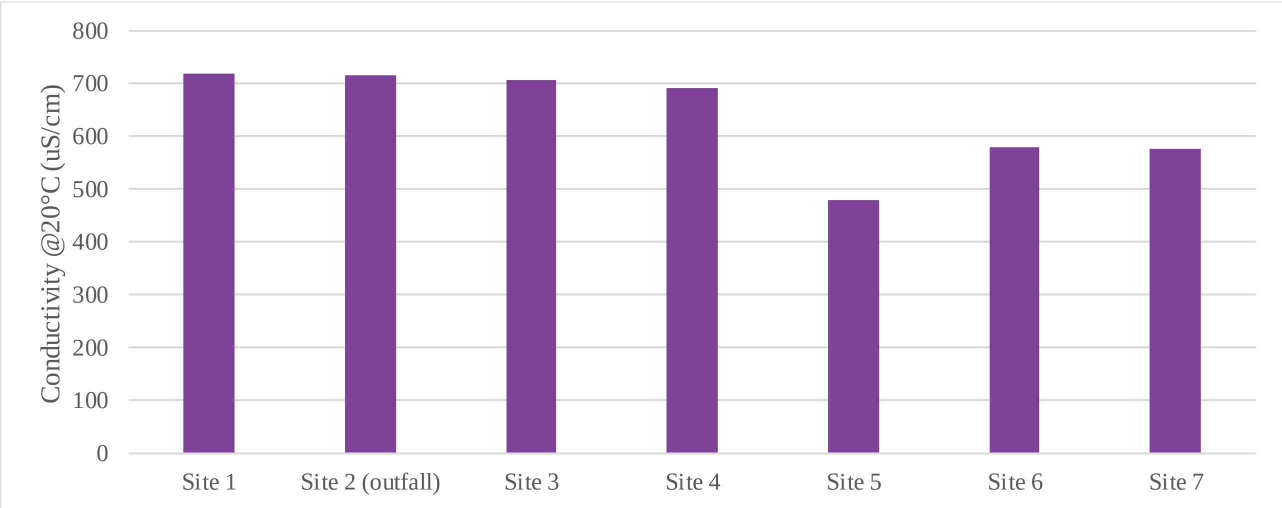


Figure 5.16 Baseline conductivity in Cross River

5.1.3.4 Acidification

The pH of a water body is the measure of how acidic or alkaline the water is on a scale of 0-14. It is a measure of hydrogen ion concentration with the range of pH 6 - 9 being optimum for salmonid and cyprinid species of fish. The recorded pH results at each sample location displayed little variation and were within a relatively narrow range of between pH 6.803 at RS26C100400, the most downstream station considered, and pH 8.6 at the same station. Each of the reported pH results for all EPA stations did not exceed the adopted screening criteria range of between pH 6 to pH 9 as set out in the EC Directive 2006/44/EC for the protection of fish in salmonid and cyprinid waters. The pH levels at the 2024 sample sites were also within an acceptable range within the river and lake (Table 5.8). The pH reflected the calcareous influences of the site. Lough Funshinagh had a higher pH than the river samples.

[21] According to the EC Directive 98/83/EC: EU Drinking Water Regs 2014 (S.I. 122 of 2014) conductivity limit of 2,500 uS/cm

Table 5.8 Acidity of Cross River and Lough Funshinagh considering EC Directive 2006/44/EC[22]; EC Directive 98/83/EC[23]; Directive 2006/11/EC[24]

Sample site	Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges
RS26C100100	pH	pH units	8.3	8.3	8.3	8.3	1	2010
RS26C100200	pH	pH units	8.57	6.9	7.6164	7.976	125	2012-2013 2015-2024
RS26C100300	pH	pH units	8.58	6.985	7.741	8.04	293	2007-2024
RS26C100400	pH	pH units	8.6	6.803	7.858	8.1	266	2007-2024

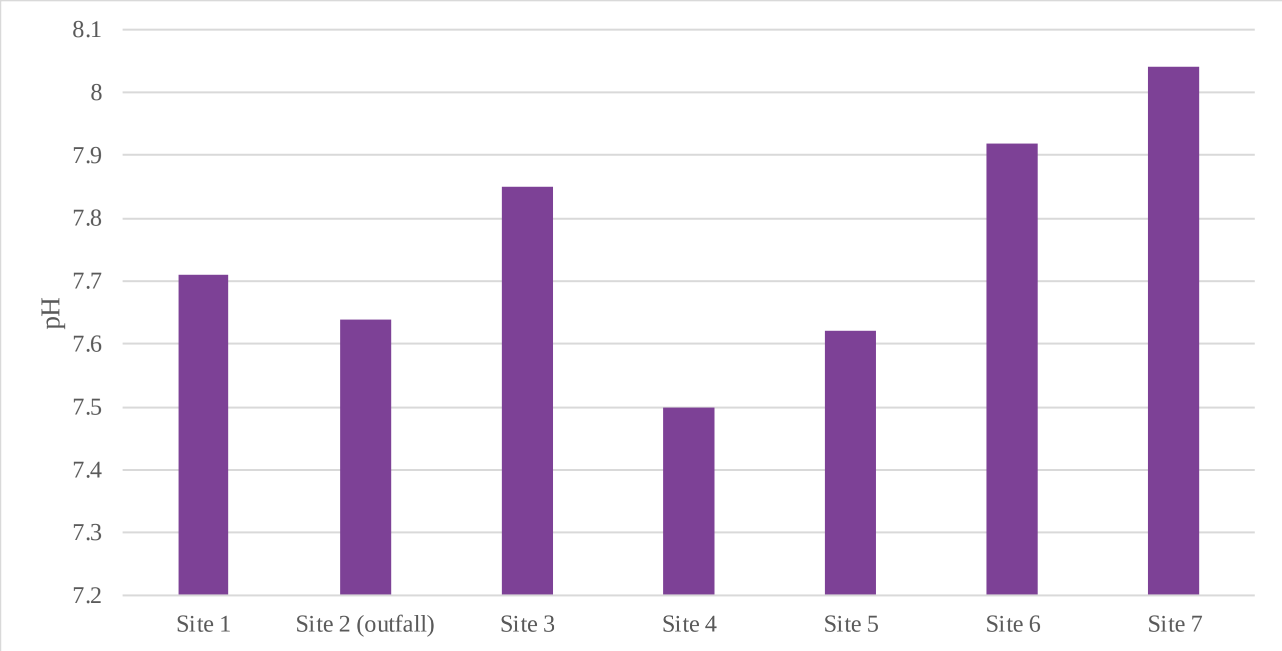


Figure 5.17 Baseline acidity in Cross River

5.1.3.5 Nutrient conditions

Agriculture is one of the main pressures in the Cross River. The presence of excess nutrients such as phosphorous and nitrogen primarily originate from agricultural fertilisers and wastewater sources. Excess concentrations of nitrogen and phosphorus in lakes can cause algae to grow at rapid rates which can overwhelm natural ecosystems. Significant increases in algae can adversely impact upon water quality, food resources, habitats, and decrease the oxygen that fish and other aquatic life need to survive. Large growths of algae are called algal blooms which can severely reduce or eliminate oxygen in the water which often results in fish kills. Algal blooms may also potentially be harmful to humans because they produce elevated toxins and bacterial growth that can cause sickness in humans if they come into contact with polluted water, consume tainted fish or shellfish, or drink contaminated water.

[22] According to the EC Directive 2006/44/EC pH range of 6 to 9 for Salmonid and Cyprid Waters

[23] According to EC Directive 98/83/EC: EU Drinking Water Regs 2014 (S.I. 122 of 2014) pH range of 6.5 to 9.5 and 4.5 to 9

[24] According to Directive 2006/11/EC: Environmental Objectives Surface Water Regulations (S.I. 77 of 2019) pH range of 4.5 to 9 (soft water) 6.5 to 9 (hard water)

The total N values found in the stations analysed vary from 0.091 in RS26C100400 to 4.532 in RS26C100300. In general, station RS26C100300 presents the highest values of total N. Nitrate and nitrite are naturally occurring ions composed of oxygen and nitrogen that form part of the nitrogen cycle. Nitrate nitrogen is the most readily available form of artificial nitrogen fertiliser for plant roots. The other types have to be converted to this form by soil acting bacteria before they can be utilised by crops. Nitrate is very easily washed out of the soil and can be harmful to human health if elevated concentrations are present in drinking water supplies. A maximum allowable concentration (MAC) for nitrate as NO_3 of 50 mg/l is set out in the EU Drinking Water Regulations (S.I. 122 of 2014) which although for drinking water supply, the MAC nevertheless serves as a useful comparison point. All of the EPA samples had a concentration below the MAC. The nitrate concentration ranges from 0.081 to 4.521 mg/l in RS26C100300. Concentrations of nitrite as NO_2 were below the cyprinid and salmonid limits in the water samples from stations RS26C100100 and RS26C100200. However, for stations RS26C100300 and RS26C100400 from 2017 onwards the concentration values spiked.

The concentration of total phosphorus was recorded only 8 times between stations RS26C100200, RS26C100300 and RS26C100400 in the years 2007, 2015 and 2017. All the samples recorded exceed the P concentration limit for both high and good ecological status as required by the WFD. Orthophosphate is a form of reactive phosphorus that is essentially the amount of phosphorus that is available to chemically or biologically react**.** In none of the recorded stations was the indicative screening criteria for both salmonid and cyprinid waters exceeded. Stations RS26C100200, RS26C100300 and RS26C100400 exceeded the threshold for both good and high-status water bodies. The maximum orthophosphate concentrations recorded were 0.188 in RS26C100400, 0.15 in RS26C100300 and 0.147 mg/l P in RS26C100200, surpassing the criteria of the Surface Water Regulations, but not the ones established by the Directive 2006/44/EC limits. In most stations, the average orthophosphate concentrations recorded remained below the Surface Water Regulations and Directive 2006/44/EC limits, except for RS26C100400 which, with an average of 0.022 mg/l P, exceeded the Surface Water Regulations orthophosphate limits for high status waterbodies.

Levels of total oxidised nitrogen (TON) were within normal parameters for a lowland river, ranging from 0.636 to 1.561 mg/l (Figure 5.18). TON is comprised mainly of nitrate (N as NO_3) given that the concentration of nitrite is typically negligible (O'Boyle et al., 2019). The European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. 77 of 2019) sets no specific boundary conditions for nitrate. However, EPA assessment of high-quality water sources has set boundary conditions of $\leq$0.8mg/l NO_3-N (nitrate as nitrogen) for high quality waters and $\leq$1.8mg/l NO_3-N for good quality waters. Thus, all sampling sites on the Cross River fell within accepted parameters for good quality water based on TON levels.

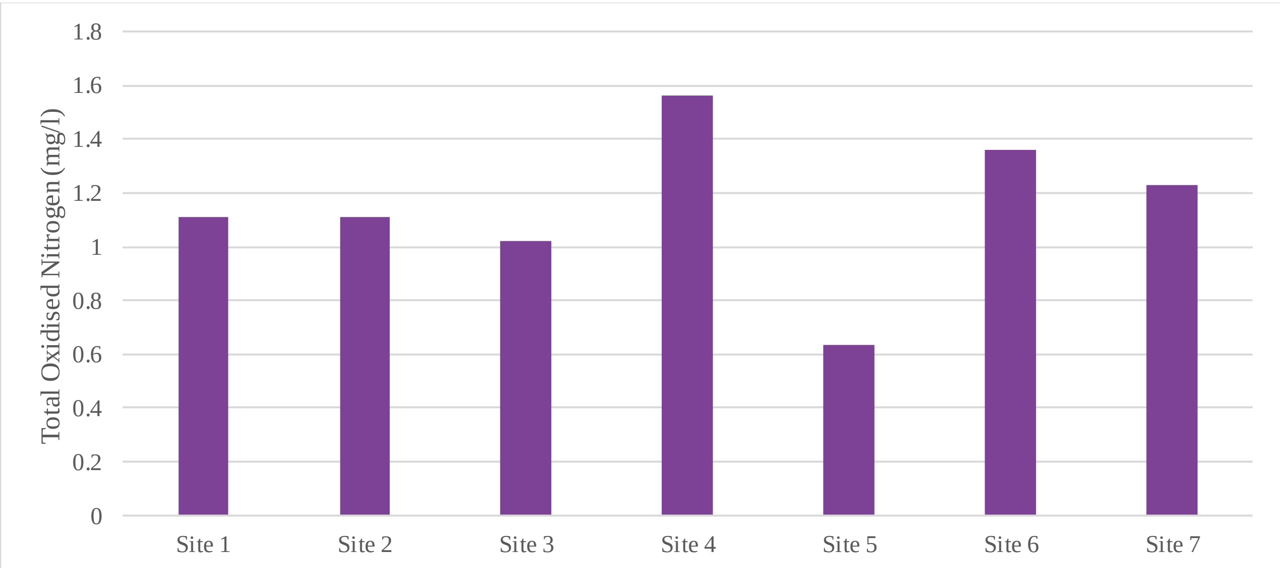


Figure 5.18 Baseline total oxidised nitrogen in Cross River

All sampling sites met the good status targets for total ammonia (i.e. ≤0.040 mg N/l) as set out under the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77/2019) (Figure 5.19). Levels of unionised ammonia were low across the sites (≤0.001).

Figure 5.19 Baseline total ammonia in Cross River

All sampling sites showed low levels of Molybdate Reactive Phosphorus (MRP) (the amount of phosphorus bioavailable for plant uptake) (i.e. ≤0.011 mg P/l) and thus complied with the Surface Water Regulations (S.I. 77 of 2019) good status target for rivers of ≤0.035 mg P/l (Figure 5.20).

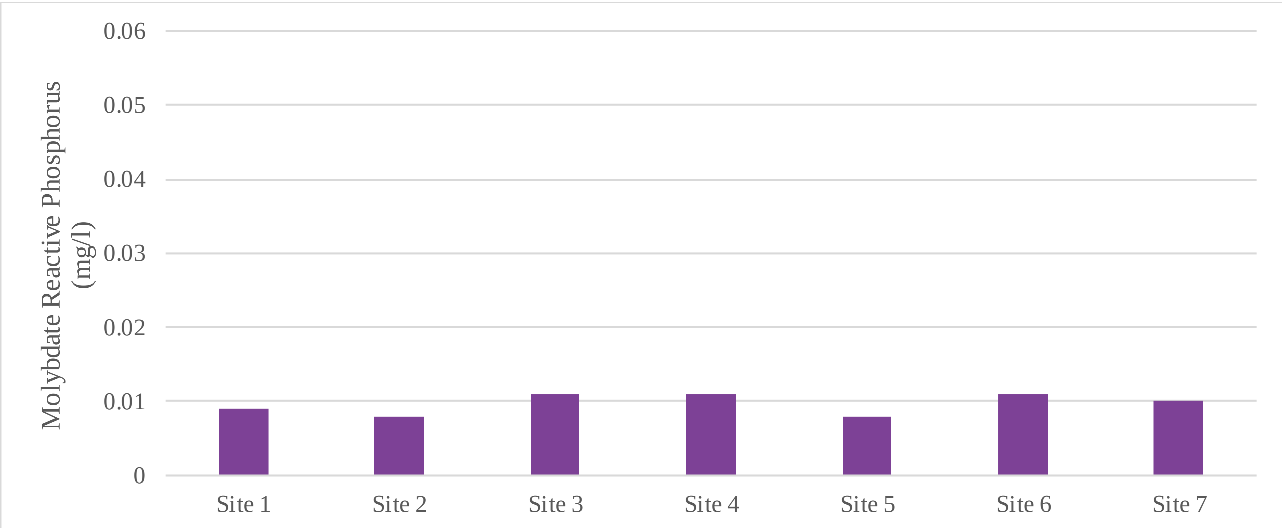


Figure 5.20 Baseline phosphorous in Cross River

5.1.3.6 Waste Assimilative Capacity Assessment

The baseline water quality monitoring from August 2024 for the 7 sites along the Cross River and 3 sites at Lough Funshinagh were used to assess the Waste Assimilative Capacity (WAC) of the Cross River for the proposed pumped water from Lake Funshinagh. Additional parameters were taken from EPA monitoring station RS26C100200 and RS26C100400. No upstream monitoring stations were available for the Cross River. River flow data was taken from the low flow analysis (i.e. 50% and 95%ile flow) (MWP, 2024) for the outfall location and a site upstream of the outfall. The maximum flow rate from the proposed pumped flow will be 300l/s, with a worst-case scenario of continuous pumping over a 24-hour period. The maximum daily flow volume to the Cross River will be 25,920 m^3/day.

