National Barrier Programme Annual Report

2023

IFI/2024/1-4708

An Roinn Tithíochta, Pleanála agus Rialtais Áitiúil
Department of Housing, Planning and Local Government

NATIONAL BARRIERS PROGRAMME

Iascach Intíre Éireann
Inland Fisheries Ireland

fisheriesireland.ie

National Barriers Programme Annual Report 2023

IFI Report Number: IFI/2024/1-4708

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Executive Summary

Utilising the IFI Barrier Assessment and Screening Tool (I-BAST) 45.8% of the 73,382 "potential" barriers to fish passage identified in the Irish River network has been assessed. As of Spring 2024, 33,585 structures have been assessed and 7,822 barriers to fish passage have been identified.

The NBP has completed 255 large barrier assessments on major rivers and has delivered reports detailing fish passage issues at the barrier complexes on the River Boyne and Liffey. It has also produced fish passage documentation on IFI fish counters. 14 other structures of interest were assessed and reports produced to highlight fish passage requirement to the planning authorities, representing a primary step in potential barrier mitigation programmes undertaken, or supported, by Inland Fisheries Ireland.

The NBP is undertaking experimental programmes to quantify the effect of weirs and weir complexes on river habitat, flows and water temperature in the Boyne catchment. Synergistically, in conjunction with other IFI research programmes the NBP is investigation the effects of flow alterations, through abstraction and hydropeaking on the Liffey, Vartry and Dodder Catchments. In the pretext of investigating potential environmental flow recommendations.

Interrogation of the National Inventory of Architectural Heritages (NIAH) online database, has identified 572 structures as barriers to fish passage. Indicating a possible conflict between built and natural heritage. The mitigation of a culvert (bridge, viaduct, aqueduct) to improve fish passage may not directly impact on the built heritage. However the mitigation of a Weir, may result in the removal, partial removal or substantial reconstruction of the structure to improve fish passage and recover impounded upstream habitat. This may lead to conflict with other Prescribed Bodies and effect the timely completion of mitigation works. Addressing the potential conflict of built and natural heritage, at departmental level may mediate this conflict and lead to a road map of direct action. This process should be underlined by the EU Commission Biodiversity Strategy 2030 which has underlined the critical importance of river network connectivity, calling for greater efforts to restore freshwater ecosystems and the natural functions of rivers.

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Introduction

Inland Fisheries Ireland (IFI), the state agency responsible for the protection, management, and conservation of Ireland's inland fisheries and sea angling resources. Ireland has over 74,000 kilometres of rivers and streams and 128,000 hectares of lakes, all of which fall under the jurisdiction of IFI.

The EU Water Framework Directive (WFD) views water quality in an all-round sense of ecological quality and uses several elements to assess 'water quality' in each water body. These elements include the fish and invertebrate community and how these communities may differ from natural conditions. Another important quality element in the WFD is that of 'hydromorphology'. This term incorporates the quantity of water (hydrology) and the quality of the physical habitat (morphology and ecology). Another component of hydromorphology is that of 'continuity' i.e., the flow of water (fluvial geomorphology) is undisturbed by obstructions or barriers, allowing both fish and other wildlife to pass both upstream and downstream and allowing normal downstream transport of sediment.

Migratory species such as Atlantic salmon, sea trout, sea lamprey, river lamprey, twaite and allis shad, and European eel all make long migratory journeys to reproduce. However, a range of other fish, such as pike, brown trout, and bream, live entirely in fresh water but also make extended feeding or spawning migrations within this habitat. Any restrictions to fish migrations may have negative consequences for their reproductive and feeding capacity and could lead to decline in population. Fish movements and migrations can be affected by different man-made structures in rivers. These structures may include bridge floors, culverts, sluices, dams and weirs. Fish require freedom of movement to feed, grow, find shelter, and reproduce effectively. Barriers can have negative impacts on reproduction and somatic growth by creating physical, hydrological, and behavioural restrictions to these natural migrations.

To facilitate fish passage at artificial barriers, a range of applied techniques have been developed (e.g. barrier removal, bypass channel, fish ladders, lifts). However, historically attention was focussed on relatively few species, driven primarily by their economic, recreational, and cultural importance. As a result, the majority of fish passage research and mitigation measures have concentrated on upstream migrating adult salmonids. Despite this bias, current WFD and Habitats Directive legislation has led to advanced progress in the development of fish passage and screening criteria for multiple species throughout their life-histories including other threatened, but weak swimming species such as European eel and lamprey species.

A typical run-of-the-river weir affects river habitat and continuity for both biota and sediment. One important effect is the reduction of flow velocity, which directly changes sediment composition, bed structure and water residence times. In simplistic terms, modifying lotic (moving water) habitat to lentic (static water) habitat. Benthic invertebrates are highly sensitive to impact by those alterations, but fish are also significantly affected, by a reduction in habitats (Spawning, nursery), migration barriers or changes to thermal regimes. Plant communities (macrophytes) can also be severely impacted as reductions in flow velocity causes changes in abundance and occurrence of species with different growth forms and habitat requirements.

The impact of hydromorphology as a key pressure under the Water Framework and Habitat Directives has led to added impetus to address such issues in the current cycle of the WFD. The Department of Housing, Local Government, and Heritage invited IFI to undertake a series of investigations in regard to barrier issues and to develop plans and protocols for WFD cycle 3 implementations.

This programme aims to deliver an inventory of barriers structures on Irish rivers supported by applied studies that will inform best practice approaches to barrier mitigation. This will make a significant contribution to the programme of measures included in the 3rd cycle of the river basin management plan (2021-2025) and provide critical information for the 4th cycle of the river basin management plans.

1. Further integration and evolution of barrier assessment tools into the streamlined approach that has been developed in the National Barrier Programme.

SNIFFER Survey

The NBP Team digitised the WFD111 (2a) – SNIFFER Survey to ESRI Survey123 to evaluate impediments to fish migration. Presently, over 233 records have been seamlessly integrated into the geodatabase. This linkage to an ESRI Geodatabase is vital, as it streamlines the management, analysis, and visualization of spatial data, thereby empowering informed decision-making and optimizing workflow efficiency.

After developing this survey, it became evident that the extensive calculations required for its operation necessitated additional development to enhance efficiency and speed. Consequently, a workspace was configured using FME (Feature Manipulation Engine) to automate the processing of Section 6 of the survey, facilitating the generation of final assessment scores. This automated process not only expedites the survey but also ensures seamless uploading of the Geodatabase to AGOL.

Building on this achievement, future iterations of the survey updates will aim to centralize all calculations within FME, thereby optimizing the performance of the SNIFFER survey. This enhancement will not only streamline field data collection but also expedite result processing, allowing for swift uploading to AGOL upon returning to the office.

Redd Count Survey

The Redd Count Survey, developed by the NBP and Habitats Directive monitoring team using ESRI's Survey123, serves as a vital tool for both research and operational purposes at Inland Fisheries Ireland. It aids in locating and visualizing spawning sites for various fish species including Salmon, Brown Trout, Sea Trout, Salmonids, Brook Lamprey, River Lamprey, and Sea Lamprey. Additionally, the survey allows for recording potential sightings and approximate counts, particularly in cases where precise enumeration proves challenging. This survey holds immense value for the NBP team, as it underscores the significant impact of long-term barrier mitigation on fish migration patterns. Presently, over 121 records have been seamlessly integrated into the newly created geodatabase.

The Redd count survey data will be visualised utilising an ESRI dashboard. This will allow real time visualization of field data and a means to quickly report on and export field data. Training has been provided by the Habitats Directive Team to IFI staff around Ireland who carry out redd counts. In future an inventory of active salmon and lamprey spawning rivers and tributaries will be available, through the IFI Data Portal.

Completed Works Survey

Another survey devised by the NBP team in collaboration with the OPW EDMRP team is the Completed Works Survey, crafted through the ESRI Survey123 application. Its primary aim is to catalogue all modifications, interventions or river restoration actions conducted within rivers and Irish waterways including conservation measures such as fencing, tree planting, installation of wood into rivers along with barrier mitigation measures . This survey serves as a crucial tool in identifying river reaches and structures that have undergone mitigation, facilitating subsequent assessments by the NBP team to comprehensively evaluate the impact of related works on fish migration both upstream and downstream. This tool will also facilitate the reporting requirements under Article 17 of the Habitats Directive. Data collected through this applications will be made available through an interactive dashboard.

Reporting using ESRI Products

In 2022, the NBP team generated a dataset that has been made accessible through IFI's Open Data Portal. It exclusively contains information on structures evaluated by the NBP team, encompassing over 33,582 records of surveyed barriers (as depicted in Figure 1). The availability of this data on the open platform facilitates both public and external users in understanding the impact of river structures on fish passage in Ireland's rivers. As of 2023, this dataset undergoes monthly updates facilitated by FME, automating the extraction of all points assessed by the NBP team. Moreover, this openly available dataset has spurred the creation of various applications, dashboards, and story maps, enhancing accessibility for reporting and visualization purposes.