The Cross River has assimilative capacity for nutrients and conductivity for low flow (i.e. 50%ile and 95%ile flow) at the outfall site and above the outfall site (Table 5.9). The details of the WAC assessment are provided in Appendix C.

Table 5.9 The waste assimilative capacity for Cross River receiving proposed pumped flow from Lough Funshinagh upstream of the outfall and at the outfall site

Location	Category	Details
Above outfall (i.e. Site 1)	Nutrients	The Cross River has assimilative capacity for nutrients, including nitrate, nitrite, orthophosphate and ammonia for both 95%ile and 50%ile scenarios.
		The L. Funshinagh discharge to the Cross River will have no discernible effect for nitrate and nitrite for both 95%ile and 50%ile scenarios.
		There is no data available for orthophosphate and ammonia in the lough, so it cannot be determined whether the discharge into the Cross River will have a discernible effect on the river.
	Conductivity	The Cross River has assimilative capacity for conductivity for both 95%ile and 50%ile scenarios.
		The L. Funshinagh discharge to the Cross River will have no discernible effect for conductivity for both 95%ile and 50%ile scenarios.
	Other parameters	For the 95%ile and 50%ile scenarios, background concentration is above the acceptable limit for manganese. The river does not have assimilative capacity for manganese.
		There is no data available for manganese concentration in the lough, so it cannot be determined whether the discharge into Cross River will have a discernible effect on the river.
		The Cross River has assimilative capacity for chloride, boron, copper, BOD5 and selenium for both 95%ile and 50%ile scenarios.
		The L. Funshinagh discharge to the Cross River will have no discernible effect for chloride for both 95%ile and 50%ile scenarios.
		There is no data available for boron, copper, BOD5 and selenium in the lough, so it cannot be determined whether the discharge into Cross River will have a discernible effect on the river.
At outfall (i.e. Site 2)	Nutrients	The Cross River has assimilative capacity for nutrients, including nitrate, nitrite, orthophosphate and ammonia for both 95%ile and 50%ile scenarios.
		The L. Funshinagh discharge to the Cross River will have no discernible effect for nitrate and nitrite for both 95%ile and 50%ile scenarios.
		There is no data available for orthophosphate and ammonia in the lough, so it cannot be determined whether the discharge into Cross River will have a discernible effect on the river.
	Conductivity	The Cross River has assimilative capacity for conductivity for both 95%ile and 50%ile scenarios.
		The L. Funshinagh discharge to the Cross River will have no discernible effect for conductivity for both 95%ile and 50%ile scenarios.
	Other parameters	For the 95%ile and 50%ile scenarios, background concentration is above the acceptable limit for manganese. The river does not have assimilative capacity for manganese.
		There is no data available for manganese concentration in the lough, so it cannot be determined whether the discharge into Cross River will have a discernible effect on the river.
		The Cross River has assimilative capacity for chloride, boron, copper, BOD5 and selenium for both 95%ile and 50%ile scenarios.
		The L. Funshinagh discharge to the Cross River will have no discernible effect for chloride for both 95%ile and 50%ile scenarios.
		There is no data available for boron, copper, BOD5 and selenium in the lough, so it cannot be determined whether the discharge into Cross River will have a discernible effect on the river.

5.1.4 Biological Quality

The Aquatic Assessment assessed the sampling sites for biological water quality through Q-sampling. Samples were converted to Q-ratings as per Toner et al. (2005) and assigned to WFD status classes. Any rare invertebrate species were identified from the NPWS Red List publications for beetles (Foster et al., 2009), mayflies (Kelly-Quinn & Regan, 2012), stoneflies (Feeley et al., 2020) and other relevant taxa (i.e. Byrne et al., 2009; Nelson et al., 2011).

None of the sample sites achieved greater than Q3-4 (moderate status) and thus all sites failed to meet the target good status (⩾Q4) requirements of the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 and the Water Framework Directive (2000/60/EC) (Figure 5.21).

Sites S4, S5 and S6 achieved Q3-4 (moderate status) water quality. Despite the presence of the EPA group A (most pollution sensitive) mayflies *Ecdyonurus dispar*, *Heptagenia sulphurea* and or an unidentified *Leptophlebiidae* species, these were only recorded in low numbers (<5% of total sample) and thus did not meet the qualifying criteria for good status as set out by Toner et al. (2005).

The remaining sites S1, S2, S3 and S7 achieved Q3 (poor status) water quality based on an absence of group A species, low numbers or an absence of group B species and a dominance of group C species such as the mayflies *Baetis rhodani* and *Seratella ignita*, freshwater shrimp (*Gammarus duebeni*), riffle beetle (*Elmis aenea*) and blackfly larvae (*Simuliidae*).

It should be noted that the Q-rating for sites S4 and S7 are tentative only given poor flows and the absence of suitable riffle areas for sampling (as per Toner et al., 2005).

A low diversity of fish species was recorded during the electro-fishing survey, with brown trout, lamprey (*Lampetra* sp.), gudgeon, three-spined stickleback and non-native roach[25] captured. Despite physical suitability, including spawning and nursery habitat, the upper reaches of the Cross River (sites S1, S2, S3 & S4) did not support salmonids. This was in keeping with previous surveys of the river which only recorded stickleback in these areas. The upper reaches are accessible to salmonids and so their absence is indicative of other factors such as low summer flows and influence of calcification (bed compaction) on spawning habitat. Dissolved oxygen levels were also relatively low (and significantly higher downstream) and this may have had a bearing on salmonid distribution.

Brown trout were present from site S5 downstream, where higher flow volumes and better quality instream habitats persisted. Sites S5 and S6 provided particularly good quality holding and foraging habitat for adult trout, which were present in good densities. Overall, salmonid spawning habitat in the alkaline river was typically of poor quality in light of historical modifications and natural bed compaction (calcification). Siltation was an evident pressure on spawning habitat in the lower reaches (e.g. site S6, S7).

Despite some good physical suitability in the middle to lower reaches, no Atlantic salmon were recorded via electro-fishing or eDNA sampling during the recent survey. This reflects the significant downstream barriers on the River Shannon (hydroelectric dams) which heavily restricts the numbers of returning adults to the Upper Shannon catchment (TEGOS, 2023)[26]. However, salmon have been recorded from the Cross River in the recent past (at Millbrook Bridge) and occasional utilisation of the watercourse does occur. The aforementioned instream barriers also explain the absence of Red-listed and critically endangered European eel (Pike et al., 2020; King et al., 2011) in the current survey and paucity in the Upper Shannon.

Although lamprey (*Lampetra* sp.[27]) ammocoetes were only recorded via electro-fishing at site S2 (proposed outfall), strong eDNA signatures of the species were detected throughout the Cross River (at sites S1, S4 and S7). This would suggest lamprey are widely distributed throughout the watercourse. General observations were that while suitable lamprey spawning habitat (i.e. finer gravel) was present at most survey sites, areas of soft sediment with suitable characteristics for ammocoete burial were not.

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[25] An invasive species in Ireland, listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011-2021 (S.I. 477/2011)

[26] Due to downstream migration barriers (such as hydroelectric dams and weirs), Atlantic salmon distribution is highly restricted in the upper Shannon catchment and the river is only achieving 5% of its conservation limit above Parteen weir in recent years (TEGOS, 2023).

[27] In light of impassable downstream barriers on the River Shannon, these would likely be potadromous brook lamprey (*Lampetra planeri*)

This was due to the predominance of higher energy conditions which discourage the settlement of deeper silt/sand deposits >5cm in depth required by larval lamprey (Aronsuu & Virkkala, 2014; Goodwin et al., 2008; Gardiner, 2003).

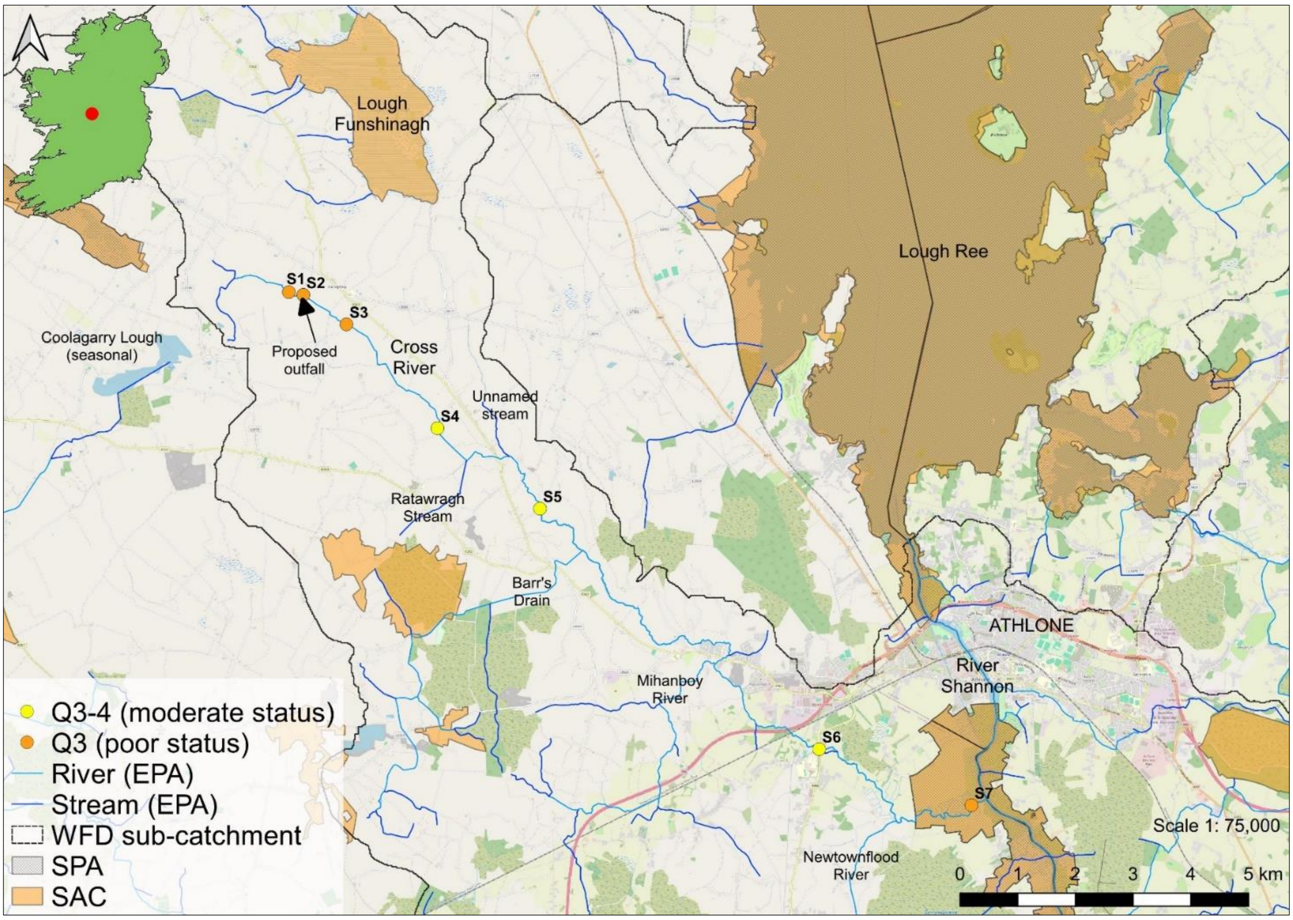

Figure 5.21 Overview of the biological water quality status in the vicinity of the proposed interim scheme (ref)

Table 5.10 Biological quality assessment of the Cross River

Site	Q-Value	Rare of protected macrophytes/aquatic bryophytes	Rare or Benthic invertebrate fauna	Fish fauna
1	3	None		Lampetra sp. (via eDNA)
2	3	None		Lampetra sp. (via electro-fishing)
3	3	None		
4	3-4	None		Lampetra sp. (via eDNA)
5	3-4	None		
6	3-4	None		
7	3	None	White clawed crayfish (via eDNA)	Lampetra sp. (via eDNA)

5.2 Hydrologically connected protected areas

5.2.1 Lough Funshinagh SAC (IE0000611)

Lough Funshinagh is designated as a SAC under the European Communities (Birds and Natural Habitats) Regulations 2011 (SI No 477 of 2011). It is a disappearing lake/turlough located 13km to the north west of Athlone town in Co. Roscommon and is approximately 430ha in area with an approximate length of 12.5km. The turlough straddles 8 townlands in south Co. Roscommon, near Kiltoom. In a clockwise direction, starting from the north of the lake, these are the townlands of Rahara, Ballagh, Lisphelim, Inchiroe and Gortfree, Carrickbeg, Carrick, Kildurney, and Lysterfield. The proposed scheme starts in the townland of Carrick.

5.2.1.1 Hydrological regime

Lough Funshinagh is a local topographical low where the surrounding streams combine to form the lake as there is no surface outflow and the subsurface outflow is restricted. This results in the water backing up within the topographical low and forming the lake. Two swallow holes have been identified within in the southeastern part of Lough Funshinagh and provide drainage to the aquifer[28]. A tracer test conducted in the swallow hole located in the southeast of the lake identified a connection to a spring located 4.5 km to the south of the swallow hole at Atteagh Corn Mill with a flow velocity of 70 m/hr[6].

Surface inflows to the lake include 6 surface water streams located on the northern and the western shores of the lake. The EPA operates a gauging station on the Kilmass Stream and during rainfall events over 40% of the net volume is contributed to Lough Funshinagh by this stream[29]. This indicates the lake is predominantly surface water fed and groundwater drained.

Historically Lough Funshinagh dried out 2-3 times every 10 years. However, post a flood event in 2015/2016, GSI recorded the net inflow to Lough Funshinagh was 3 orders of magnitude higher than the outflow recorded. The peak water level over this period was recorded to be 69.38 m OD in April 2024 and the lowest level was 65.34 in August 2019, see Figure 5.22. The levels suggested a change in the subsurface drainage network following the 2015/2016 flood event. Figure 5.22 shows that between 2016 and 2024 the annual fluctuations in Lough Funshinagh were between 1 to 3 m[28]. The natural pattern of the lake draining and filling up is altered by rising water levels observed since 2016.

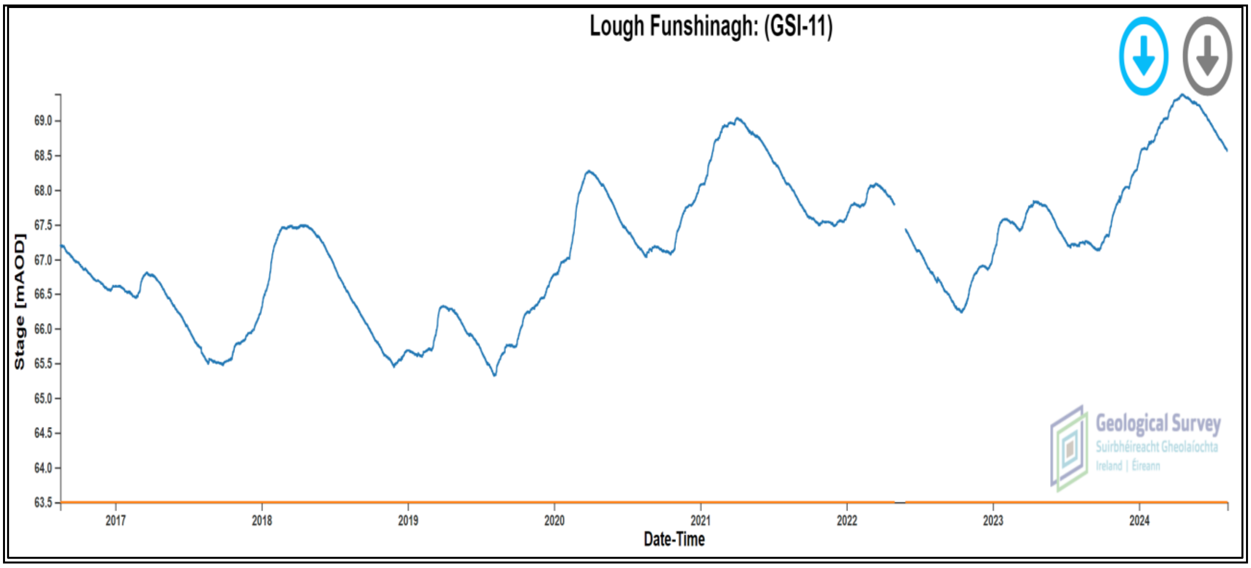

Figure 5.22 GSI monitoring water levels at Lough Funshinagh [accessed August 2024 - https://gwlevel.ie/]

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[28] OPW, 2024 - Lough Funshinagh State of Knowledge report

[29] McCormac, T E Karst Hydrogeology of Mid-Roscommon, IAH (Irish Group, 2018)

GSI conducted a borehole survey in September 2016 to examine the groundwater levels in relation to the water levels in the lake. A total of six domestic boreholes were measured around Lough Funshinagh and indicated the well water levels were 2-3 m below the lake level[30].

The elevated lake level, in comparison to the surrounding groundwater levels, suggest some hydraulic separation between the lake and the underlying karst aquifer, possibly due to the lake bed sediments. Therefore, the only hydraulic connection to the groundwater is provided by the swallow holes, which are presumed to provide a more direct connection to the aquifer where the rock head is close to the lake bed in the south of the lake. As a result, when the rate of inflow to the lake exceeds the outflow capacity of the swallow holes the lake level rises. The water level will lower when inflows reduce below the swallow hole discharge rate.

Hydraulic modelling of the water levels in Lough Funshinagh has been carried out by GSI to evaluate flood durations in three scenarios: the conditions pre-2015/16 (Past), the current conditions post-2015/16 (Present) and a prediction of the conditions if an artificial drainage channel was implemented at 65.8mOD (Present-altered).[31] It should be noted that the Present-altered scenario is not the design assessed within this project. The analysis shows that prior to 2015 4.6% of the SAC was flooded 90% of the time but post 2016 85% of the SAC was flooded 90% of the time. The modelling is presented spatially in Figure 5.25 and highlights the notable increase in flood duration throughout Lough Funshinagh post 2016 (A). It also illustrates that a drainage channel at 65.8mOD would have the greatest impact at the edges of the SAC (B), and even with a drainage channel at 65.8mOD the inner part of Lough Funshinagh will still have greater flood durations than pre-2016 (C).

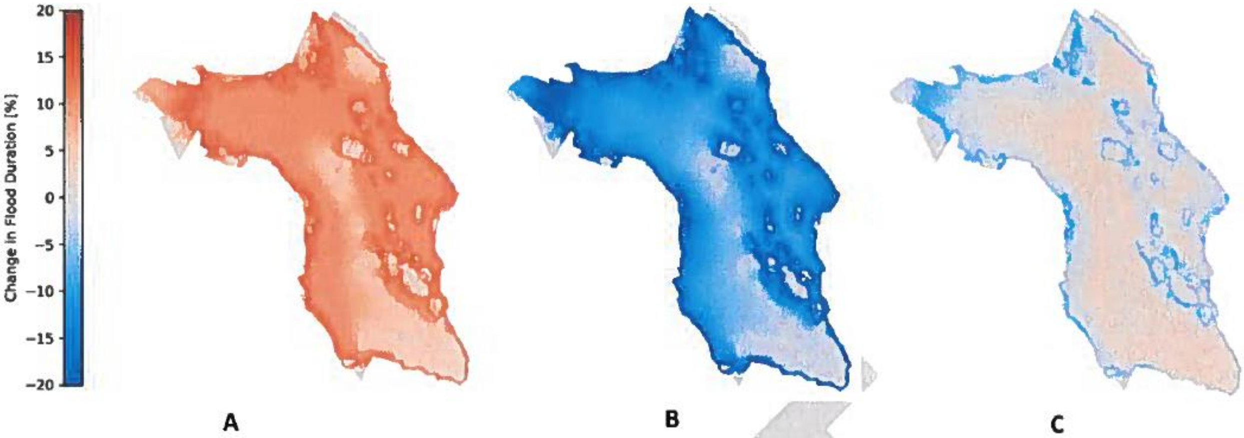

Figure 5.23 Spatial coverage of altered flood duration: A) Past vs Present Scenarios, B) Present vs Present-altered scenario and C) Past vs Present-altered scenario.

Figure 5.24 shows the cross section adopted to represent the conceptual understanding of the groundwater dynamics of Lough Funshinagh. The conceptual site model illustrates the groundwater flows primarily in a north-south direction. Water draining from the swallow holes ultimately discharges in the springs located to the south of the Cross River tributary at Atteagh Corn Mill. The alluvium and gravel deposits at the springs and Cross River present a highly permeable material through which the spring discharge can occur, see Figure 5.25.

[30] GSI, September 2016 - Preliminary Assessment of Flooding in Lough Funshinagh, Co. Roscommon.

[31] Naughton, O., McCormack, T., Regan, S. and Johnston, P. (2024) Report – Modelling and Analysis of Changes to Lough Funhinagh Flood Levels

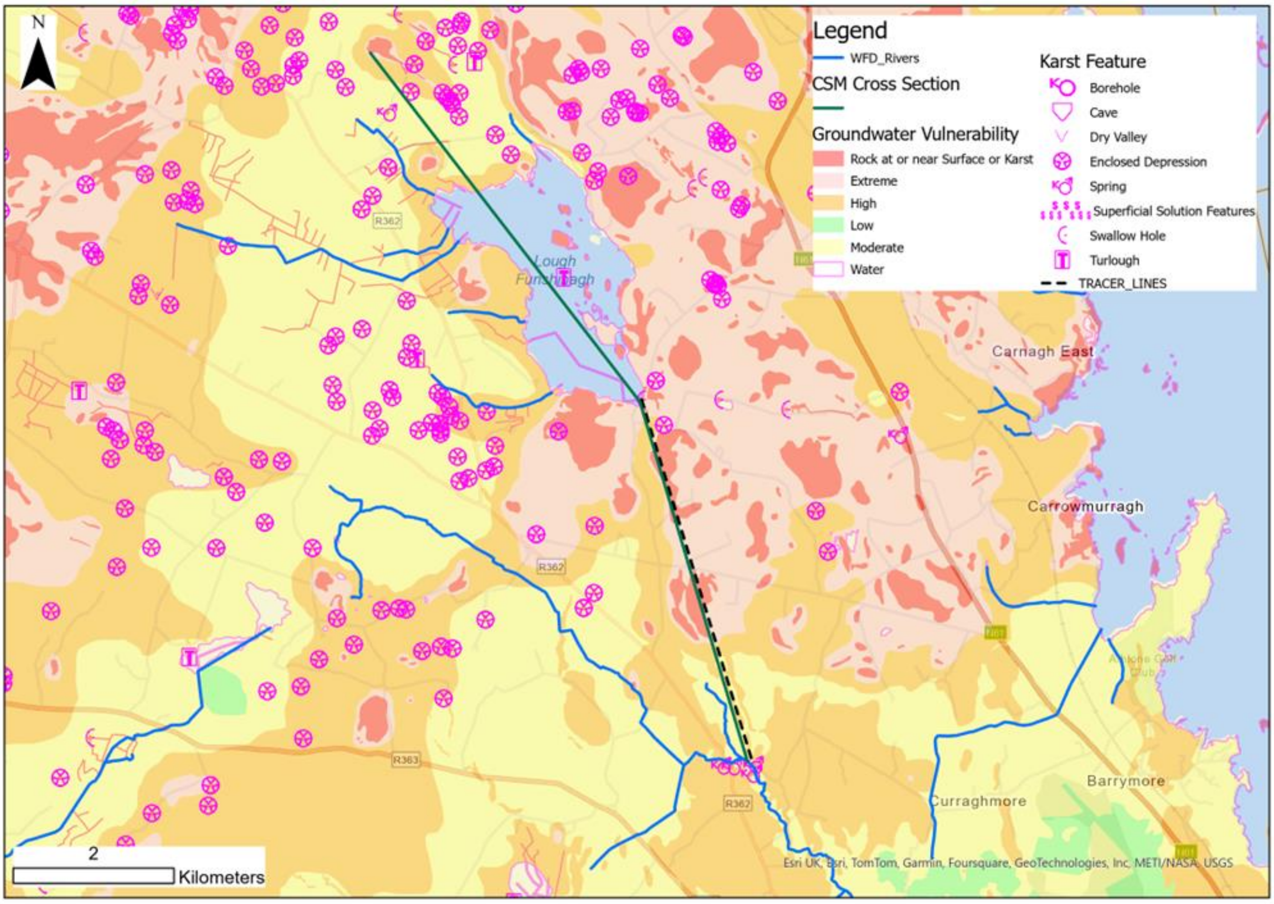

Figure 5.24 Lough Funshinagh conceptual site model cross section location

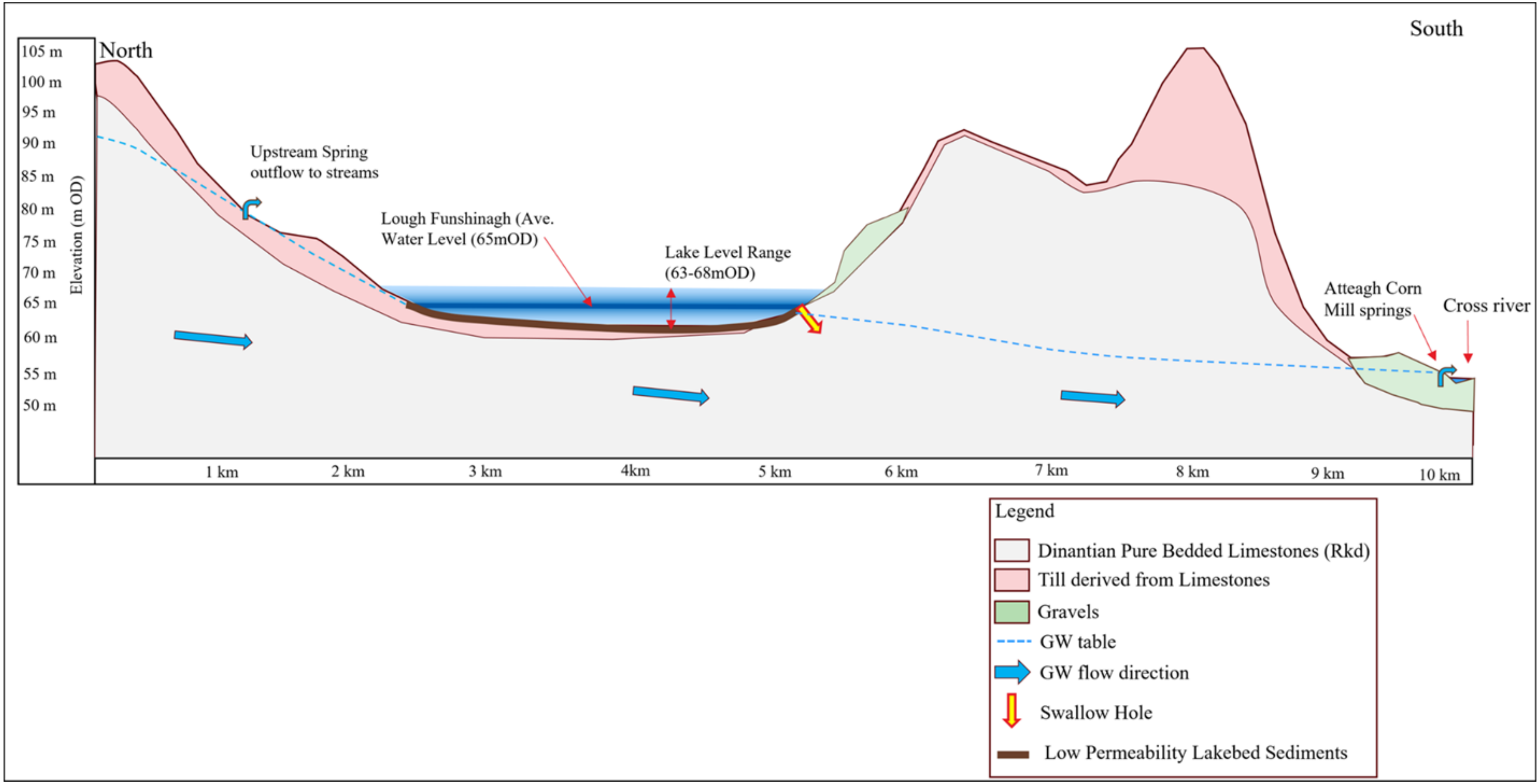

Figure 5.25 Lough Funshinagh Conceptual Site Model

5.2.1.2 Water quality

Water quality data is presented in Appendix B. The EPA does not routinely monitor Lough Funshinagh as it is not a designated WFD lake waterbody. Historical lake monitoring is available from 2010. Monitoring was conducted in 2023 as part of the Emergency Flooding Works by OPW. Two of the sample sites occur within the Cross River WFD river waterbody (IE_SH_26C100060**).** Temperature and DO for these two sites ranged from 16 to 23^{o}C and 5 to 9 mg/l respectively (Table 5.11).

Table 5.11 Thermal and oxygenation conditions of Lough Funshinagh

Sample site	Parameter	Unit	Max	Min	Average	Count	Date Ranges
SW1 (Lake)	Temperature	oC	-	-	16.78	1	2023
SW2 (Lake)	Temperature	oC	23.88	16.3	19.14	3	2023
SW1 (Lake)	DO	mg/l	-	-	9.07	1	2023
SW2 (Lake)	DO	mg/l	8.40	5.63	7.4	3	2023

The baseline sampling in 2024 indicated that the pH level of Lough Funshinagh was high (mean 8.2) (Figure 5.26) and indicative of hard water, reflecting local calcareous geologies. The lough also had a high alkalinity (mean 158.7mg/l CaCO3) and a moderately high conductivity (mean 332.3µS/cm) (Figure 5.27) typical of high-alkalinity waterbodies. The recorded alkalinity, size and depth aligns with a WFD classification lake typology 12 (i.e., high alkalinity (>100 mg/1 CaCO3), deep (>4m) and large (>50 ha).