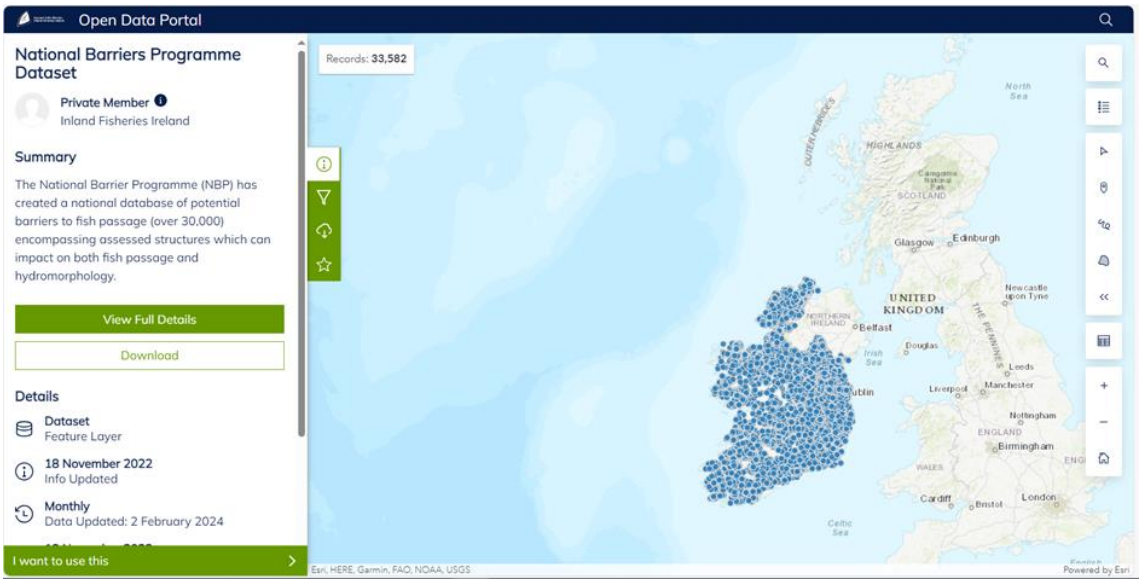

Figure 1. NBP Dataset, housed on the IFI Open Data portal. Data on all assessed instream structures.

NBP Dashboards

This year, the NBP team enhanced the NBP Dashboards, which are utilized for showcasing information related to the Potential Barrier Geodatabase. Leveraging ESRI Dashboards, these tools offer robust capabilities for real-time visualization and presentation of spatial data, empowering stakeholders with interactive displays that enhance decision-making processes. Specifically, two dashboards were developed: one tailored for the open data hub, providing real-time updates to publicly accessible data (Figure 2), and another designed for internal use, focusing on aspects such as the assessment of potential barriers that are yet to be evaluated (Figure 3) and providing barrier data to all staff at an organisational level.

Figure 2. NBP's publicly assessable (data hub) dashboard, giving data on all assessed instream structures

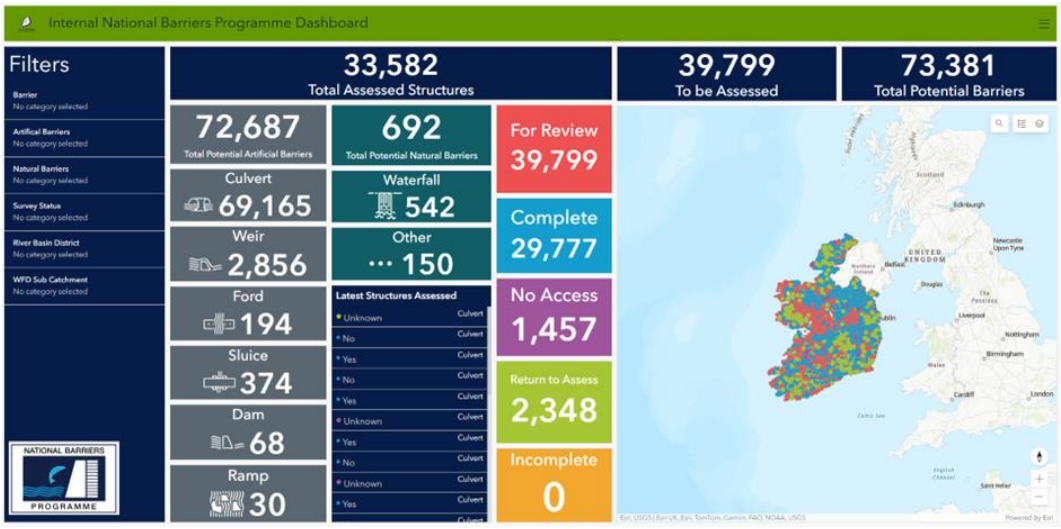

Figure 3. NBP's Internal Dashboard, created to disseminate all available data to IFI fisheries managers at a regional and local level.

NBP Application

The NBP also utilizes ESRI Experience Builder. This platform enables the NBP team to showcase and report on collected data. Created specifically to display barrier and IFI data interactively to the public, this application empowers users to craft immersive, interactive, and customized experiences, integrating spatial data for enhanced user engagement and informed decision-making (Figure 4). Differing from the data portal, the experience builder platform allows users to filter, sort and rank selected data allowing for greater data interrogation and visualisation. In comparison, the open data portal is an archival process where users can download data for further analysis.

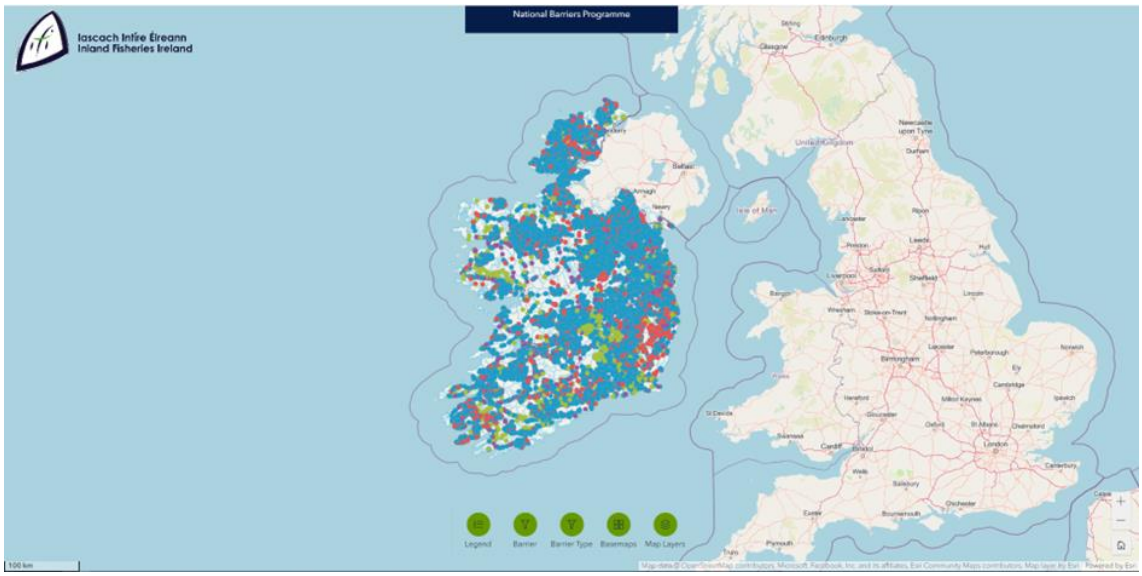

Figure 4. NBP database information shown utilising ESRI experience builder. Facilitating the use of collected data for enhanced user engagement and informed decision-making

2. A comprehensive programme of barrier surveys, risk assessments, applied research of barrier impacts/mitigation effectiveness and reporting in line with available resources.

I-BAST

A level I assessment tool that was developed by the NBP team to identify and appraise instream barriers to Irish river connectivity. The IFI Barrier Assessment and Screening Tool (I-BAST) is a standardised method of recording the dimensions, distribution, and degree of impact to fish passage of instream structures such as bridges, culverts, fords, and weirs.

There are currently 73,382 "potential barriers" in the Republic of Ireland. As of January 12th 2024, the total number of structures assessed was 33,585 (45.8%). This leaves 39,797 potential barriers (54.2%) outstanding for appraisal (Figure 5). Of these outstanding structures, 2,350 have been preliminarily surveyed, identified as barriers, and marked as Return to Assess sites.

As of December 2023, IFI Operations in conjunction with the NBP team have assessed >75% of potential barriers in 181 of the 583 WFD sub-catchments in the Republic of Ireland, ranging across all seven River Basin Districts (Figure 6). More than 25% barrier assessment coverage exists in 247 sub-catchments. From the 20th June to the 20th October 2023, the NBP team conducted 1,578 IBAST assessments, totalling approximately 39 per day (Table 1).

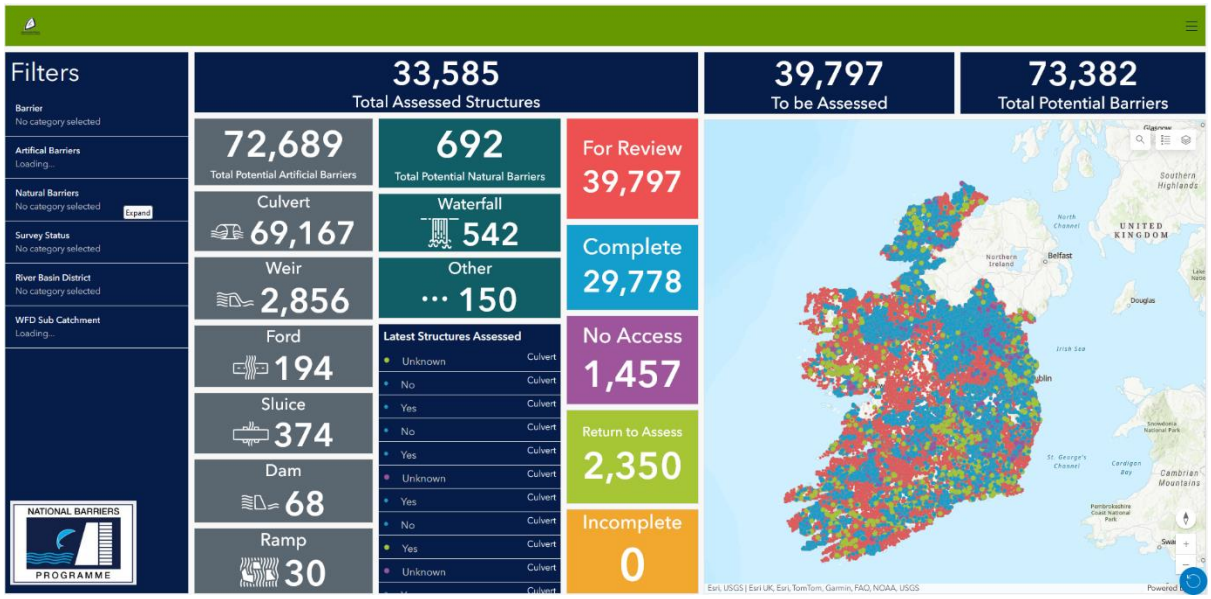

Figure 5. NBP Internal Dashboard showing national barrier assessment status January 12th 2024

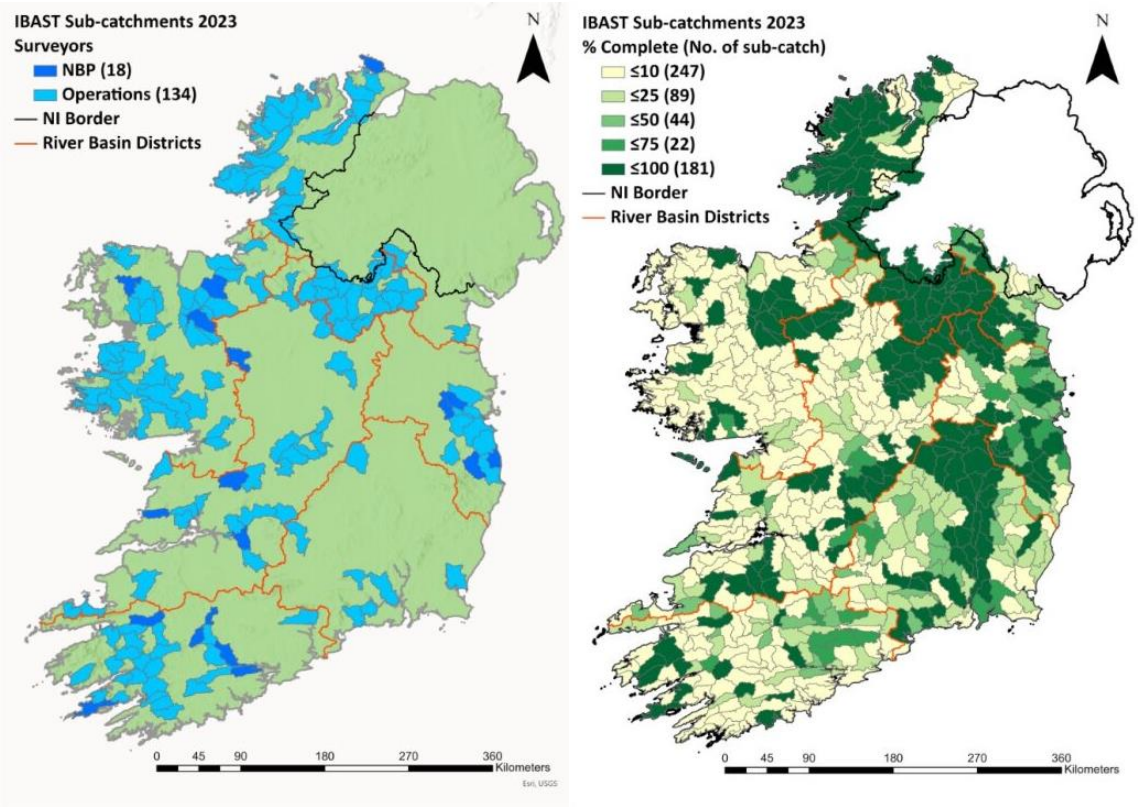

Figure 6. Left: WFD sub-catchments surveyed with the I-BAST application by the NBP team (dark blue) and IFI Operations (light blue) in 2023. Right: Percentage of potential barriers assessed within each WFD sub-catchment as of 20/11/2023.

Table 1. The number of potential barriers assessed by the NBP team from the 20th June 2023 to the 20th October 2023, encompasing 18 WFD sub-catchments.

Column1	RBD	County	Sub-catchment	No. Barriers Assessed
1	ERBD	CO. KILDARE/MEATH	Liffey_SC_080	28
2	ERBD	CO. MEATH/DUBLIN	Tolka_SC_010	39
3	ERBD	CO. WICKLOW	Avonmore_SC_010	28
4	ERBD	CO. WICKLOW	NEWCASTLE[WICKLOW]_SC_010	52
5	NWRBD	CO. DONEGAL	Malin[Stream]_SC_010	109
6	ShRBD	CO. CLARE	Annageeragh_SC_010	59
7	ShRBD	CO. CLARE	Graney[Shannon]_SC_020	125
8	ShRBD	CO. LIMERICK	Shannon[Lower]_SC_090	178
9	ShRBD	CO. ROSCOMMON/GALWAY	Suck_SC_020	87
10	SWRBD	CO. CORK	Blackwater[Munster]_SC_050	16
11	SWRBD	CO. CORK	Blackwater[Munster]_SC_060	22
12	SWRBD	CO. CORK	FANAHY_SC_010	194
13	SWRBD	CO. CORK	Glasheen[Corkcity]_SC_010	2
14	SWRBD	CO. CORK	Lee[Cork]_SC_060	108
15	SWRBD	CO. KERRY	Maine_SC_020	131
16	WRBD	CO. MAYO	Moy_SC_050	187
17	WRBD	CO. MAYO	Owenmore[Mayo]_SC_020	52
18	WRBD	CO. SLIGO	Moy_SC_010	161
Total				**1578**

SNIFFER Surveys

To date, 255 SNIFFER surveys have been conducted in seven River Basin Districts (Figure 7). A small portion of these surveys were repeat assessments, such as at Annacotty Weir, Limerick. 16 SNIFFER surveys were conducted in 2023, less than 2022 (35), this was due to high water levels from mid-summer. Elevated water levels prevent the safe assessment of large main stem weir structures and this caused the cancellation of SNIFFER assessments on the Lennon, Shannon and Nore.

Important structures assessed in 2023 are shown in Figure 8, being Fermoy Weir, Munster Blackwater, the Old Water Works Weir, River Lee and Clarendon Lock, Boyle River on the Upper Shannon.