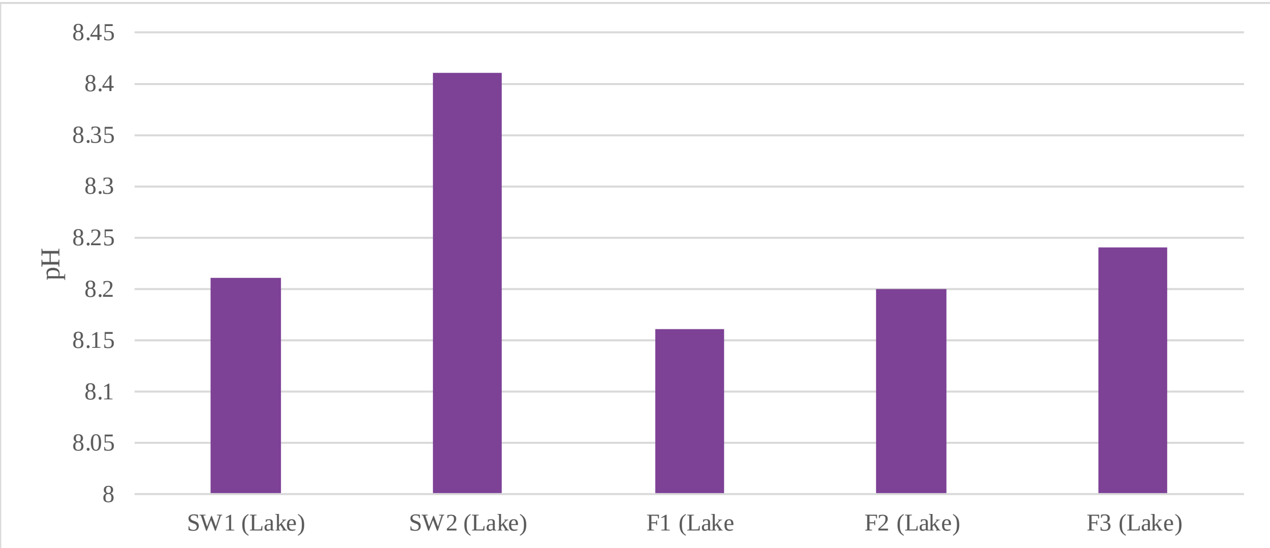

Figure 5.26 pH for Lough Funshinagh during monitoring in 2023 (SW1-SW2) and 2024 (F1-F3)

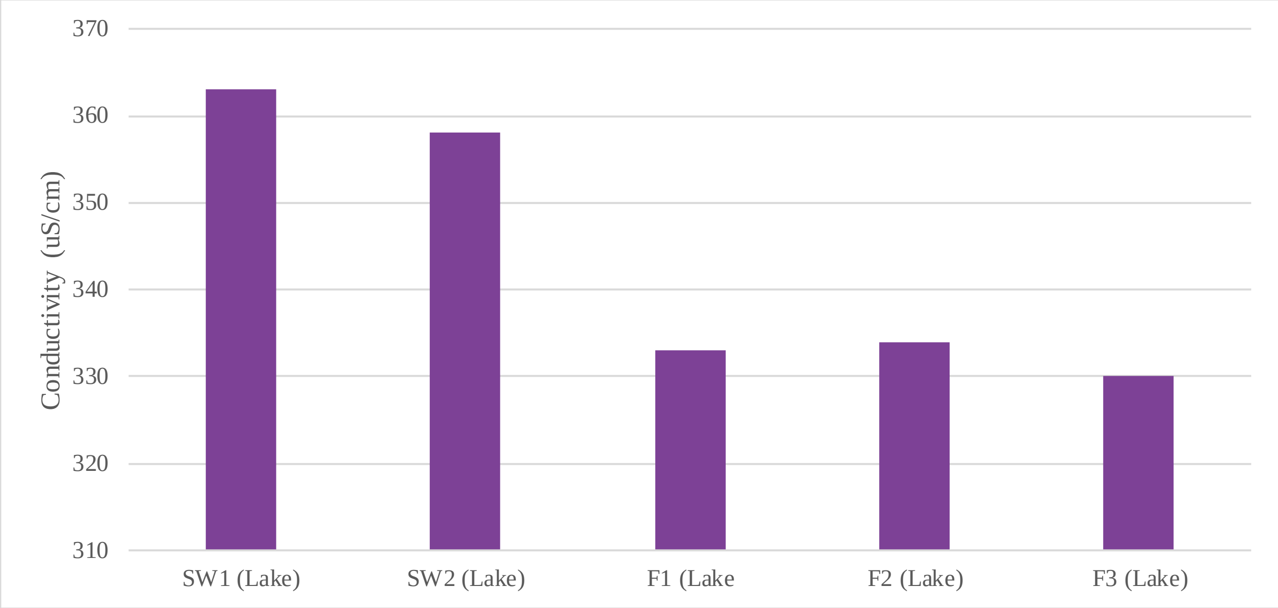

Figure 5.27 Conductivity for Lough Funshinagh during monitoring in 2023 (SW1-SW2) and 2024 (F1-F3)

The level of total phosphorus (mean 0.048mg P/l) did not meet the good status threshold as required in the European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. 77/2019) (i.e., good status is ⩽0.025mg P/l). The levels of total phosphorus place Lough Funshinagh within the hyper-eutrophic band for lakes (OECD, 1982). This was also supported by the correlated high chlorophyll α concentrations (mean value of 45.4; Figure 5.29). However, it should be noted that lake trophic status is only reliably calculated from annual maximum values of chlorophyll a, total phosphorus and water transparency (Secchi disc depth readings) across ⩾10 samples during months with the greatest planktonic growth (O' Boyle et al., 2019).

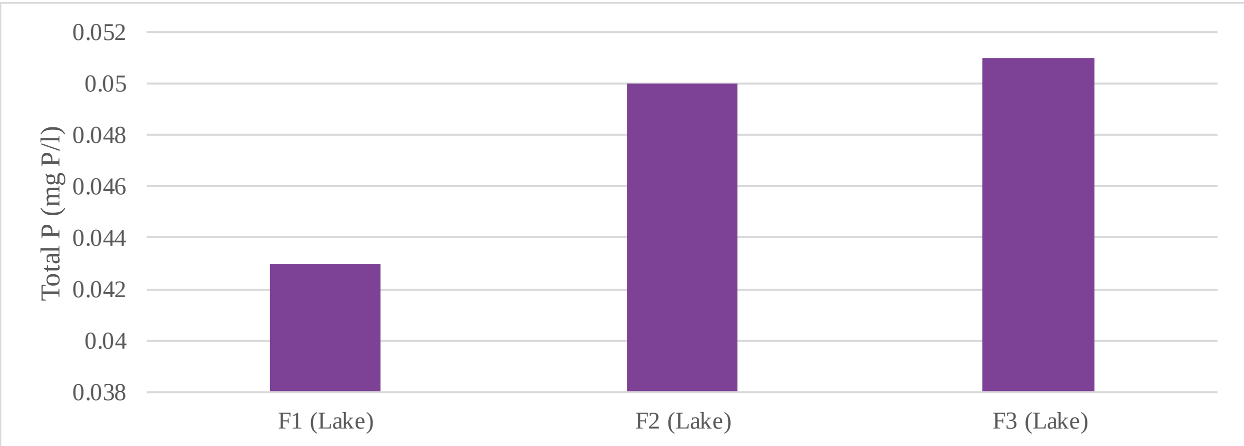

Figure 5.28 Total phosphorus for Lough Funshinagh during monitoring in 2024 (F1-F3)

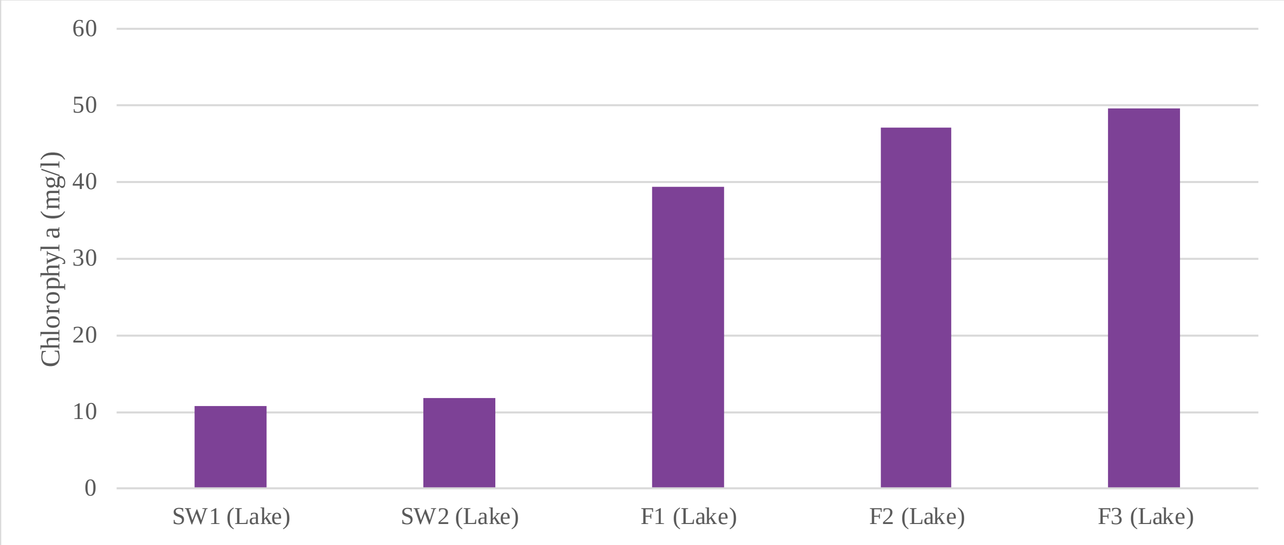

Figure 5.29 Chlorohyl a for Lough Funshinagh during monitoring in 2023 (SW1-SW2) and 2024 (F1-F3)

Whilst S.I. 77/2019 sets no specific boundary conditions for nitrate in lakes, EPA assessment of high-quality water (riverine) sources has set boundary conditions of 0.8 mg/l NO3-N for high quality waters and 1.8 mg/l NO3-N for good quality waters (O'Boyle et al., 2019). Levels in baseline Lough Funshinagh samples may be considered good overall (mean 0.027 mg/l N) (Figure 5.30). Furthermore, biological uptake of the available nitrogen by plants and algae during the growth season may result in lower annual concentrations in August and true values may be higher over the course of a year. The ammonia levels were also low for both total ammonia and unionised ammonia factions, the latter being toxic to aquatic life when high.

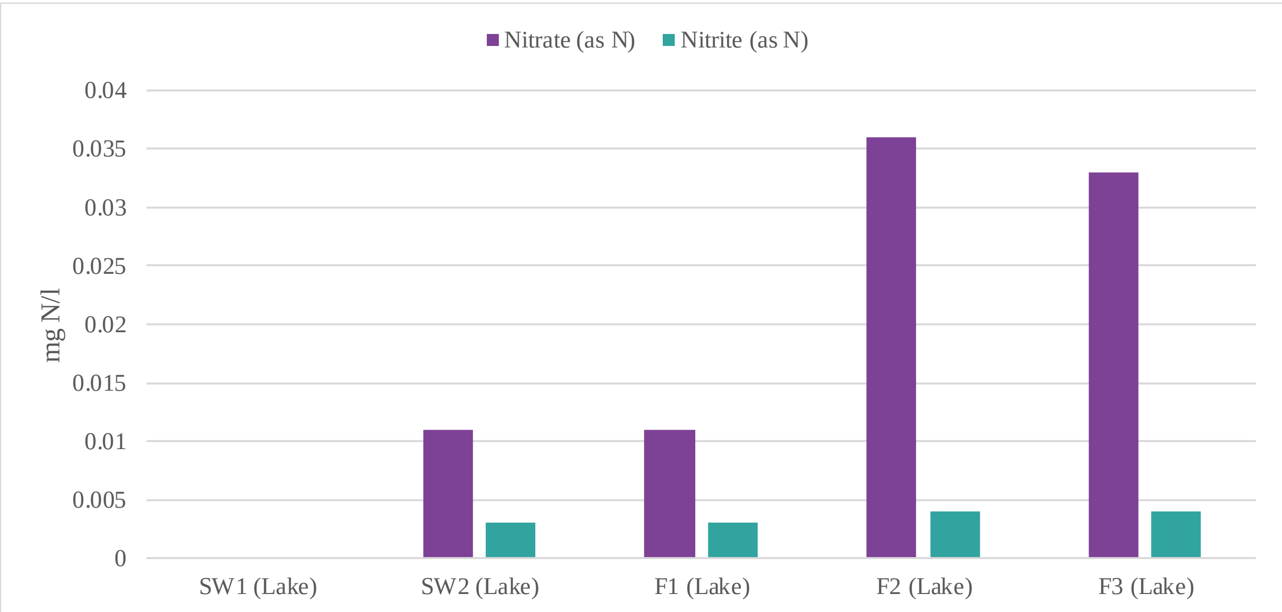

Figure 5.30 Nitrate and nitrite for Lough Funshinagh during monitoring in 2023 (SW1-SW2) and 2024 (F1-F3)

5.2.1.3 Habitat area and distribution

Vegetation ascribable to the E.U. Habitats Directive Annex I type 'rivers with muddy banks with *Chenopodion rubri p.p.* and *Bidention p.p.* vegetation' [Annex Code: 3270] occurs at Lough Funshinagh. The habitat is found on damp mineral soils, often fine, alluvial muds, but also stony substratum. This comprises vegetation of small, short-lived, fast-growing annuals that are poor competitors. Typical species of 3270 include: vernal water-starwort (*Callitriche palustris*), *chenopodium rubrum* (*Oxybasis rubra*), low cudweed (*Gnaphalium uliginosum*), water mudwort, pygmy smartweed (*Persicaria minor*), Iceland watercress (*Rorippa islandicasis*), orange foxtail (*Alopecurus aequalis*), needle spikesedge (*Eleocharis acicularis*) and cavernous crystalwort (*Riccia cavernosa*).

According to the site's Conservation Objectives a large area of the habitat was recorded at Lough Funshinagh in September 2004, it was reported as abundant in northern yellow-cross with perennial aquatic species scattered over the water surface, particularly fine-leaved water-dropwort (*Oenanthe aquatica*) and water mint. The overall status for this habitat in Ireland is Favourable with a stable trend, unchanged since the 2013 assessment.

During the aquatic sampling no Annex I habitats were recorded within the proposed scheme despite a section of the proposed scheme being present within Lough Funshinagh SAC. Ecologists in-situ were unable to find any indicator species of '3180 turloughs' or '3270 Rivers with muddy banks with *Chenopodion rubri p.p.* and *Bidention p.p.* vegetation'. This was predominantly due to the above average flood levels present in Lough Funshinagh during summer 2024.

Twenty-one habitats were recorded within the proposed scheme area between Lough Funshinagh and the Cross River and can be referred to within the Triturus (2024) report. No Annex I habitats were identified during the ecological walkover or dedicated aquatic survey within the footprint of the proposed scheme.

5.2.2 The Middle Shannon Callows SPA (IE0004096) and River Shannon Callows SAC (IE0000216)

Due to the hydrological connection of the Cross River with the protected areas IE0004096 and IE0000216 the hydrological regime and habitat distribution was assessed.

5.2.2.1 Hydrological regime

The groundwater dependant habitats within the Shannon Callows SAC include Molinia Meadows [6410], Alkaline fens [7230] and Alluvial forests [91EO]. These habitats are all downstream of the Cross River confluence to the Shannon River. Alluvial forests [91EO] require periodic flooding along river and lake floodplains. Alkaline fens [7230] require high groundwater levels which are at or above the ground surface for a large proportion of the year. Alkaline Fens also require water with natural levels of iron, magnesium and calcium, poor in nutrients (where phosphorus is the limiting factor) and relatively rich in calcium.

Section 5.1.2. indicated that the proposed pumped flow will not have a significant impact on water levels for high flow.

5.2.2.2 Habitat distribution

The Qualifying Interests features of the Shannon Callows Annex I habitats are Molinia Meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410]; Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) [6510]; Alkaline fens [7230]; Limestone pavements [8240]; Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] and *Lutra lutra* (Otter) [1355].

The Special Qualifying Interests features of the Middle Shannon Callows are whooper swan (*Cygnus cygnus*), wigeon (*Anas penelope*), corncrake (*Crex crex*), golden plover (*Pluvialis apricaria*), lapwing (*Vanellus vanellus*) black-tailed godwit (*Limosa limosa*), black-headed gull (*Chroicocephalus ridibundus*) and Wetland and Waterbirds [A999].

5.3 STAGE 3 Assessment

The Stage 3 Assessment for the WFD river water body **IE_SH_26C100060, IE_SH_26C100200, IE_SH_26C100300** and **IE_SH_26D100400** (i.e. Cross River) indicated that there was uncertainty about the effect on the following:

- Morphology: river bed structure
- Hydrology: quantity and dynamics of flow; and
- Biological quality elements: Phytoplankton; Macrophytes and phytobenthos; Benthic invertebrate fauna; Fish fauna.

The Article 4(7) test for exemption was not applied due to the practical mitigation measures proposed, the limited likelihood of the river waterbody status being reduced, modification being of overriding public interest and the demonstration that there are no alternatives in the short-term (Table 5.12 and Table 5.13). No residual effects on the status of any element at water body level is expected.

The Stage 3 Assessment for the WFD river water body **IE_SH_26C100060, IE_SH_26C100200, IE_SH_26C100300** and **IE_SH_26D100400** (i.e. Cross River) indicated that there would be insignificant effects on the following:

- Physico-chemical supporting elements: Thermal conditions; Oxygenation; Salinity; Acidification; Nutrient conditions.