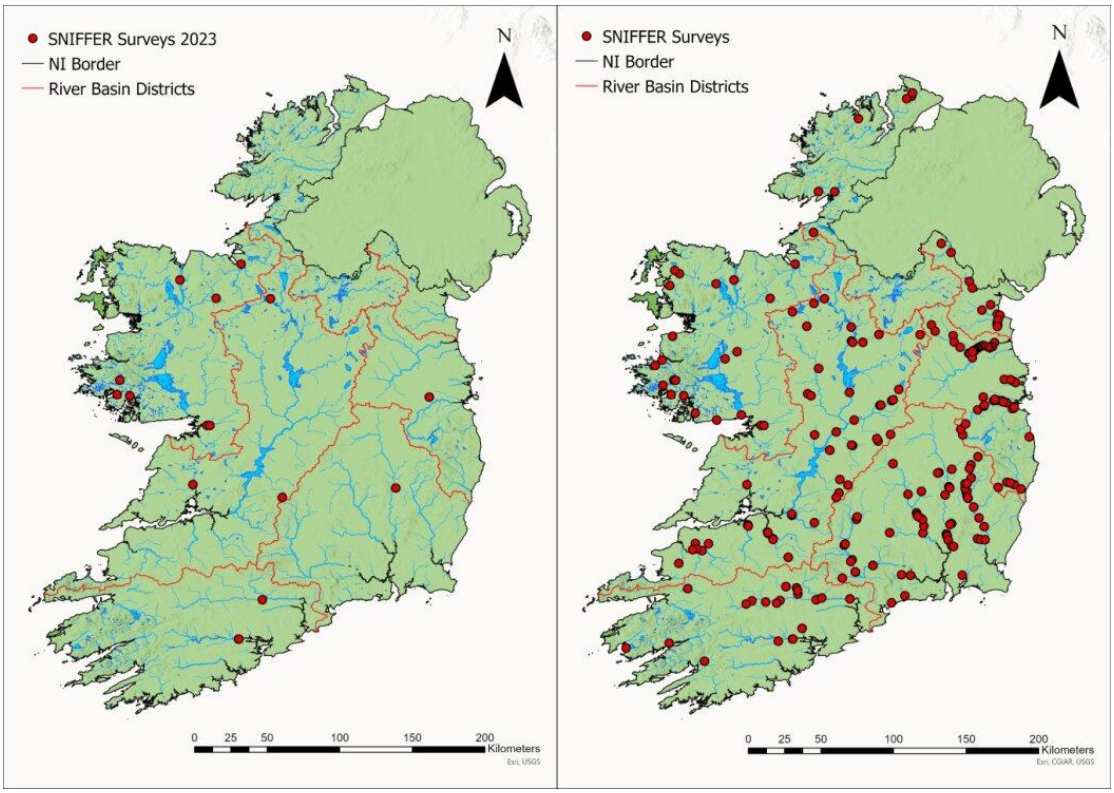

Figure 7. Left: The locations of the 16 SNIFFER surveys conducted in 2022. Right: All 255 SNIFFER surveys conducted to date.

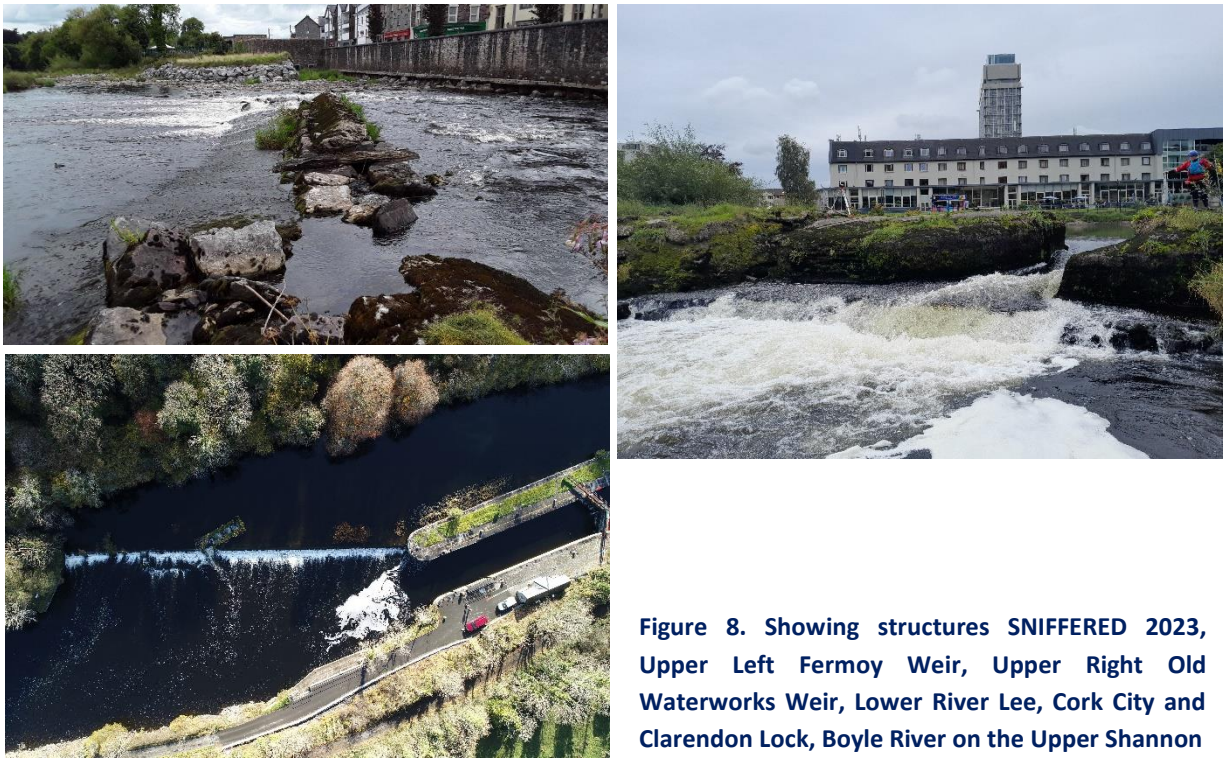

Figure 8. Showing structures SNIFFERED 2023, Upper Left Fermoy Weir, Upper Right Old Waterworks Weir, Lower River Lee, Cork City and Clarendon Lock, Boyle River on the Upper Shannon

Fish Counter SNIFFERS

The NBP completed the assessment of fish counters in 2023. Fish counters are operated by IFI, the Marine Institute (Trap System), the ESB in partnership with IFI, IFI in partnership with fishery owners and in several cases the Fishery owner maintain a private fish counter (Figure 9).

IFI operate two types of fish counters. The most versatile and robust is the Logie resistivity counter which can be operated in two configurations: a fibreglass tube or on a crump weir (Figure 10). Inland Fisheries Ireland have integrated camera software with these resistivity counters to enable it to verify each fish with video footage as it's counted. The second counter type is a VAKI Riverwatcher which is an optical counter using infra-red scanners. The Vaki Riverwatcher is used where the fish are required to swim through a narrow opening. This optical counter works extremely well where a fish pass or ladder exists or where a trapping facility is in place.

The majority of the fish counters are Logie resistivity (31) counters and there are a number of Vaki counters (12). In total 32 of 43 fish counters have been assessed. Counters in ESB dams and fish traps have not been assessed due to health and safety reasons. In a number of instances historic weirs have been replaced (Bandon) and in other circumstances the fish counter has been decommissioned due to operational reasons.

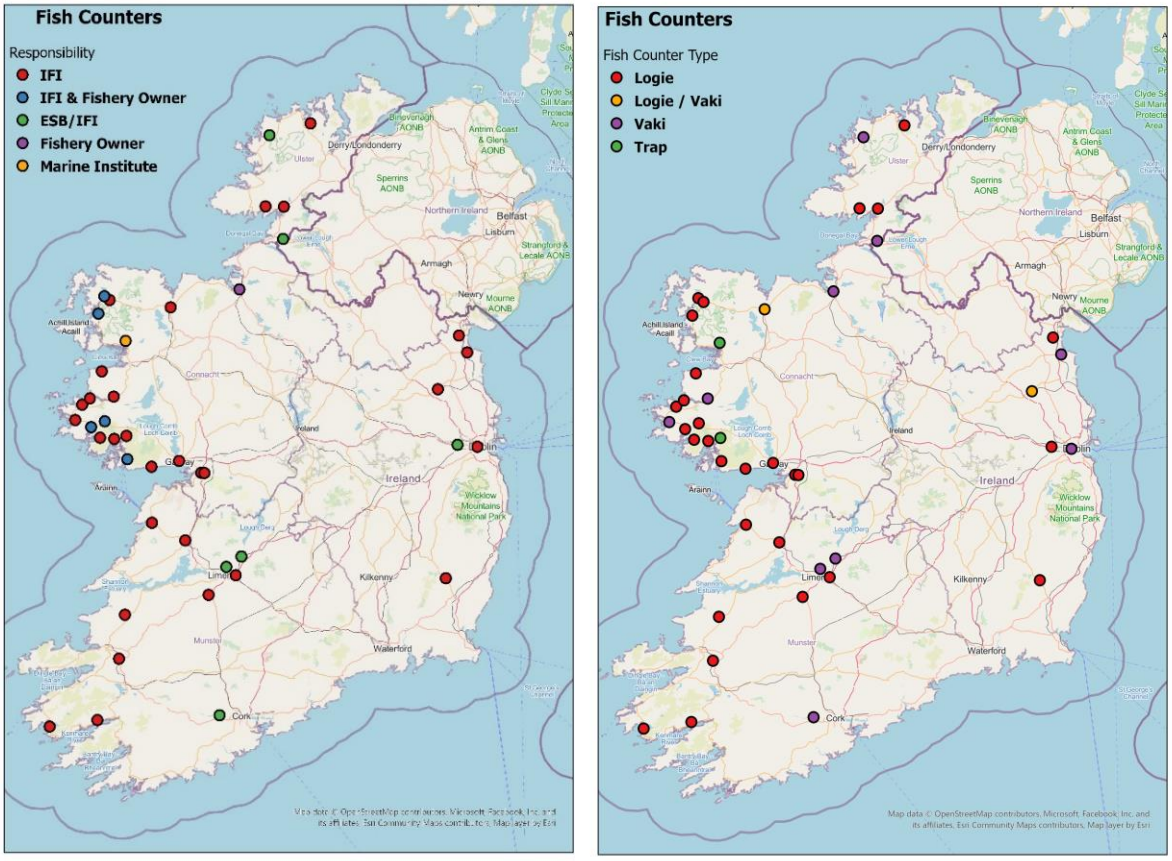

Figure 9. Left: The location and operator of Fish counters in Irish Rivers. Right: fish counter types in the Irish River Network.

Figure 10. Logie resistivity fish counters Left: Bunowen River, Right Owenduff (Bangor)

Table 2. Percentage breakdown of SNIFFER fish passage results from the 32 assessed fish counters.

Species	Impact on Upstream migration			
	Complete Barrier	High Impact	Low Impact	No Barrier
Adult Salmon	53%	41%	3%	3%
Adult Trout	34%	53%	9%	3%
Juvenile Salmonids	44%	47%	6%	3%
Lamprey *Sp.*	78%	19%	0%	3%
Cyprinids/ Pike	69%	28%	0%	3%

Assessing the impact of fish counters on the upstream migration of adult and juvenile salmonids, Lamprey *sp.* and Cyprinids/Pike (Table 2). In low summer flows 53% of the fish counters are a complete barrier to Adult salmon and 78% are a complete barrier to Lamprey *sp.*

In low summer flows the shallow water depths on the face of the crump weirs on which the Logie resistivity (31) counters are mounted goes some way to explain the passage difference between Adult salmon and Adult trout. Water depths below 0.07 m are considered a complete barrier to adult salmon, water depths below 0.05 m are considered a complete barrier to adult trout. The slope (>20%) and water velocities (>1.5 m/sec) on the face of the Logie resistivity crump weirs are the restricting factor for Lamprey *Sp.* passage at these structures.

Recommendations for the improvement of fish passage at the assessed fish counters is being developed. This will most likely entail the re-engineering of the slope/depth of water on the face of Logi counters. By, increasing water depths, reducing velocity and lowering slope values fish passage efficiencies would be improved in low summer flows.

Waters of Life

The Waters of LIFE is an EU LIFE Integrated Project which aims to help reverse the deterioration of Ireland's most pristine waters. The ongoing loss of high status waters is among the most concerning, protracted and persistent water quality trend in Ireland. Other water quality trends have well-understood cause and effect, with detailed plans in place to mitigate impacts. More actions are necessary to protect pristine waters. Many of these waters are small, upland streams. The protection and restoration of these waters is one of the key underpinning principles of the Water Framework Directive. The overall objective of the Waters of LIFE IP is to support the implementation of measures to protect and enhance High-Status Waters and thus to support the work of the Blue Dot Catchments Programme.

The project hopes to demonstrate the effective implementation of an integrated catchment-based approach for the application of measures to protect and/or restore all waters for which a high-status objective has been identified in Ireland's River Basin Management Plan.

Six sub catchments have been chosen as demonstration catchments for the waters of life project (Table 3). Measures to address various pressures including hydromorphology, forestry, agriculture, wastewater and other pressures will be trialled in five of these areas, with the sixth acting as a control. With the exception of the control, these catchments have been chosen because they are at risk of failing to meet the high status objective that has been set for them under the River Basin Management Plan for Ireland 2022-2027.

The five experimental catchments in the Waters of life Programme are the Avonmore, Awbeg (Kilbrin) part of the Munster Blackwater, The Graney a Shannon tributary, The Island River a tributary of the Suck and the Shournagh River a tributary of the Lee. The sixth and control catchment is the Sheen River a tributary of the Kenmare River.

Table 3. Breakdown of barrier assessment numbers and results in the six waters of life catchments.

Catchment/ Survey Status	Outstanding	No	No Access	Yes	Yes (Return To Assess)	Grand Total
Avonmore	1	19		32	4	55
Awbeg (Kilbrin)	5	19	1	2		27
Graney		97	2	25	1	127
Islands		61		21		82
Sheen	129	3	1		1	134
Shournagh		88	4	18		110
Total	**135**	**289**	**8**	**98**	**6**	**535**

The majority of the Sheen Catchment is outstanding for assessment. This is currently being assessed by IFI regional staff, water levels permitting (Spring 2024). Output from these assessments was presented to the EPA RESTORE Project - Requirements Workshop on the 8th of December 2023 (Table 4). Outputs such as Figure 11 were presented. Highlighting structures for mitigation after a preliminary examination of the collected data.

Table 4. Breakdown of identified barriers to fish passage in the six waters of life catchments.

Catchment	Culvert	Ford	Other	Bedrock Waterfall	Sluice	Weir	Grand Total
Avonmore	27	2	1	3	1	1	35
Awbeg (kilbrin)	1					1	2
Graney	23	2		1			26
Islands	18				1	2	21
Sheen				1		1	2
Shournagh	17					1	18
Grand Total	**86**	**4**	**1**	**5**	**2**	**6**	**104**

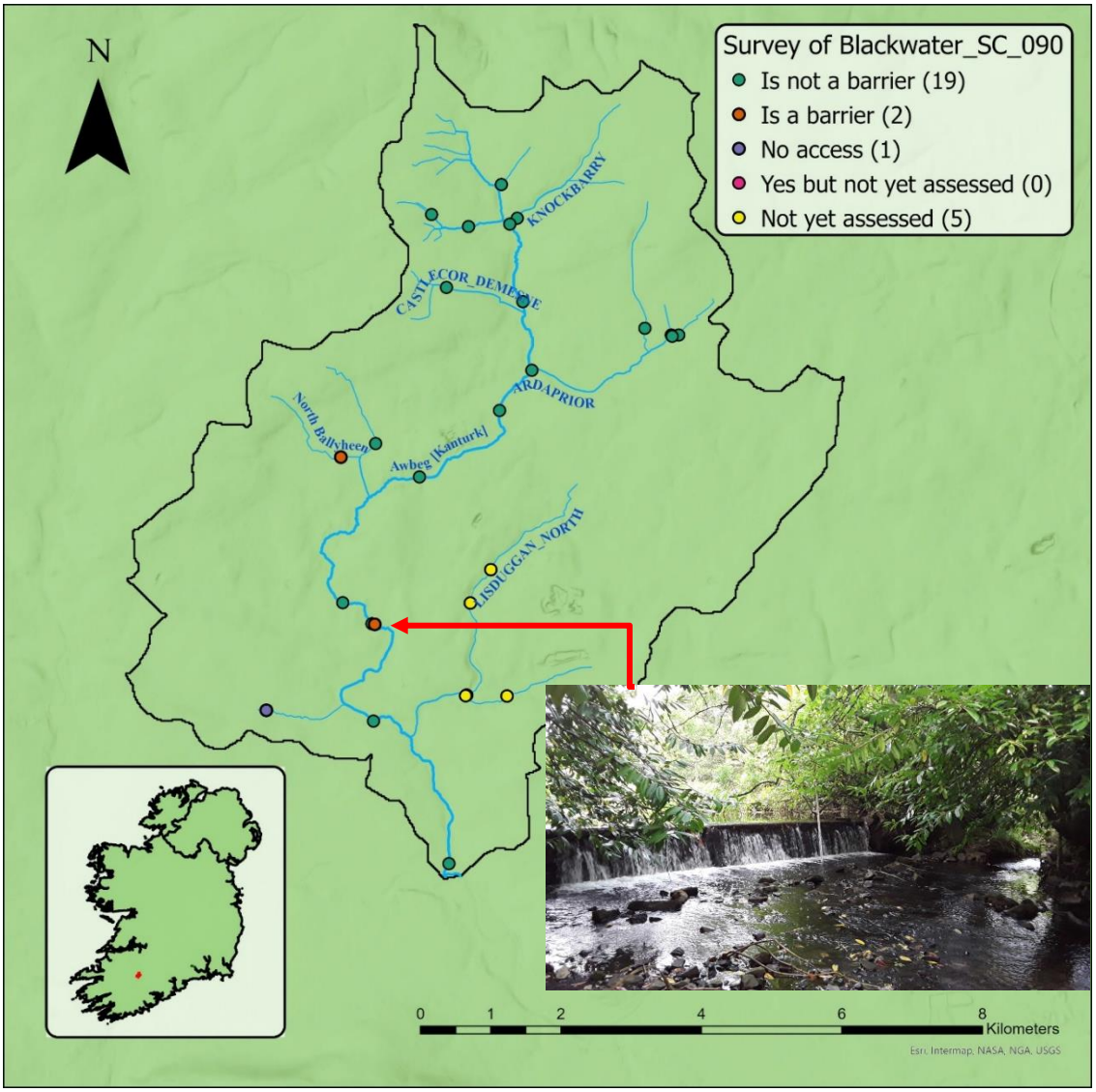

Figure 11. Map of the Awbeg (Kilbrin) Catchment presented at the EPA RESTORE Project - Requirements Workshop. Showing the location and barrier to fish passage on the main Awbeg river.