The Stage 3 Assessment for the **IE0000611** protected area would be an improvement of the habitat and water regime; both **IE0004096** and **IE0000216** would have insignificant effects.

Table 5.12 WFD significance test (Rivers)

	WFD supporting element	WFD elements	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
IE_SH_26C100060	Hydromorphological supporting element	Hydrology: quantity and dynamics of flow	Stage 3 assessment of high and low flow conditions at the proposed outfall indicate that there will be an increase in flow in the order of magnitude of double the current low flow conditions.	The river waterbody is in a moderate condition, with existing hydromorphology (channel and bank modification) and agricultural pressure (nutrients).	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.
		Hydrology: connection to groundwaters	There is no significant connection to groundwater.			
		River continuity	Fish passage at proposed outfall location.			
		Morphology: river depth and width	Existing hydromorphology condition is poor. Stage 3 assessment of high flow conditions within river waterbody indicate limited change to water level.			
		Morphology: river bed structure, substrate	Stage 3 assessment of stream power within river waterbody indicate stream power of proposed pumped flow is below the erosion threshold.			
	Physico-chemical supporting elements	Thermal conditions	Water quality monitoring plan to monitor that temperature in river does not exceed EU Directive limits			
		Oxygenation	Water quality monitoring plan to monitor that oxygenation in river does not exceed EU Directive limits.			
		Salinity	Water quality monitoring plan to monitor that salinity in river does not exceed EU Directive limits.			
		Acidification	Water quality monitoring plan to monitor that acidification in river does not exceed EU Directive limits.			
		Nutrient conditions	Cross River has capacity for L.Funshinagh nutrients. Water quality monitoring plan to monitor that nutrient conditions in river does not exceed EU Directive limits.			

	WFD supporting element	WFD elements	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
	Biological quality elements	Phytoplankton	Q-values were below 'good' status. Design of the outfall location allows for fish passage. Current flow with proposed pumped flow is below the erosive threshold therefore impact to the biological quality is expected to be low.			
		Macrophytes and phytobenthos				
		Benthic invertebrate fauna				
		Fish fauna				
IE_SH_26C100200	Hydromorphological supporting element	Hydrology: quantity and dynamics of flow	Stage 3 assessment of high and low flow conditions at the proposed outfall indicate that there will be an increase in flow in the order of magnitude of double the current low flow conditions.	The river waterbody is in a moderate condition, with existing hydromorphology (channel and bank modification) and agricultural pressure (nutrients).	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.
		Morphology: river depth and width	Existing hydromorphology condition is poor. Stage 3 assessment of high flow conditions within river waterbody indicate limited change to water level.			
		Morphology: river bed structure, substrate	Stage 3 assessment of stream power within river waterbody indicate stream power of proposed pumped flow is below the erosion threshold.			
	Physico-chemical supporting elements	Thermal conditions	Water quality monitoring plan to monitor that temperature in river does not change more than 1.5 C.			
		Oxygenation	Water quality monitoring plan to monitor that oxygenation in river does not exceed EU Directive limits.			
		Salinity	Water quality monitoring plan to monitor that salinity in river does not exceed EU Directive limits.			
		Acidification	Water quality monitoring plan to monitor that acidification in river does not exceed EU Directive limits.			

	WFD supporting element	WFD elements	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
		Nutrient conditions	Cross River has capacity for L.Funshinagh nutrients. Water quality monitoring plan to monitor that nutrient conditions in river does not exceed EU Directive limits.			
	Biological quality elements	Phytoplankton	Q-values were below ‘good’ status. Current flow with proposed pumped flow is below the erosive threshold therefore impact to the biological quality is expected to be low.			
		Macrophytes and phytobenthos				
		Benthic invertebrate fauna				
		Fish fauna				
IE_SH_26C100300	Hydromorphological supporting element	Hydrology: quantity and dynamics of flow	Stage 3 assessment of high and low flow conditions at the proposed outfall indicate that there will be an increase in flow in the order of magnitude of double the current low flow conditions.	The river waterbody is in a moderate condition, with existing hydromorphology (channel and bank modification) and agricultural pressure (nutrients).	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.
		Morphology: river depth and width	Existing hydromorphology condition is poor. Stage 3 assessment of high flow conditions within river waterbody indicate limited change to water level.			
		Morphology: river bed structure, substrate	Stage 3 assessment of stream power within river waterbody indicate stream power of proposed pumped flow is below the erosion threshold.			
	Physico-chemical supporting elements	Thermal conditions	Water quality monitoring plan to monitor that temperature in river does not exceed EU Directive limits.			
		Oxygenation	Water quality monitoring plan to monitor that oxygenation in river does not exceed EU Directive limits.			
		Salinity	Water quality monitoring plan to monitor that salinity in river does not exceed EU Directive limits.			

	WFD supporting element	WFD elements	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
		Acidification	Water quality monitoring plan to monitor that acidification in river does not exceed EU Directive limits.			
		Nutrient conditions	Cross River has capacity for L.Funshinagh nutrients. Water quality monitoring plan to monitor that nutrient conditions in river does not exceed EU Directive limits.			
	Biological quality elements	Phytoplankton	Q-values were below 'good' status. Current flow with proposed pumped flow is below the erosive threshold therefore impact to the biological quality is expected to be low.			
		Macrophytes and phytobenthos				
		Benthic invertebrate fauna				
		Fish fauna				
IE_SH_26C100400	Hydromorphological supporting element	Hydrology: quantity and dynamics of flow	Stage 3 assessment of high and low flow conditions at the proposed outfall indicate that there will be an increase in flow in the order of magnitude of double the current low flow conditions.	The river waterbody is in a moderate condition, with existing hydromorphology (channel and bank modification) and agricultural pressure (nutrients).	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.
		Morphology: river depth and width	Existing hydromorphology condition is poor. Stage 3 assessment of high flow conditions within river waterbody indicate limited change to water level.			
		Morphology: river bed structure, substrate	Stage 3 assessment of stream power within river waterbody indicate stream power of proposed pumped flow is below the erosion threshold.			
	Physico-chemical supporting elements	Thermal conditions	Water quality monitoring plan to monitor that temperature in river does not change more than 1.5 C.			
		Oxygenation	Water quality monitoring plan to monitor that oxygenation in river does not exceed EU Directive limits.			

	WFD supporting element	WFD elements	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
		Salinity	Water quality monitoring plan to monitor that salinity in river does not exceed EU Directive limits.			
		Acidification	Water quality monitoring plan to monitor that acidification in river does not exceed EU Directive limits..			
		Nutrient conditions	Cross River has capacity for L.Funshinagh nutrients. Water quality monitoring plan to monitor that nutrient conditions in river does not exceed EU Directive limits.			
	Biological quality elements	Phytoplankton	Q-values were below ‘good’ status. Current flow with proposed pumped flow is below the erosive threshold therefore impact to the biological quality is expected to be low.			
		Macrophytes and phytobenthos				
		Benthic invertebrate fauna				
		Fish fauna				

Table 5.13 WFD significance test (Hydrologically connected protected areas)

	EU code	Description	Qualifying interests	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
EU protected areas	IE0000611	Lough Funshinagh SAC	Appendix E Turloughs [3180] Appendix F: Rivers with muddy banks with *Chenopodion rubri p.p*. and *Bidention p.p.* vegetation [3270]	Water monitoring plan to monitor Lough Funshinagh water quality and water levels.	L.Funshinagh is not currently achieving its Qualifying Interests due to high water levels. Reducing water levels would improve the condition of the habitat.	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.
	IE0004096	Middle Shannon Callows SPA	Whooper Swan (*Cygnus cygnus*) [A038] Wigeon (*Anas penelope*) [A050] Corncrake (*Crex crex*) [A122] Golden Plover (*Pluvialis apricaria*) [A140] Lapwing (*Vanellus vanellus*) [A142] Black-tailed Godwit (*Limosa limosa*) [A156] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Wetland and Waterbirds [A999]	Water monitoring plan to monitor water quality and water level in Cross River.	The Qualifying Interests of the Middle Shannon Callows SPA will not be impacted by the proposed pumped flow.	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.
	IE0000216	River Shannon Callows SAC	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410] Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) [6510] Alkaline fens [7230]	Water monitoring plan to monitor water quality and water level in Cross River.	The Qualifying Interests of the River Shannon SAC will not be impacted by the proposed pumped flow.	The proposed pumping of water from L.Funshinagh will provide flood relief benefit to the residents of Curraghboy and surrounds. Without the measures it is likely that the water levels in L.Funshinagh will continue to rise.	An alternative permanent solution is being investigated to transfer water from L.Funshinagh to L.Ree. This solution requires detailed assessment and will not be viable in the short-term.

	EU code	Description	Qualifying interests	All practical mitigation in place	Relevance to RBMP	Overriding public interest	Alternatives considered
			Limestone pavements [8240] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0] *Lutra lutra* (Otter) [1355]				

6. Conclusions

6.1 Summary

The proposed scheme intends to extract a sufficient volume of water from Lough Funshinagh that will negate or partly the predicted increase in level prior to the development of a permanent scheme, and to limit the peak water level to a level that will allow the flood risk at the properties around the lough to be successfully managed. The WFD Compliance Assessment has been prepared to determine if the proposed scheme is compliant with objectives of the WFD.

Four WFD river waterbodies, one WFD groundwater body and seven protected areas were screened in for assessment due to possible direct and indirect causal effect from the proposed scheme. Following the scoping assessment, all construction phase impacts have been screened out for all receptors, subject to the use of best practice mitigation. A detailed assessment was required for the operational phase of the proposed development. Hydromorphological, physico-chemical supporting elements and biological quality elements were scoped in for detailed assessment for four WFD river waterbodies (IE_SH_26C100060, IE_SH_26C100200, IE_SH_26C100300, IE_SH_26D100400) and three protected areas (IE0000611, IE0004096, IE0000216) were screened in for the impact of the proposed scheme on the Conservation Objectives through hydrological regime and habitat effects. The one WFD groundwater body was scoped out of the assessment due to there being no significant effect.

All WFD river waterbodies have a 'moderate' to 'poor' status mainly due to agriculture and hydromorphology pressure. The biological quality of EPA sites indicate that the Cross River is strongly influenced by groundwater in its upper reaches downstream of Lough Funshinagh, which results in typically low dissolved oxygen saturation for a river. Although there were improvements to good quality in the middle reaches a decline was reached at the confluence of the river with the River Shannon. The water quality status of the WFD river waterbodies under the third RBMP indicated that the water quality status of the WFD water bodies reaches a 'good' status in the middle WFD waterbodies but reduces to moderate and poor in the lower WFD waterbodies. The upper waterbody had a 'poor' water quality status.

Site assessment suggests the river typology for the upper reaches of the Cross River (i.e. above site 3 within IE_SH_26C100060) is 'pool riffle glide'. This morphology is characterised by low to moderate gradient channel beds. Sediment is predominantly gravel, with patches of cobbles and sand. Flow types are made up of riffle sections interspersed with pools and glides. The current channel morphology is poor as it is modified into a trapezoidal shape. There is an opportunity to improve the hydromorphology resilience to low flow conditions through the introduction of flow from the proposed scheme as the bed is predominantly gravel. This river waterbody also had a poor biological quality although lamprey seem to be widely distributed throughout the watercourse (i.e. suitable lamprey spawning habitat of finer gravel was present at most survey sites, areas of soft sediment with suitable characteristics for ammocoete burial were not). The lower reaches of the Cross River (i.e. IE_SH_26C100200, IE_SH_26C100300, IE_SH_26D100400) are 'lowland meandering', which is characterised by low to no gradient lowland streams with smooth flow and fine substrates. Analysis indicates that the introduction of flow from the proposed scheme should minimise risk of erosion of the bed. Moderate biological quality was recorded here. The design of the proposed outfall will consider erosion reduction measures and fish passage.

There will be an increase in flow in the order of magnitude of double the current low flow conditions. Analysis indicated that the channel has enough capacity for additional flow. Additional energy will be dissipated by the design of the rock armour and geotextile. Streampower calculations indicate that erosion will be localised at the outfall. The WFD river waterbodies have capacity for the additional nutrients from the proposed pumped Lough Funshinagh water. Water levels, geomorphology and water quality will be monitored throughout the proposed scheme as part of a water monitoring plan.

6.2 Conclusion

Provided the mitigation identified within this report is incorporated into the construction methodology and final scheme design, it can be concluded that the scheme is WFD compliant.

6.3 Recommendation

The following recommendations are made:

- This assessment has been made based on the proposed scheme construction methodology and anticipated design available as of September 2024. Should there be a fundamental change to the proposals against which this assessment has been made, this report must be updated
- The final construction phase methodology and mitigation must be agreed with the EPA and IFI, prior to commencement. It is strongly recommended that a fluvial geomorphologist and ecologist supervise installation and mitigation at the outfall location.; and
- Detailed design of all scheme components and monitoring should be made in consultation with a suitably qualified Geomorphologist and Ecologist, and must be agreed and approved by the EPA, prior to construction.

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Appendix A

River Habitat of Cross River

Table A River habitat assessment of the Cross River

Site	Channel width (m)	Channel depth (m)	Lateral/longitudinal change	Habitat type	Substrate	In-stream vegetation	Riparian vegetation	Surrounding landuse
1	2	0.05-0.15	Has been extensively deepened and locally straightened, resulting in a trapezoidal channel with steep banks of 2-4m. Bank slumping as a result of livestock poaching was present along the south bank.	Riffle and shallow, slow-flowing glide with very occasional small pool.	Highly alkaline lowland river dominated by mixed gravels and cobble. Boulder was rare. These were heavily bedded and calcified, with high rates of siltation. Soft sediment accumulations of sand and shallow silts were occasional along channel margins.	Fool's watercress (Helosciadium nodiflorum) was frequent with occasional water mint (Mentha aquatica), water forget-me-not (Myosotis scorpioides) and common duckweed (Lemna minor). Aquatic bryophyte coverage was low with occasional Leptodictyum riparium[32] and rare Rhynchostegium riparioides mosses. Filamentous rhodophyta (Batrachospermum sp.) were rare on larger substrata.	The steep banks were heavily scrubbed with locally abundant bramble (Rubus fruticosus agg.) and scattered elder (Sambucus nigra), hawthorn (Crataegus monogyna) and sycamore (Acer psuedoplatanus). Riparian shading was low overall (banks often open) with abundant herbaceous vegetation and rank grasses.	Bordered by improved pasture (GA1) and calcareous/neutral grassland (GS1) with little to no riparian borders and hawthorn-dominated hedgerows along field boundaries.
2	2	0.3	Had been extensively deepened and locally straightened resulting in a trapezoidal channel with steep banks of up to 4m.	Shallow glide and occasional riffle with localised small pool only.	Highly alkaline lowland river. The substrata were dominated by fine and medium gravels with frequent small cobble. Boulder was rare. Pool slacks, often associated with macrophyte beds and meanders, featured soft sediment accumulations of sand and shallow silts. Siltation was moderate to high locally.	Fool's watercress was frequent with occasional water mint, water forget-me-not and common duckweed. Aquatic bryophyte coverage was low given the predominance of smaller substrata, with scattered Leptodictyum riparium, Rhynchostegium riparioides and rare Chiloscyphus polyanthos.	Pellia sp. liverwort was present on muddy sections of steep banks. The narrow, steep sided channel encouraged encroachment of terrestrial herbaceous and scrub vegetation which provided shading to the otherwise open (historically cleared) banks.	Bordered by improved pasture (GA1) with little to no riparian borders and hawthorn-dominated hedgerows along field boundaries.

[32] Indicator of eutrophication (Weekes et al., 2021)

Site	Channel width (m)	Channel depth (m)	Lateral/longitudinal change	Habitat type	Substrate	In-stream vegetation	Riparian vegetation	Surrounding landuse
3	2-2.5	0.1-0.3	Historically deepened and locally straightened, with bank modifications and revetment in vicinity of the bridge (box culvert).	Good flow diversity despite modifications. The profile comprised a mix of riffle, glide and pool.	The substrata were dominated by heavily calcified cobble and boulder with localised mixed gravels and sands. Siltation was moderate overall although soft sediment accumulations were rare and flocculent where present.	Given bed compaction and riparian shading, macrophyte growth was sparse with occasional fool's watercress, common duckweed and water mint. Ivy-leaved duckweed (Lemna trisulca) was present but rare. The compacted bed supported locally abundant Pellia endiviifolia and localised Leptodictyum riparium. Filamentous rhodophyta (Batrachospermum sp.) were present on larger boulder.	The riparian zones supported mature treelines of ash (Fraxinus excelsior), hawthorn and sycamore with bramble scrub which caused local tunnelling of the channel.	The site was bordered by improved pasture (GA1) with narrow buffers.
4	2.5-3	>0.5	Extensively deepened historically and locally straightened along the road. This resulted in a homogenous trapezoidal channel with steep, historically cleared banks of up to 3m.	Profile comprising deep slow-flowing glide and pool (no riffle areas).	The substrata were dominated by deep silt with a high clay fraction. Mixed superficial gravels were present locally (but heavily silted) with rare boulder.	The slow-flowing site was heavily vegetated with abundant branched bur-reed (Sparganium erectum), common reed (Phragmites australis), ivy-leaved duckweed and fool's watercress. Water mint, common duckweed, water starwort (Callitriche sp.) and water forget-me-not were also present locally. Aquatic bryophyte s were limited to rare Leptodictyum riparium and Pellia endiviifolia.	The steep banks offered low riparian shading and were dominated by rank grasses, common reed and hedge bindweed (Calystegia riparium) with scattered scrub only.	The site was bordered by improved pasture (GA1) with little to no riparian buffers.

Site	Channel width (m)	Channel depth (m)	Lateral/longitudinal change	Habitat type	Substrate	In-stream vegetation	Riparian vegetation	Surrounding landuse
5	4-5	0.3-1.2	The river had been deepened historically with some local straightening in vicinity of the former mill. However, good instream recovery had occurred with a good flow diversity and strong flows, and the river retained sinuosity upstream and downstream of the site.	Significantly higher flows compared with upstream (given the confluence with other channels).	The substrata were dominated by heavily compacted/calcified cobble and abundant boulder. Mixed gravels were present interstitially with occasional sand/flocculent silt accumulations in pool slacks. Siltation was low overall given high flow rates.	The site supported abundant beds of heterophyllus lesser water parsnip (Berula erecta) and fool's watercress with occasional branched bur-reed, water starwort (Callitriche sp.) and ivy-leaved duckweed. Water mint, common duckweed and water forget-me-not were also locally frequent. Cover of aquatic bryophytes was very high with abundant Fontinalis antipyretica in addition to frequent Chiloscyphus polyanthos, Rhynchostegium riparioides, Leptodictyum riparium and Cinclidotus fontinaloides.	The historically cleared banks supported only scattered hawthorn and grey willow (Salix cinerea) with abundant herbaceous vegetation dominated by great willowherb (Epilobium hirsutum) and reed canary grass (Phalaris arundinacea).	The site was bordered by improved pasture (GA1) with dry meadow borders (GS2).
6	5-7	0.4-1.4	High energy lowland river (FW2) had been modified historically (deepened with bank revetment) but retained a good diversity of instream habitats.	A profile comprising fast-flowing glide and pool with localised riffle.	The substrata were dominated by bedded cobble and boulder with localised coarser gravels and sand. In contrast to upstream sites, siltation was moderate with significant plumes underfoot despite high flow rates.	Macrophyte cover was locally high with frequent unbranched bur-reed (Sparganium emersum) and water crowfoot (Ranunculus sp.) with occasional iris (Iris psuedacorus) and branched bur-reed along the littorals. Water mint, fine-leaved water dropwort (Oenanthe aquatica) and fool's watercress were also present. Aquatic bryophyte coverage was high with abundant Fontinalis antipyretica, Leptodictyum riparium and Rhynchostegium riparioides.	The typically open banks supported abundant reed canary grass and a nitrophilous community with scattered grey willow and ash.	The site was bordered by residential areas (BL3) and semi-improved pasture (GA1).

Site	Channel width (m)	Channel depth (m)	Lateral/longitudinal change	Habitat type	Substrate	In-stream vegetation	Riparian vegetation	Surrounding landuse
						The aquatic vegetation community was representative of the Annex I habitat Water courses of plain to montane levels, with submerged or floating vegetation of the Ranunculion fluitantis and Callitricho-Batrachion (low water level during summer) or aquatic mosses [3260]'. Filamentous algal and floc[33] cover was moderate, indicating enrichment (Cladophora & Vaucheria sp.).		
7	8-10	>1.5	Channel deepened historically but not straightened with low-lying clay banks adjoined by extensive flood plains.	Profile of deep glide and pool (no riffle).	The substrata were dominated by deep silt with scattered compacted/bedded boulder and cobble, mostly confined to the bridge apron. Hard substrata were calcified (with cyanobacterial crusts).	Given the predominance of deep glide, macrophyte cover was low although unbranched bur-reed and broad-leaved pondweed (Potamogeton natans) was present locally. Littoral areas also supported scattered water mint and great yellow cress (Rorippa amphibia).	The banks supported abundant reed canary grass with some purple loosestrife (Lythrum salicaria) and scattered grey willow.	The site was bordered by wet grassland (GS4) and semi-improved (reclaimed) grassland (GA1).

[33] floc is defined as an aggregation of (mostly dead) organic material, mainly from algae and diatoms, but also with potential origins from decaying macrophytes and associated decomposers (bacteria and fungi) (Moorkens & Killeen, 2020)

Appendix B

Water Quality Assessment for Cross River

Lough Funshinagh – 11/06/2021

Water Quality Parameter	Sample Site			
	SW1	SW2	SW3	SW4
Total Suspended Solids (mg/l)1	<2	12	2	<2
pH	8.21	8.29	7.49	7.37
Temperature	16.78	17.24	16.46	11.64
Dissolved Oxygen (mg/l)	9.07	9.89	5.96	7.9
Conductivity@20°C (µS/cm)	363	358	440	612
Total Dissolved Solids (mg/l)	254	251	308	429
Turbidity (NTU)	5.17	8.02	5.19	0.83
Colour (mg/l Pt Co)	55.7	70.3	68.5	8.3
Total Nitrogen as N (mg/l)	< 0.5	< 0.5	0.66	2.53
Nitrite as NO_2 (mg/l)	<0.017	<0.017	<0.017	0.26
Nitrate as NO_3 (mg/l) <0.44	<0.44	<0.44	<0.44	11.8
Total Phosphorous as P (mg/l)	<0.05	<0.05	0.13	<0.05
Orthophosphate as PO_4-P (mg/l)	<0.01	<0.01	0.036	<0.01
Chlorophyll a (µg/l)	10.7	11.7	5.87	<1

Cross River - 12/08/2024

Water Quality Parameter	Sample Site						
	S1	S2	S3	S4	S5	S6	S7
pH	7.71	7.64	7.85	7.50	7.62	7.92	8.04
Conductivity @25°C (µs/cm)	718	716	706	691	479	579	576
Total Alkalinity (mg CaCO3/l)	377	374	370	350	237	257	258
Total Oxidised Nitrogen (mg N/l)	1.108	1.113	1.021	1.561	0.636	1.36	1.228
Nitrate (mg N/l) 1	1.103	1.107	1.015	1.556	0.627	1.352	1.223
Nitrite (mg N/l)	0.005	0.006	0.006	0.005	0.009	0.008	0.005
Total ammonia (mg N/l)	0.030	0.031	0.028	0.019	0.039	0.014	0.027
Unionised ammonia (mg N/l)	0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001
MRP (mg P/l)	0.009	0.008	0.011	0.011	0.008	0.011	0.010
BOD (mg O2/l)	1.1	0.6	0.8	0.9	0.9	0.8	0.8
COD (mg O2/l)	14.4	14.9	14.9	17.9	18.7	19.6	21.3
Suspended solids (mg/l)	1.3	1.3	1.0	7.2	1.0	2.0	2.0
Chloride (mg Cl/l)	13.3	13.4	13.2	15.8	12.9	29.2	28.0
Dissolved oxygen (mg O2/l)	7.7	7.9	8.2	8.9	12.7	10.8	10.1

Lough Funshinagh – 12/08/2024

Water Quality Parameter	Sample Site		
	F1	F2	F3
Total Alkalinity (mg CaCO3)	159	160	157
Conductivity@25°C (µS/cm)	333	334	330
pH	8.16	8.20	8.24
Total Oxidised Nitrogen (mg N/l)	0.014	0.040	0.037
Total Ammonia (mg N/l)	0.021	0.014	0.007
Unionised Ammonia (mg N/l)	0.001	0.001	<0.001
Nitrate (mg N/l)	0.011	0.036	0.033
Nitrite (mg N/l)	0.003	0.004	0.004
Molybdate Reactive Phosphorus (mg P/l)	<0.001	<0.001	<0.001
Total P (mg P/l)	0.043	0.050	0.051
Chlorophyll a (µg/l)	39.4	47.2	49.7
Suspended Solids (mg/l)	4.5	5.8	6.0
Chloride (mg/l)	11.51	11.42	11.42

River Cross – EPA Samples

RS26C100100

In the EPA Database, only 15 samples were associated to Station RS26C100100, all taken in 2010. For this station, there was no data available for the following parameters: conductivity @20°C and sulphate.

Water Quality Summary Station RS26C100100

RS26C100100 - Water Quality Summary												
Water Quality Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges	EC Directive 2006/44/EC		EC Directive 98/83/EC	Directive 2006/11/EC	Other
								Cyprinid Waters	Salmonid Waters	EU Drinking Water Regs 2014 (S.I. 122 of 2014)	Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)	
Alkalinity-total (as CaCO3)	mg/l											
Ammonia-Total (as N)	mg/l	0.019	0.019	0.019	0.019	1	2010	-	-	-	-	-
BOD - 5 days (Total)	mg/l	2.28	2.28	2.28	2.28	1	2010	-	-	-	-	-
Chloride	mg/l	18.65	18.65	18.65	18.65	1	2010	-	-	-	-	-
Conductivity @20°C	uS/cm							-	-	2,500	-	-
Nitrate (as N)	mg/l	1.924	1.924	1.924	1.924	1	2010			50	-	-
Nitrite (as N)	mg/l	0.007	0.007	0.007	0.007	1	2010	≤ 0.01	≤ 0.03	0.5		-
ortho-Phosphate (as P)	mg/l	0.006	0.006	0.006	0.006	1	2010	0.4[3]	0.2[3]	-	High status (≤ 0.025 mg/l P mean)[4] Good status (≤ 0.035 mg/l P mean)[4]	-

RS26C100100 - Water Quality Summary												
Water Quality Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges	EC Directive 2006/44/EC		EC Directive 98/83/EC	Directive 2006/11/EC	Other
								Cyprinid Waters	Salmonid Waters	EU Drinking Water Regs 2014 (S.I. 122 of 2014)	Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)	
pH	pH units	8.3	8.3	8.3	8.3	1	2010	6 to 9	6 to 9	6.5 to 9.5 4.5 to 9	4.5 to 9 (soft water) 6.5 to 9 (hard water)	-
Sulphate	mg/l							-	-	-	-	-
Temperature	oC	2.6	2.6	2.6	2.6	1	2010	Thermal discharge must not raise temperature > of 1.5 °C				
Total Hardness (as CaCO3)	mg/l	309	309	309	309	1	2010	-	-	-	-	-

RS26C100200

In the EPA Database, 1058 samples were associated to Station RS26C100200, taken from 2012 to 2024, with a gap in the year 2014 for several parameters. For this station, there was no data available for the following parameters: alkalinity-total (as CaCO3), chloride, sulphate and total hardness (as CaCO3).

Water Quality Summary Station RS26C100200

RS26C100200 - Water Quality Summary												
Water Quality Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges	EC Directive 2006/44/EC		EC Directive 98/83/EC	Directive 2006/11/EC	Other
								Cyprinid Waters	Salmonid Waters	EU Drinking Water Regs 2014 (S.I. 122 of 2014)	Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)	
Alkalinity-total (as CaCO3)	mg/l							-	-	-	-	-
Ammonia-Total (as N)	mg/l	0.326	0.01	0.051	0.1238	108	2012-2013 2015-2024	-	-	-	-	-
BOD - 5 days (Total)	mg/l	3.2	1	1.386	2.2	75		-	-	-	-	-
Chloride	mg/l							-	-	-	-	-
Conductivity @20°C	uS/cm	545	545	545	545	1	2015	-	-	2,500	-	-
Nitrate (as N)	mg/l	1.889	0.379	1.22	1.8474	24	2012-2013			50	-	-
Nitrite (as N)	mg/l	0.008	0.004	0.0525	0.007	24	2012-2013	≤ 0.01	≤ 0.03	0.5		-
ortho-Phosphate (as P)	mg/l	0.147	0.006	0.0176	0.0485	111	2012-2013 2015-2023	0.4[3]	0.2[3]	-	High status (≤ 0.025 mg /l P mean)[4] Good status (≤ 0.035 mg /l P mean)[4]	-
pH	pH units	8.57	6.9	7.6164	7.976	125	2012-2013 2015-2024	6 to 9	6 to 9	6.5 to 9.5 4.5 to 9	4.5 to 9 (soft water) 6.5 to 9 (hard water)	-

RS26C100200 - Water Quality Summary												
Water Quality Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges	EC Directive 2006/44/EC		EC Directive 98/83/EC	Directive 2006/11/EC	Other
								Cyprinid Waters	Salmonid Waters	EU Drinking Water Regs 2014 (S.I. 122 of 2014)	Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)	
Sulphate	mg/l							-	-	-	-	-
Temperature	oC	16.9	6.1	10.96	15.37	124	2012-2013 2015-2024	Thermal discharge must not raise temperature > of 1.5 °C				
Total Hardness (as CaCO3)	mg/l							-	-	-	-	-

RS26C100300

In the EPA Database, 3399 samples were associated to Station RS26C100400, taken from 2007 to 2024, with measures starting in 2010 for several parameters. For this station, there was no data available for sulphate.

Water Quality Summary Station RS26C100300

RS26C100300 - Water Quality Summary												
Water Quality Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges	EC Directive 2006/44/EC		EC Directive 98/83/EC	Directive 2006/11/EC	Other
								Cyprinid Waters	Salmonid Waters	EU Drinking Water Regs 2014 (S.I. 122 of 2014)	Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)	
Alkalinity-total (as CaCO3)	mg/l	331.6	207	271.67	318.7	54	2014-2024	-	-	-	-	-
Ammonia-Total (as N)	mg/l	0.75	0.009	0.067	0.2176	239	2010-2024	-	-	-	-	-
BOD - 5 days (Total)	mg/l	8.7	0.51	1.494	2.745	169	2010-2024	-	-	-	-	-
Chloride	mg/l	36.7	12.08	22.25	30.695	108	2010-2024	-	-	-	-	-
Conductivity @20°C	uS/cm	582	452	524.8	576.5939	15	2014-2015	-	-	2,500	-	-
Nitrate (as N)	mg/l	4.521	0.774	1.824	2.8703	172	2014-2024	-	-	50	-	-
Nitrite (as N)	mg/l	56.4	0.001	1.96	10.093	162	2007-2022	≤ 0.01	≤ 0.03	0.5		-
ortho-Phosphate (as P)	mg/l	0.15	0.002	0.0178	0.06125	233	2010-2024	0.4[3]	0.2[3]	-	High status (≤ 0.025 mg /l P mean)[4] Good status (≤ 0.035 mg /l P mean)[4]	-
pH	pH units	8.58	6.985	7.741	8.04	293	2007-2024	6 to 9	6 to 9	6.5 to 9.5 4.5 to 9	4.5 to 9 (soft water) 6.5 to 9 (hard water)	-

RS26C100300 - Water Quality Summary												
Water Quality Parameter	Unit	Max	Min	Average	95%ile	Count	Date Ranges	EC Directive 2006/44/EC		EC Directive 98/83/EC	Directive 2006/11/EC	Other
								Cyprinid Waters	Salmonid Waters	EU Drinking Water Regs 2014 (S.I. 122 of 2014)	Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)	
Sulphate	mg/l							-	-	-	-	-
Temperature	oC	17.6	2.6	11.19	15.9	290	2007-2024	Thermal discharge must not raise temperature > of 1.5 °C				
Total Hardness (as CaCO3)	mg/l	339.7	225.1	301.55	361.7	108	2010-2024	-	-	-	-	-

RS26C100400

In the EPA Database, 6660 samples were associated to Station RS26C100400, taken from 2007 to 2024, with measures starting in 2010 for several parameters. For this station, data was available for all the parameters that were elected for the evaluation.