Changes to the hydromorphological characteristics of surface waters is estimated to be a significant pressure in almost 29% of high status objective waterbodies that are At Risk of not meeting their environmental objectives. It is the most prevalent significant pressure within high surface objective water bodies.

Helping to ensure continued high status under the Water framework Directive (WFD), good hydromorphology refers to the physical character of the river and includes the flow of water in the river, the course the river takes or the form and shape of the river channel. Good hydromorphological conditions support aquatic ecosystems (i.e. hydromorphological elements such as water flow and substrate provide physical habitat for biota such as fish, invertebrates and aquatic macrophytes). Removal of barriers in these high status rivers will improve the hydromorphology thereby improving resilience of the river itself and the aquatic organisms in it to natural and man-made changes. The ~103 identified barriers in the five experimental waters of life catchment will be used to trouble shoot the NBP's automated prioritisation matrix (sections 3, below). Outputs will be made available to the waters of life team.

3. Further develop a national, regional and catchment-based prioritisation matrix to identify structures for mitigation and provide documentation for funding proposals for mitigation works.

Prioritisation

Barriers associated with human infrastructure have a widespread impact in freshwater ecosystems worldwide, disrupting connectivity along river networks and key processes. Spatial optimisation methods can help inform decisions on what barriers to remove to maximise gain in connectivity under limited budgets. However, current optimisation approaches rely on programming skills that are not easily accessible, which restricts the use of these methods.

McKay *et al.,* 2020 outline there is no one way to prioritise barrier mitigation given the technical and political constraints of implementing most projects; hence we have outlined several strategies to reduce the risk of delay and failure and to mitigate enough structures to improve hydromorphology and WFD status at a catchment level. These strategies will also facilitate Irelands requirements under the EU biodiversity strategy.

Prioritization methods can be broadly grouped into six main types depending on whether they are reactive or proactive, whether they are typically applied at local or larger spatial scales, and whether they employ an informal or a formal approach. These include, in increasing order of complexity:

1. Opportunistic response
2. Use of local knowledge and expert opinion
3. Scoring and ranking index
4. Geographic information system (GIS) scenario analysis
5. Graph theory
6. Mathematical optimization.

As noted by Garcia de Leaniz and O'Hanley (2021), mathematical optimization sets the gold standard for effective and robust barrier mitigation planning. But to be implemented, it needs to factor in the constraints imposed by uncertainties and opportunities. Therefore, a hybrid approach encompassing uncertainty, natural barriers, future-proofing, and opportunities provided by local knowledge is likely to be the best overall approach. Also as highlighted by the authors, the more computationally complicated optimisation approaches are difficult to explain to stakeholders. The rationale behind the identification and targeting of a specific structure must be easily explained for general consumption, to mediate accusations of potential bias towards a specific structure.

Prioritisation for the National Barrier Mitigation Programme 2024 – 2027

To ensure a significant number of structures are mitigated during the 1st phase of the project National Barrier Mitigation Programme it was proposed to target 3 strands of action. (Barrier Mitigation Plan 2024 – 2027)

- **Strand A: Large scale structures:** This is in line with the barrier optimisation framework laid out in the National Barriers Programme 1st Cycle: Final Report 2018-21.
- **Strand B: Large and medium scale structures:** Rank the existing structures (n = 255) with SNIFFER† Reports and prioritise based on guiding principles outlined below. Proceed with structures in progress by IFI.
- **Strand C: Small scale structures:** Target small (<10m river width) structures with support from other agencies; local county councils, OPW, LAWPRO etc.

†SNIFFER reports refers to the WFD111 (2a) Coarse resolution rapid-assessment methodology to assess obstacles to fish migration, level A assessment.

The prioritisation scoring and ranking matrix laid out below will aid in highlighting structures for mitigation in strands B and C. The prioritisation matrix laid out below will leverage I-BAST assessments to identify priority barriers for mitigation.

Prioritisation Matrix

Scoring and ranking- guiding Principles

The scoring and ranking index is based on principles widely regarded as important to fish migration and current best practice. We considered the mitigation of artificial barriers a priority in catchments where:

1. The lowest (most downstream) barrier should be prioritised because these have the most immediate impact on upstream fish migration.
2. The channel length upstream of the barrier is significantly longer than the downstream length and, hence, mitigation would significantly increase the available habitat for upstream migrants.
3. The watercourse has a low level of longitudinal fragmentation (i.e., the restoration of the continuum requires a lower number of interventions).
4. Upstream habitat quality and quantity is sufficient to support migrants.
5. There is the presence of protected migratory fish species within a waterbody designated for conservation.

These guiding principles inform a filter process that is based on a list of criteria and indicators that capture the ecological key factors important to effective barrier mitigation (Catchment geography/ hydrology, connectivity, biodiversity, water quality), as well as crucial socioeconomic aspects (e.g. infrastructure, flood protection, public attitude) that need to be considered when planning for intervention (Table 5).

Table 5. Outlining catchment and barrier parameters used for rank and soft prioritisation. Items 1-6 variables calculated utilising GIS software, Item 6 onsite barrier assessment data and items 8 to 10 supporting data available from IFI data repository and other state agencies.

No	Barrier & Catchment Parameters	Description
1	Total length of available upstream habitat	Upstream channel length (km) from barrier to next barrier or sourse
2	Total length of available downstream habitat	Downstream channel length (km) from barrier to next barrier or outflow
3	Distance from sea/ outfall	The distance (km) to sea/ outfall
4	Catchments barrier density	Estimated barrier density per river km in catchment (Barrier per km)
5	Upstream barrier density	Count of known upstream structures / length of channel (Barrier per km)
6	Downstream barrier Density	Count of downstream structures (straight line to sea) / Length of channel (Barrier per km)
7	Barrier permeability	The score assigned in I-BAST / SNIFFER
8	River Quality Element	Metric: Upstream EPA "Q-Value", SAC/NHA/P. Mussel, MQI Score
9	Est. Cost of Construction	Price estimate
10	Socio Economic Status	Structure functioning (ESB, Irish Water), Protected Structure, Local importance, Technical Expert Group on Salmon (TEGOS)

The matrix utilises the inventory of existing obstacles (I-BAST, SNIFFER), river catchment spatial data, known fish species mobility, their life history requirements, and an evaluation of the ecological benefits against the general socio-economic feasibility of remediation measures. This information is collated in a geo-database at a national level. Catchments, Sub_Catchment or river basins will then be scored and ranked to produce a prioritisation rating (Scoring Sheet - Appendix 1).

Free Flowing Rivers Criteria

In December 2023 ECOSTAT held a workshop on the criteria developed for Free Flowing Rivers. This criteria explains what a free flowing river is in relation to both longitudinal and lateral connectivity ie presence of barriers to fish migration but also connection with the floodplain. The criteria takes into account the presence of embankments either on the river bank or stepped away from the river bank. It then takes into account the proportion of embankments in relation to the river reach length. The criteria also takes into account the wider catchment looking at sediment sources from upstream

to our designated reach and whether there are barriers further downstream impeding access to the areas upstream.

The criteria is designed to be used to highlight areas that can be mitigated with measures to open up free flowing rivers.

Assessments and Reports to Stakeholders

In 2023, 8 SNIFFER reports on individual or multiple structures were issued to assist in planning permission or at the request of IFI Operations. Six reports based on I-BAST assessments were also delivered. Additionally, SNIFFER catchment report, detailing the assessments of multiple structures within a river system, were issued for the River Liffey. The River Boyne is an outstanding SNIFFER catchment report requested by IFI Operations (surveys done and writeup is being prepared).

Reports produced in 2023.

SNIFFER:

- River Liffey - WFD III Barrier Assessment Obstacles to Fish Passage and Mitigation Options
- Curry Weir, Owengarve R. (Moy) SNIFFER Report
- Ballisodare Waterfall and fish pass - SNIFFER Report
- Templederry Bridge - Neanagh River – SNIFFER Report
- Ballina Salmon Weir - SNIFFER Report
- Lough Mucknow Headworks - SNIFFER Report (Uisce Éireann)
- Carondonagh Town Bridge - SNIFFER Report
- Derryclare culvert (Inagh River, Galway) – SNIFFER Report

I-BAST:

- Ward River fish passage improvement – Fingal County Council
- St. Endas Park (Owendore, Dodder Tributary) RHAT and IBAST Report – OPW / ERBD
- Drowes River and Lough Melvin I-BAST Barrier Assessment Report - NWRBD
- Owenerk Bridge - I-BAST Fish Passage Report - OPW
- Deansgrange River - Barriers to fish passage and habitat mitigation through flood relief - Dún Laoghaire-Rathdown County Council
- Owendalulleegh River - Barriers to fish passage

Information Requests:

- Clady and Crolly Potential Barrier Mitigation Works – NWRBD/ ESB

4. Provide a data led research and monitoring programme to evaluate the impact of barriers and the effectiveness of management approaches.