Water Quality Summary Station RS26C100400

RS26C100400 - Water Quality Summary												
Water Quality Parameter	**Unit**	**Max**	**Min**	**Average**	**95%ile**	**Count**	**Date Ranges**	**EC Directive 2006/44/EC**		**EC Directive 98/83/EC**	**Directive 2006/11/EC**	**Other**
								Cyprinid Waters	**Salmonid Waters**	**EU Drinking Water Regs 2014 (S.I. 122 of 2014)**	**Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)**	
Alkalinity-total (as CaCO3)	mg/l	337	140	266.55	319.75	172	2010-2024	-	-	-	-	-
Ammonia-Total (as N)	mg/l	0.44	0.009	0.048	0.12	154	2010-2024	-	-	-	-	-
BOD - 5 days (Total)	mg/l	4	0.63	1.341	2.4	112	2010-2024	-	-	-	-	-
Chloride	mg/l	42.6	11.11	20.8	28.255	216	2010-2024	-	-	-	-	-
Conductivity @20°C	uS/cm	609	266	515.73	566.774 4	22	2007-2009 2014-2015	-	-	2,500	-	-
Nitrate (as N)	mg/l	3.487	0.086	1.500	2.3599	147	2007-2024			50	-	-
Nitrite (as N)	mg/l	50.5	0.002	4.02	21.3	198	2007-2022	≤ 0.01	≤ 0.03	0.5		-
ortho-Phosphate (as P)	mg/l	0.188	0.005	0.0223	0.057	174	2010-2024	0.4[3]	0.2[3]	-	High status (≤ 0.025 mg /l P mean)[4] Good status (≤ 0.035 mg /l P mean)[4]	-
pH	pH units	8.6	6.803	7.858	8.1	266	2007-2024	6 to 9	6 to 9	6.5 to 9.5 4.5 to 9	4.5 to 9 (soft water) 6.5 to 9 (hard water)	-

RS26C100400 - Water Quality Summary												
Water Quality Parameter	**Unit**	**Max**	**Min**	**Average**	**95%ile**	**Count**	**Date Ranges**	**EC Directive 2006/44/EC**		**EC Directive 98/83/EC**	**Directive 2006/11/EC**	**Other**
								Cyprinid Waters	**Salmonid Waters**	**EU Drinking Water Regs 2014 (S.I. 122 of 2014)**	**Environmental Objectives Surface Water Regulations (S.I. 77 of 2019)**	
Sulphate	mg/l	22.88	12.73	16.12	21.866	3	2007	-	-	-	-	-
Temperature	oC	18.5	3.7	11.35	16.17	267	2007-2024	Thermal discharge must not raise temperature > of 1.5 °C				
Total Hardness (as CaCO3)	mg/l	387	158	297.21	355	216	2010-2024	-	-	-	-	-

Appendix C

Waste Assimilative Assessment for Cross River

WAC assessment for CS134

River Data	
Site Name	Lough Funshinagh Interim Flood Management Measures
Receiving Waters	River Cross
River Flow Data	Upstream River Flow - 95%ile
River Categorisation	Surface Waters Intended For The Abstraction of Drinking Water
If All Surface Waters, include Classification of Ecological Status. If not, please select N/A	Moderate Status: The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.
River Water Quality - Water Harness [mg/l CaCO3], 95%ile	339.60
River Water Quality - Water Alkalinity [mg/l CaCO3], 95%ile	376.10

Flow Data

Design Parameters	Value	Unit	Comments
Total Site Peak Flow	1080.0	m3/h	Based on 300 l/s pump capacity
Total Site Peak Day Volume	25920	m3/d	m3 per peak day (if pump constantly running)
Total Site Annual Volume	4730400	m3/yr	m3 per annum (assume 6 months operating)
River Flow - 95%ile	0.112	m3/s	Upstream River Flow - 95%ile Source of Information: EPA.ie
River Flow - 95%ile	9676.8	m3/d	Upstream River Flow - 95%ile

Prescribed Concentrations as per applicable Standards and Regulation

Design Parameters	Value	Unit	Comments
Temperature	Not greater than a 1.5°C rise in ambient temperature outside the mixing zone.	°C	
pH	6.5-9.5	pH Units	
Total Ammonia (as N)	0.09	mg/l	
Total Residual Chlorine	N.V.	mg/l	
Conductivity	2500	µs/cm-1 at 20 °C	
Sodium Na	200	mg/l	
Manganese Mn	0.05	mg/l	
Chloride Cl	250	mg/l	
Fluoride F	N.V.	mg/l	
Sulphate SO4	250	mg/l	
Nitrate (as N) NO3	250	mg/l	
Nitrite (as N) NO2	0.5	mg/l	
Boron B	1	mg/l	
Chlorides (as Cl-)	250	mg/l	
Copper	2	mg/l	
Suspended Solids	Acceptable to consumers and no abnormal change	mg/l	
Zinc	N.V.	mg/l	
BOD5	2.6	mg/l	
Iron	0.2	mg/l	
Selenium	10	mg/l	
Orthoposhpates as P. MRP	0.075	mg/l	

Waste Assimilative Capacity Calculation - 95%ile River Flow

Parameter	Receiving Waters Upstream				Waste Assimilative Capacity		Receiving Waters Downstream			Discharge Standard		L. Funshinagh Water Quality
	Background Concentration - Sampled		River Flow	River Load	Site Discharge Flow (F_{DC} discharge)	River Load- Assimilative Capacity	Combined River and Discharge Flow	Threshold Value (Cmax)	Maximum Load in the River	Total Load	Maximum Site Discharge Concentration	
	mg/l		m3/d	kg/d	m3/d	kg/d	m3/d	mg/l	kg/d	kg/d	mg/l	mg/l
Total Ammonia (as N)	95%ile	0.04	9676.8	0.35	25920	0.52	35596.8	0.09	3.20	2.85	0.11	0.02
Conductivity	95%ile	717.40	9676.8	6942.14	25920	17249.86	35596.8	2500	88992.00	82049.86	3165.50	334.00
Manganese Mn	95%ile	0.08	9676.8	0.81	25920	-0.33	35596.8	0.05	1.78	0.97	0.04	
Chloride Cl	95%ile	28.84	9676.8	279.08	25920	2140.12	35596.8	250	8899.20	8620.12	332.57	11.51
Nitrate (as N) NO3	95%ile	1.49	9676.8	14.46	25920	2404.74	35596.8	250	8899.20	8884.74	342.78	0.04
Nitrite (as N) NO2	95%ile	0.01	9676.8	0.08	25920	4.75	35596.8	0.5	17.80	17.71	0.68	0.004
Boron B	95%ile	0.14	9676.8	1.33	25920	8.35	35596.8	1	35.60	34.27	1.32	
Copper	95%ile	0.00	9676.8	0.03	25920	19.33	35596.8	2	71.19	71.17	2.75	
BOD5	95%ile	1.04	9676.8	10.06	25920	15.10	35596.8	2.6	92.55	82.49	3.18	
Selenium	95%ile	0.00	9676.8	0.00	25920	96.76	35596.8	10	355.97	355.96	13.73	
Orthoposhpates as P. MRP	95%ile	0.04	9676.8	0.36	25920	0.37	35596.8	0.075	2.67	2.31	0.09	

Lough Funshinagh Water Discharge			
Parameter	Site Discharge Flow	Threshold Discharge Values	
	m3/d	mg/l	kg/d
Total Ammonia (as N)	25920	0.11	2.85
Conductivity	25920	3165.50	82049.86
Sodium Na	25920	274.67	7119.36
Manganese Mn	25920	0.04	0.97
Chloride Cl	25920	332.57	8620.12
Sulphate SO4	25920	343.33	8899.20
Nitrate (as N) NO3	25920	342.78	8884.74
Nitrite (as N) NO2	25920	0.68	17.71
Boron B	25920	1.32	34.27
Chlorides (as Cl-)	25920	343.33	8899.20
Copper	25920	2.75	71.17
BOD5	25920	3.18	82.49
Iron	25920	0.27	7.12
Selenium	25920	13.73	355.96
Orthoposhpates as P. MRP	25920	0.09	2.31

RECEIVING WATERS

Cross River

Cross River Flow & Water Quality Upstream of the Discharge			
Parameter	River Flow	River Concentration	River Load
	m3/d	mg/l	kg/d
Total Ammonia (as N)	9677	0.037	0.35
Conductivity	9677	717.400	6942.14
Sodium Na	9677	0.000	0.00
Manganese Mn	9677	0.084	0.81
Chloride Cl	9677	28.840	279.08
Sulphate SO4	9677	0.000	0.00
Nitrate (as N) NO3	9677	1.495	14.46
Nitrite (as N) NO2	9677	0.009	0.08
Boron B	9677	0.137	1.33
Chlorides (as Cl-)	9677	0.000	0.00
Copper	9677	0.003	0.03
BOD5	9677	1.040	10.06
Iron	9677	0.000	0.00
Selenium	9677	0.001	0.00
Orthoposhpates as P. MRP	9677	0.037	0.36

Cross River Flow & Water Quality Downstream of the Discharge			
Parameter	Combined Flow	Prescribed D/S Concentration in the River	Maximum Load in the River
	m3/d	mg/l	kg/d
Total Ammonia (as N)	35596.8	0.09	3.20
Conductivity	35596.8	2500	88992.00
Sodium Na	35596.8	200	7119.36
Manganese Mn	35596.8	0.05	1.78
Chloride Cl	35596.8	250	8899.20
Sulphate SO4	35596.8	250	8899.20
Nitrate (as N) NO3	35596.8	250	8899.20
Nitrite (as N) NO2	35596.8	0.5	17.80
Boron B	35596.8	1	35.60
Chlorides (as Cl-)	35596.8	250	8899.20
Copper	35596.8	2	71.19
BOD5	35596.8	2.6	92.55
Iron	35596.8	0.2	7.12
Selenium	35596.8	10	355.97
Orthoposhpates as P. MRP	35596.8	0.075	2.67

River Data	
Site Name	Lough Funshinagh Interim Flood Management Measures
Receiving Waters	River Cross
River Flow Data	Upstream River Flow - 50%ile
River Categorisation	Surface Waters Intended For The Abstraction of Drinking Water
If All Surface Waters, include Classification of Ecological Status. If not, please select N/A	Good Status: The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.
River Water Quality - Water Hardness [mg/l CaCO3], 50%ile	300.04
River Water Quality - Water Alkalinity [mg/l CaCO3], 50%ile	317.57

Flow Data

Design Parameters	Value	Unit	Comments
Total Site Peak Instantaneous Flow	1080.0	m3/h	Based on 300 l/s pump capacity
Total Site Peak Day Volume	25920	m3/d	m3 per peak day (if pump constantly running)
Total Site Annual Volume	4730400	m3/yr	m3 per annum (assume 6 months operating)
River Flow - 50%ile	0.444	m3/s	Upstream River Flow - 50%ile Source of Information: EPA.ie
River Flow - 50%ile	38361.6	m3/d	Upstream River Flow - 50%ile

Prescribed Concentrations as per applicable Standards and Regulation [Adjust the water quality parameters of interest as appropriate]

Design Parameters	Value	Unit	Comments
Temperature	Not greater than a 1.5°C rise in ambient temperature outside the mixing zone.	°C	
pH	6.5-9.5	pH Units	
Total Ammonia (as N)	0.065	mg/l	
Total Residual Chlorine	N.V.	mg/l	
Conductivity	2500	µs/cm-1 at 20 °C	
Sodium Na	200	mg/l	
Manganese Mn	0.05	mg/l	
Chloride Cl	250	mg/l	
Fluoride F	N.V.	mg/l	
Sulphate SO4	250	mg/l	
Nitrate (as N) NO3	250	mg/l	
Nitrite (as N) NO2	0.5	mg/l	
Boron B	1	mg/l	
Chlorides (as Cl-)	250	mg/l	
Copper	2	mg/l	
Suspended Solids	Acceptable to consumers and no abnormal change	mg/l	
Zinc	N.V.	mg/l	
BOD5	1.5	mg/l	
Iron	0.2	mg/l	
Selenium	10	mg/l	
Orthoposhpates as P. MRP	0.035	mg/l	

Waste Assimilative Capacity Calculation - 50%ile River Flow

Parameter	Receiving Waters Upstream				Waste Assimilative Capacity		Receiving Waters Downstream			Discharge Standard		Actual Discharge Quality from Site at Outfall CoC
	Background Concentration - Sampled		River Flow	River Load	Site Discharge Flow (F_{DC} discharge)	River Load-Assimilative Capacity	Combined River and Discharge Flow	Threshold Value (Cmax)	Maximum Load in the River	Total Load	Maximum Site Discharge Concentration	
	mg/l		m3/d	kg/d	m3/d	kg/d	m3/d	mg/l	kg/d	kg/d	mg/l	mg/l
Total Ammonia (as N)	50%ile	0.03	38361.6	1.03	25920	1.46	64281.6	0.065	4.18	3.15	0.12	0.02
Conductivity	50%ile	637.86	38361.6	24469.22	25920	71434.78	64281.6	2500	160704.00	136234.78	5255.97	334.00
Manganese Mn	50%ile	0.06	38361.6	2.22	25920	-0.31	64281.6	0.05	3.21	0.99	0.04	
Chloride Cl	50%ile	17.97	38361.6	689.41	25920	8900.99	64281.6	250	16070.40	15380.99	593.40	11.51
Nitrate (as N) NO3	50%ile	1.14	38361.6	43.75	25920	9546.65	64281.6	250	16070.40	16026.65	618.31	0.04
Nitrite (as N) NO2	50%ile	0.01	38361.6	0.24	25920	18.94	64281.6	0.5	32.14	31.90	1.23	0.004
Boron B	50%ile	0.01	38361.6	0.47	25920	37.89	64281.6	1	64.28	63.81	2.46	
Copper	50%ile	0.00	38361.6	0.05	25920	76.68	64281.6	2	128.56	128.52	4.96	
BOD5	50%ile	0.84	38361.6	32.33	25920	25.21	64281.6	1.5	96.42	64.09	2.47	
Selenium	50%ile	0.00	38361.6	0.02	25920	383.60	64281.6	10	642.82	642.80	24.80	
Orthoposhpates as P. MRP	50%ile	0.02	38361.6	0.59	25920	0.75	64281.6	0.035	2.25	1.66	0.06	

Lough Funshinagh Water Discharge			
Parameter	Site Discharge Flow	Threshold Discharge Values	
	m3/d	mg/l	kg/d
Total Ammonia (as N)	25920	0.12	3.15
Conductivity	25920	5255.97	136234.78
Sodium Na	25920	496.00	12856.32
Manganese Mn	25920	0.04	0.99
Chloride Cl	25920	593.40	15380.99
Sulphate SO4	25920	620.00	16070.40
Nitrate (as N) NO3	25920	618.31	16026.65
Nitrite (as N) NO2	25920	1.23	31.90
Boron B	25920	2.46	63.81
Chlorides (as Cl-)	25920	620.00	16070.40
Copper	25920	4.96	128.52
BOD5	25920	2.47	64.09
Iron	25920	0.50	12.86
Selenium	25920	24.80	642.80
Orthoposhpates as P. MRP	25920	0.06	1.66

RECEIVING WATERS

River Cross

Cross River Flow & Water Quality Upstream of the Discharge			
Parameter	River Flow	River Concentration	River Load
	m3/d	mg/l	kg/d
Total Ammonia (as N)	38362	0.027	1.03
Conductivity	38362	637.857	24469.22
Sodium Na	38362	0.000	0.00
Manganese Mn	38362	0.058	2.22
Chloride Cl	38362	17.971	689.41
Sulphate SO4	38362	0.000	0.00
Nitrate (as N) NO3	38362	1.140	43.75
Nitrite (as N) NO2	38362	0.006	0.24
Boron B	38362	0.012	0.47
Chlorides (as Cl-)	38362	0.000	0.00
Copper	38362	0.001	0.05
BOD5	38362	0.843	32.33
Iron	38362	0.000	0.00
Selenium	38362	0.001	0.02
Orthoposhpates as P. MRP	38362	0.015	0.59

Cross River Flow & Water Quality Downstream of the Discharge			
Parameter	Combined Flow	Prescribed D/S Concentration in the River	Maximum Load in the River
	m3/d	mg/l	kg/d
Total Ammonia (as N)	64281.6	0.065	4.18
Conductivity	64281.6	2500	160704.00
Sodium Na	64281.6	200	12856.32
Manganese Mn	64281.6	0.05	3.21
Chloride Cl	64281.6	250	16070.40
Sulphate SO4	64281.6	250	16070.40
Nitrate (as N) NO3	64281.6	250	16070.40
Nitrite (as N) NO2	64281.6	0.5	32.14
Boron B	64281.6	1	64.28
Chlorides (as Cl-)	64281.6	250	16070.40
Copper	64281.6	2	128.56
BOD5	64281.6	1.5	96.42
Iron	64281.6	0.2	12.86
Selenium	64281.6	10	642.82
Orthoposhpates as P. MRP	64281.6	0.035	2.25

WAC Assessment for CS137

River Data	
Site Name	Lough Funshinagh Interim Flood Management Measures
Receiving Waters	River Cross
River Flow Data	Upstream River Flow - 95%ile
River Categorisation	Surface Waters Intended For The Abstraction of Drinking Water
If All Surface Waters, include Classification of Ecological Status. If not, please select N/A	Moderate Status: The values of the biological quality elements for the surface water body type deviate moderately from those normally associated with the surface water body type under undisturbed conditions. The values show moderate signs of distortion resulting from human activity and are significantly more disturbed than under conditions of good status.
River Water Quality - Water Harness [mg/l CaCO3], 95%ile	339.60
River Water Quality - Water Alkalinity [mg/l CaCO3], 95%ile	376.10

Flow Data

Design Parameters	Value	Unit	Comments
Total Site Peak Instantaneous Cooling Discharge Flow	1080.0	m3/h	Based on 300 l/s pump capacity
Total Site Peak Day Cooling Discharge Volume	25920	m3/d	m3 per peak day (if pump constantly running)
Total Site Annual Cooling Discharge Volume	4730400	m3/yr	m3 per annum (assume 6 months operating)
River Flow - 95%ile	0.112	m3/s	Upstream River Flow - 95%ile Source of Information: EPA.ie
River Flow - 95%ile	9676.8	m3/d	Upstream River Flow - 95%ile

Prescribed Concentrations as per applicable Standards and Regulation

Design Parameters	Value	Unit	Comments
Temperature	Not greater than a 1.5°C rise in ambient temperature outside the mixing zone.	°C	
pH	6.5-9.5	pH Units	
Total Ammonia (as N)	0.09	mg/l	
Total Residual Chlorine	N.V.	mg/l	
Conductivity	2500	µs/cm-1 at 20 °C	
Sodium Na	200	mg/l	
Manganese Mn	0.05	mg/l	
Chloride Cl	250	mg/l	
Fluoride F	N.V.	mg/l	
Sulphate SO4	250	mg/l	
Nitrate (as N) NO3	250	mg/l	
Nitrite (as N) NO2	0.5	mg/l	
Boron B	1	mg/l	
Chlorides (as Cl-)	250	mg/l	
Copper	2	mg/l	
Suspended Solids	Acceptable to consumers and no abnormal change	mg/l	
Zinc	N.V.	mg/l	
BOD5	2.6	mg/l	
Iron	0.2	mg/l	
Selenium	10	mg/l	
Orthophosphates as P, MRP	0.075	mg/l	

te Assimilative Capacity Calculation - 95%ile River Flow

Parameter	Receiving Waters Upstream				Waste Assimilative Capacity		Receiving Waters Downstream			Discharge Standard		L. Funshinagh Water Quality
	Background Concentration - Sampled		River Flow	River Load	Site Discharge Flow (F_{DC} discharge)	River Load- Assimilative Capacity	Combined River and Discharge Flow	Threshold Value (Cmax)	Maximum Load in the River	Total Load	Maximum Site Discharge Concentration	
	mg/l		m3/d	kg/d	m3/d	kg/d	m3/d	mg/l	kg/d	kg/d	mg/l	mg/l
Ammonia (as N)	95%ile	0.04	9676.8	0.35	25920	0.52	35596.8	0.09	3.20	2.85	0.11	0.02
luctivity	95%ile	717.40	9676.8	6942.14	25920	17249.86	35596.8	2500	88992.00	82049.86	3165.50	334.00
ganese Mn	95%ile	0.08	9676.8	0.81	25920	-0.33	35596.8	0.05	1.78	0.97	0.04	
ride Cl	95%ile	28.84	9676.8	279.08	25920	2140.12	35596.8	250	8899.20	8620.12	332.57	11.51
te (as N) NO3	95%ile	1.49	9676.8	14.46	25920	2404.74	35596.8	250	8899.20	8884.74	342.78	0.04
te (as N) NO2	95%ile	0.01	9676.8	0.08	25920	4.75	35596.8	0.5	17.80	17.71	0.68	0.004
n B	95%ile	0.14	9676.8	1.33	25920	8.35	35596.8	1	35.60	34.27	1.32	
per	95%ile	0.00	9676.8	0.03	25920	19.33	35596.8	2	71.19	71.17	2.75	
5	95%ile	1.04	9676.8	10.06	25920	15.10	35596.8	2.6	92.55	82.49	3.18	
nium	95%ile	0.50	9676.8	4.84	25920	91.93	35596.8	10	355.97	351.13	13.55	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

Waste Assimilative Capacity Diagram - Flow & Loads - Appendix A. Assimilative Capacity Diagram – 95%ile Condition

Lough Funshinagh Water Discharge			
Parameter	Site Discharge Flow	Threshold Discharge Values	
	m3/d	mg/l	kg/d
Total Ammonia (as N)	25920	0.11	2.85
Conductivity	25920	3165.50	82049.86
Sodium Na	25920	274.67	7119.36
Manganese Mn	25920	0.04	0.97
Chloride Cl	25920	332.57	8620.12
Sulphate SO4	25920	343.33	8899.20
Nitrate (as N) NO3	25920	342.78	8884.74
Nitrite (as N) NO2	25920	0.68	17.71
Boron B	25920	1.32	34.27
Chlorides (as Cl-)	25920	343.33	8899.20
Copper	25920	2.75	71.17
BOD5	25920	3.18	82.49
Iron	25920	0.27	7.12
Selenium	25920	13.55	351.13
Orthoposhpates as P. MRP	25920	0.09	2.31

RECEIVING WATERS

Cross River

Cross River Flow & Water Quality Upstream of the Discharge			
Parameter	River Flow	River Concentration	River Load
	m3/d	mg/l	kg/d
Total Ammonia (as N)	9677	0.037	0.35
Conductivity	9677	717.400	6942.14
Sodium Na	9677	0.000	0.00
Manganese Mn	9677	0.084	0.81
Chloride Cl	9677	28.840	279.08
Sulphate SO4	9677	0.000	0.00
Nitrate (as N) NO3	9677	1.495	14.46
Nitrite (as N) NO2	9677	0.009	0.08
Boron B	9677	0.137	1.33
Chlorides (as Cl-)	9677	0.000	0.00
Copper	9677	0.003	0.03
BOD5	9677	1.040	10.06
Iron	9677	0.000	0.00
Selenium	9677	0.500	4.84
Orthoposhpates as P. MRP	9677	0.037	0.36

Cross River Flow & Water Quality Downstream of the Discharge			
Parameter	Combined Flow	Prescribed D/S Concentration in the River	Maximum Load in the River
	m3/d	mg/l	kg/d
Total Ammonia (as N)	35596.8	0.09	3.20
Conductivity	35596.8	2500	88992.00
Sodium Na	35596.8	200	7119.36
Manganese Mn	35596.8	0.05	1.78
Chloride Cl	35596.8	250	8899.20
Sulphate SO4	35596.8	250	8899.20
Nitrate (as N) NO3	35596.8	250	8899.20
Nitrite (as N) NO2	35596.8	0.5	17.80
Boron B	35596.8	1	35.60
Chlorides (as Cl-)	35596.8	250	8899.20
Copper	35596.8	2	71.19
BOD5	35596.8	2.6	92.55
Iron	35596.8	0.2	7.12
Selenium	35596.8	10	355.97

River Data	
Site Name	Lough Funshinagh Interim Flood Management Measures
Receiving Waters	River Cross
River Flow Data	Upstream River Flow - 50%ile
River Categorisation	Surface Waters Intended For The Abstraction of Drinking Water
If All Surface Waters, include Classification of Ecological Status. If not, please select N/A	Good Status: The values of the biological quality elements for the surface water body type show low levels of distortion resulting from human activity, but deviate only slightly from those normally associated with the surface water body type under undisturbed conditions.
River Water Quality - Water Hardness [mg/l CaCO3], 50%ile	300.04
River Water Quality - Water Alkalinity [mg/l CaCO3], 50%ile	317.57

Flow Data

Design Parameters	Value	Unit	Comments
Total Site Peak Instantaneous Cooling Discharge Flow	1080.0	m3/h	Based on 300 l/s pump capacity
Total Site Peak Day Cooling Discharge Volume	25920	m3/d	m3 per peak day (if pump constantly running)
Total Site Annual Cooling Discharge Volume	4730400	m3/yr	m3 per annum (assume 6 months operating)
River Flow - 50%ile	0.444	m3/s	Upstream River Flow - 50%ile Source of Information: EPA.ie
River Flow - 50%ile	38361.6	m3/d	Upstream River Flow - 50%ile

Prescribed Concentrations as per applicable Standards and Regulation [Adjust the water quality parameters of interest as appropriate]

Design Parameters	Value	Unit	Comments
Temperature	Not greater than a 1.5°C rise in ambient temperature outside the mixing zone.	°C	
pH	6.5-9.5	pH Units	
Total Ammonia (as N)	0.065	mg/l	
Total Residual Chlorine	N.V.	mg/l	
Conductivity	2500	µs/cm-1 at 20 °C	
Sodium Na	200	mg/l	
Manganese Mn	0.05	mg/l	
Chloride Cl	250	mg/l	
Fluoride F	N.V.	mg/l	
Sulphate SO4	250	mg/l	
Nitrate (as N) NO3	250	mg/l	
Nitrite (as N) NO2	0.5	mg/l	
Boron B	1	mg/l	
Chlorides (as Cl-)	250	mg/l	
Copper	2	mg/l	
Suspended Solids	Acceptable to consumers and no abnormal change	mg/l	
Zinc	N.V.	mg/l	
BOD5	1.5	mg/l	
Iron	0.2	mg/l	
Selenium	10	mg/l	
Orthoposhpates as P. MRP	0.035	mg/l	

Waste Assimilative Capacity Calculation - 50%ile River Flow

Parameter	Receiving Waters Upstream				Waste Assimilative Capacity		Receiving Waters Downstream			Discharge Standard		Actual Discharge Quality from Site at Outfall CoC
	Background Concentration - Monitoring Station [Include the name of the monitoring station]		River Flow	River Load	Site Discharge Flow (F_{DC} discharge)	River Load-Assimilative Capacity	Combined River and Discharge Flow	Threshold Value (Cmax)	Maximum Load in the River	Total Load	Maximum Site Discharge Concentration	
	mg/l		m3/d	kg/d	m3/d	kg/d	m3/d	mg/l	kg/d	kg/d	mg/l	mg/l
Total Ammonia (as N)	50%ile	0.03	38361.6	1.03	25920	1.46	64281.6	0.065	4.18	3.15	0.12	0.02
Conductivity	50%ile	637.86	38361.6	24469.22	25920	71434.78	64281.6	2500	160704.00	136234.78	5255.97	334.00
Manganese Mn	50%ile	0.06	38361.6	2.22	25920	-0.31	64281.6	0.05	3.21	0.99	0.04	
Chloride Cl	50%ile	17.97	38361.6	689.41	25920	8900.99	64281.6	250	16070.40	15380.99	593.40	11.51
Nitrate (as N) NO3	50%ile	1.14	38361.6	43.75	25920	9546.65	64281.6	250	16070.40	16026.65	618.31	0.04
Nitrite (as N) NO2	50%ile	0.01	38361.6	0.24	25920	18.94	64281.6	0.5	32.14	31.90	1.23	0.004
Boron B	50%ile	0.01	38361.6	0.47	25920	37.89	64281.6	1	64.28	63.81	2.46	
Copper	50%ile	0.00	38361.6	0.05	25920	76.68	64281.6	2	128.56	128.52	4.96	
BOD5	50%ile	0.84	38361.6	32.33	25920	25.21	64281.6	1.5	96.42	64.09	2.47	
Selenium	50%ile	0.50	38361.6	19.18	25920	364.44	64281.6	10	642.82	623.64	24.06	

Lough Funshinagh Water Discharge			
Parameter	Site Discharge Flow	Threshold Discharge Values	
	m3/d	mg/l	kg/d
Ammonia (as N)	25920	0.12	3.15
Conductivity	25920	5255.97	136234.78
Sodium Na	25920	496.00	12856.32
anganese Mn	25920	0.04	0.99
Chloride Cl	25920	593.40	15380.99
ulphate SO4	25920	620.00	16070.40
rate (as N) NO3	25920	618.31	16026.65
rite (as N) NO2	25920	1.23	31.90
Boron B	25920	2.46	63.81
lorides (as Cl-)	25920	620.00	16070.40
Copper	25920	4.96	128.52
BOD5	25920	2.47	64.09
Iron	25920	0.50	12.86
Selenium	25920	24.06	623.64
shpates as P. MRP	25920	0.06	1.66

RECEIVING WATERS

River Cross

Cross River Flow & Water Quality Upstream of the Discharge			
Parameter	River Flow	River Concentration	River Load
	m3/d	mg/l	kg/d
Total Ammonia (as N)	38362	0.027	1.03
Conductivity	38362	637.857	24469.22
Sodium Na	38362	0.000	0.00
Manganese Mn	38362	0.058	2.22
Chloride Cl	38362	17.971	689.41
Sulphate SO4	38362	0.000	0.00
Nitrate (as N) NO3	38362	1.140	43.75
Nitrite (as N) NO2	38362	0.006	0.24
Boron B	38362	0.012	0.47
Chlorides (as Cl-)	38362	0.000	0.00
Copper	38362	0.001	0.05
BOD5	38362	0.843	32.33
Iron	38362	0.000	0.00
Selenium	38362	0.500	19.18
Orthoposhpates as P. MRP	38362	0.015	0.59

Cross River Flow & Water Quality Downstream of the Discharge			
Parameter	Combined Flow	Prescribed D/S Concentration in the River	Maximum Load in the River
	m3/d	mg/l	kg/d
Total Ammonia (as N)	64281.6	0.065	4.18
Conductivity	64281.6	2500	160704.00
Sodium Na	64281.6	200	12856.32
Manganese Mn	64281.6	0.05	3.21
Chloride Cl	64281.6	250	16070.40
Sulphate SO4	64281.6	250	16070.40
Nitrate (as N) NO3	64281.6	250	16070.40
Nitrite (as N) NO2	64281.6	0.5	32.14
Boron B	64281.6	1	64.28
Chlorides (as Cl-)	64281.6	250	16070.40
Copper	64281.6	2	128.56
BOD5	64281.6	1.5	96.42
Iron	64281.6	0.2	12.86
Selenium	64281.6	10	642.82
Orthoposhpates as P. MRP	64281.6	0.035	2.25