High Frequency Acoustic Tag Range Test – Annacotty Weir

Annacotty weir has been selected as a pilot project to assist with the design and implementation of a national barrier mitigation programme under the Basin Management Plan for Ireland 2022 – 2027. Identifying that fish passage measures at this site will have significant potential to benefit both anadromous fish and resident fish populations. The Annacotty Weir Fish Passage Project was recently successful in receiving funding through the Salmon and Sea trout Rehabilitation fund. The award fund will be used to complete the necessary environmental, engineering, and archaeological studies necessary to decide on the best fish passage improvement option. This will then be brought forward for planning to Limerick County Council.

This investigation hopes to "piggyback" on these works, allowing for a pre – post fish passage easement study at Annacotty weir. Allowing for existing weir effects on passage timing, success, mortality, and delay to be investigated in both Atlantic salmon smolts and adult sea lamprey and then following mitigation, investigate the success of works on these key variables.

To evaluate the effectiveness of mitigation works at the Annacotty Site, a high frequency acoustic telemetry study was proposed. Acoustic telemetry works by surgically inserting an acoustic tag into the fish species of interest. Acoustic tags are small sound-emitting devices that allow the detection and/or remote tracking of organisms in aquatic ecosystems. Acoustic tags are commonly used to monitor the behaviour of fish. Acoustic tag technology allows researchers to obtain locational data of tagged fish: depending on tag and receiver array configurations, researchers can receive simple presence/absence data, 2D positional data, or even 3D fish tracks in real-time with sub-meter resolutions. Acoustic Tags are paired to specific receivers which record a tags "ping", the configuration of these receivers is dependent on the deployment environment and the volume of ambient noise in that environment.

Weirs are inherently noisy both above and below the water. Leander *et al.,* (2019) quoted any ambient background noise over 21dB as being "high" in a river system, the authors did not make detections over 35dB. Therefore it was necessary to undertake a Range Test to understand how far a tags "ping" could be heard through the environment. For a positive range test at the Annacotty a tags "ping" would be heard by the receiver from a distance of >10m but not less than 5m. A low hearing distance would result in large numbers of receivers being needed in the weir pool to facilitate a large scale experiment.

RS Aqua via their parent company Innvoasea, a supplier of high frequency equipment, loaned IFI the use of 2 HF receivers in order to carry out range tests at Annacotty weir.

Annacotty Range Test:

On the day of the range test (8/3/2023), water depths through most of the site was less than 0.7 m. Water depths also shallowed out quickly to the downstream end of the weir pool (<0.4 m). There was a significant amount of white water and therefore noise at and immediately downstream of weir (Figure 12).

Two high frequency acoustic tags were attached, in a mesh bag to the RTK base station support pole at ~0.4 m from its base. Receivers were deployed, upright on the riverbed, encased in downpipe with the full cone section on the top of the receiver exposed. There were 4 receiver locations for the range test, indicated by the red dot on the "HF Range Test Location" images (Figure 13). For each receiver location (4) we had 9 to 12 Stations where tags were held stationary for ~2 minutes, including at the receivers stationary location (red dot).

Figure 12 High frequency range test Annacotty Weir 8th of March 2023. Note wite water and high turbulence downstream of weir face.

Results from the range tests (figure 13) indicated the receivers limited capacity to "hear" tag pings over any distance (>5 m). The ambient background noise detected at the 4 receiver locations was 77.2 dB (SE 0.65) and the high prevalence of air bubbles entrained into the water column (white water, figure XX), scatter the sound transmitted by tags. As indicated "pings" from acoustic tags were heard by the receiver if they were stationed in very close proximity to the receiver (<0.5 m). This is shown by the high number of pings heard as the tags where held at the receiver locations compared with other locations (23, 53, 11, 22 – figure 13).

Due to the nature of the Annacotty weir site which is confined, has shallow water depths, high noise and a high prevalence of air bubbles entrained in the water column. The bubbles entrained in the water column as the water flows over the weir are strong scatterers of sound. A large number of receivers (8+) would need to be deployed in the weir pool to adequately track fish movement and behaviour in relation to the weir. There is also the possibility of "dead" zones for detection (e.g. bottom of the denil fish pass) where noise and bubble entrained is so high as not to allow any detection. Currently this is the preferred fish passage route for adult salmonids and not being able to detect passage in this location may be a significant negative for this experimental approach.

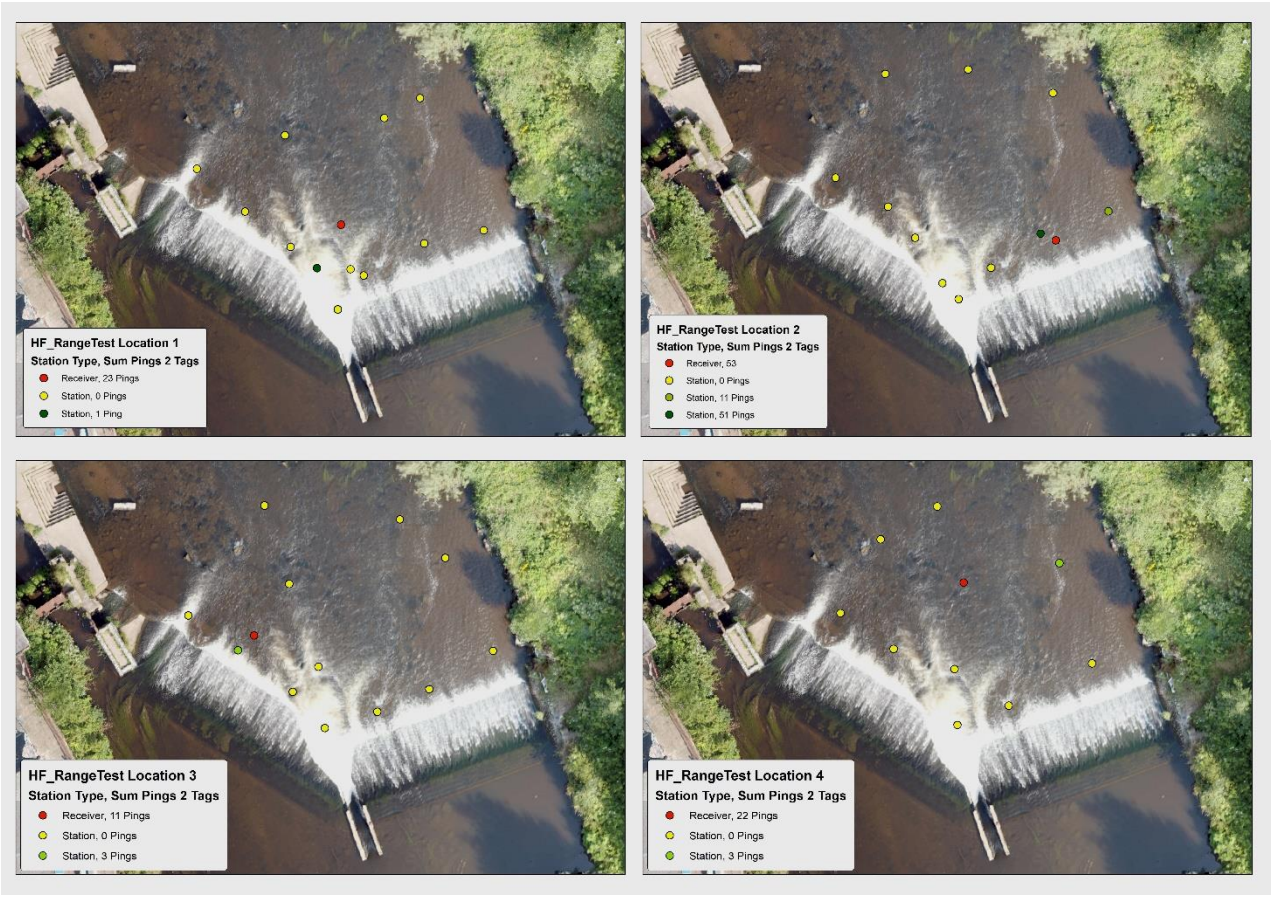

Figure 13. Results of the high frequency range test undertaken at Annacotty Weir, Spring 2023. Red dot is the location of the receiver during the 4 range tests, stations are the locations where tags where held stationary in the water for 2 minutes.

National Inventory of Architectural Heritage (NIAH) - Built and Natural heritage Conflict

The National Inventory of Architectural Heritage (NIAH) is a state initiative under the administration of the Department of Housing, Local Government and Heritage. The purpose of the NIAH is to identify, record, and evaluate the post-1700 architectural heritage of Ireland, uniformly and consistently as an aid in the protection and conservation of the built heritage. NIAH surveys provide the basis for the recommendations of the Minister for Housing, Local Government and Heritage to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS).

In 2022, a desk study was conducted to identify barriers to fish passage from the National Inventory of Architectural Heritage (NIAH) website. The goal of this desk study was to establish whether the structure would act as a barrier to fish passage by looking at over 2,632 (Table 6) records with a number of image attachments. Further desktop analysis in 2023, utilising an online image search and Google Street view facilitated the assessment of these structure for fish passage. This study identified a total of 1,973 locations/structures as not a barrier to fish migration, 572 identified as Yes a potential barrier and 87 were unidentifiable from the images provided by the NIAH website.

Table 6. Breakdown of structures assessed as barriers to fish passage from the NIAH online database

	Barrier to Fish Passage			
Structure Type	**Yes**	**No**	**Unidentifiable**	**Total**
Culvert	523	1968	86	2577
Weir	43	4	1	48
Dam	6	1	0	7
Grand Total	**572**	**1973**	**87**	**2632**

The presence of 572 structures as barriers to fish passage on the NIAH online database indicates a possible conflict between built and natural heritage. The mitigation of a culvert (bridge, viaduct, aqueduct) to improve fish passage may not directly impact on the built heritage. However the mitigation of a Weir, may result in the removal, partial removal or substantial reconstruction of the structure to improve fish passage and recover the impounded habitat upstream.

Further dialogue between the Heritage Council, DHLGH, other relevant state bodies (County Council heritage officers, An Taisce) and IFI will be necessary to educate all parties of this potential conflict point. Specifically, the impact of dams and weir in light of the WFD/ Habitats directives and the new EU restoration law with its emphasis on free flowing rivers.

An Taisce

Dam and weirs create an innate conflict between our natural and built heritage. These structures impact on the natural processes (hydromorphology) of a river system and can affect the natural migration of numerous endangered species (salmon, eels, lamprey). This brings these structures into direct conflict with the Habitats and Water Framework Directive as some significantly impactful weirs on the Irish river network are considered 'protected' built heritage.

An online meeting with An Taisce was organised to better understand this conflict. An Taisce have an advocacy role in both the natural and built environment. The discussion was based around the idea that several of our major waterways are significantly impacted by heritage structures (weirs) and an understanding that their removal would not be achievable or necessary. It was acknowledged that some of these structures have significant heritage value, recreational uses and amenity value. However, some are in a poor state of repair, with little or no community amenity value and poor fish passage. The discussion then revolved around how is it possible to mitigate fish passage and biodiversity loss while being mindful of the heritage structure.

Some points/suggestions:

- When dealing with a complex of structures (e.g. Lower Liffey) have a short list of weirs you would be looking to mitigate. Utilise this list in conjunction with the local councils heritage officer to identify structures of least importance for mitigation.

- In terms of removal of a protected structure there is a mechanism – requirement of exceptional circumstance test – this is granted from the natural monuments service.

- Identify how many weir structures are "Protected" and possibly highlight this to the department as a concern for mitigation problems.

- Host a round table workshop on weir mitigation for improving the riverscape/fish passage/biodiversity. With stakeholders who might be on the periphery, but with a built heritage view.

Fingal County Council – Options Assessment Fish Barrier Removal River Liffey

The NBP through IFI Environmental Officers engaged with Hans Visser, Fingal County Councils Biodiversity Officer to investigate the possibility of barrier mitigation on the main stem of the River Liffey downstream of Leixlip reservoir. A draft copy of the "River Liffey - WFD III Barrier Assessment Obstacles to Fish Passage and Mitigation Options" was released to Fingal county council.

Feedback from Fingal County councils Architectural conservation officer highlighted the major conflict of legislation between the EU Habitats/ EU Water framework Directives versus the Planning/ Monuments Acts. The majority of weirs on the lower Liffey are on Fingal County Councils record of protected structures. IFI's preferred option for barrier mitigation is removal, however in feedback it was outlined that the preferred option would not be acceptable for the majority of the structures. That barrier breaching would also raise concerns and would need clarification as to the extent and exact nature of this option.

The concern is that fish passage on large historic main stem weirs is poor for all non-salmonids and retaining the current Status quo is incompatible with Ecological Quality Ratings and river connectivity targets relating to the WFD and EU Biodiversity targets.

Low Head Barrier Temperature Study – River Boyne

A temperature study was devised by the NBP to quantify the impacts of thermal disruption by low head artificial instream structures. Instream structures have the potential to create not just physical barriers, but also thermal environments inhospitable to native fish populations. Temperature is an important ecological variable that impacts the reproduction, feeding, growth, and migration of aquatic biota. Thermal thresholds exist for native species that have the potential to be exceeded in barrier-impacted river reaches. The ramifications of barriers for thermal regimes in Irish rivers are currently poorly understood, despite the prevalence of instream structures. The results of this study will help to inform effective barrier mitigation and are especially relevant for mitigation designs in the context of climate change.

Figure 14. Left: Dunmoe Weir. Right: Stackallen Weir.

The 2022 pilot study was developed into a more comprehensive 2023 programme that sought to investigate the cumulative thermal load that river systems with multiple sequential barriers are subjected to. Sixteen temperature probes were installed at locations in the Boyne, Rye Water, and Liffey rivers in June 2023 (Figure 15). The pilot study locations of Dunmoe, Stackallan, and Ballinter were included as repeat sites. Due to high water levels, only seven of the 16 probes had data retrieved in October 2023. All 16 probes remain in-situ. The Straffan, Leixlip Bridge, And Wren's Nest loggers were installed downstream of impoundments.

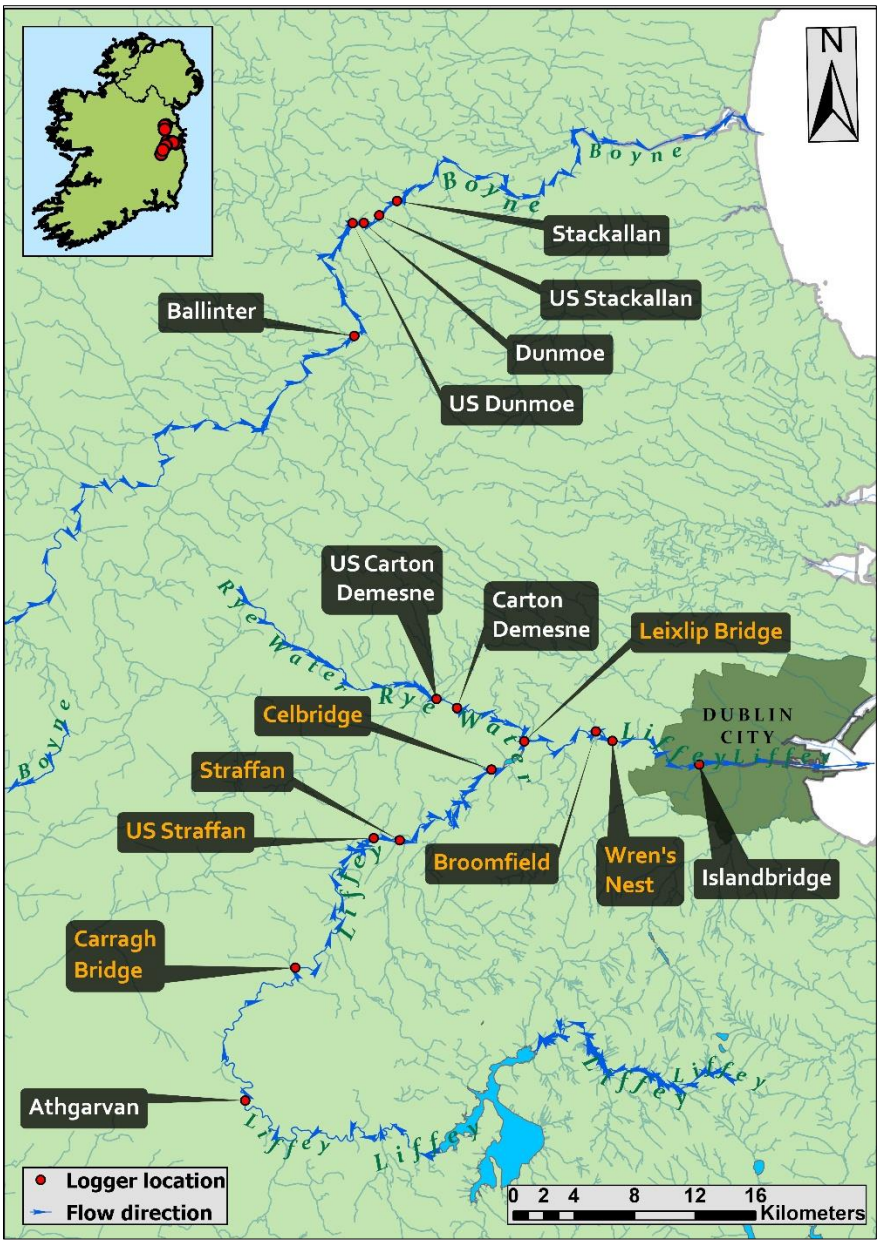

Figure 15. The locations of temperature loggers on the River Boyne, Rye Water, and Liffey (US=upstream). The seven loggers that data was retrieved from are labelled in orange.

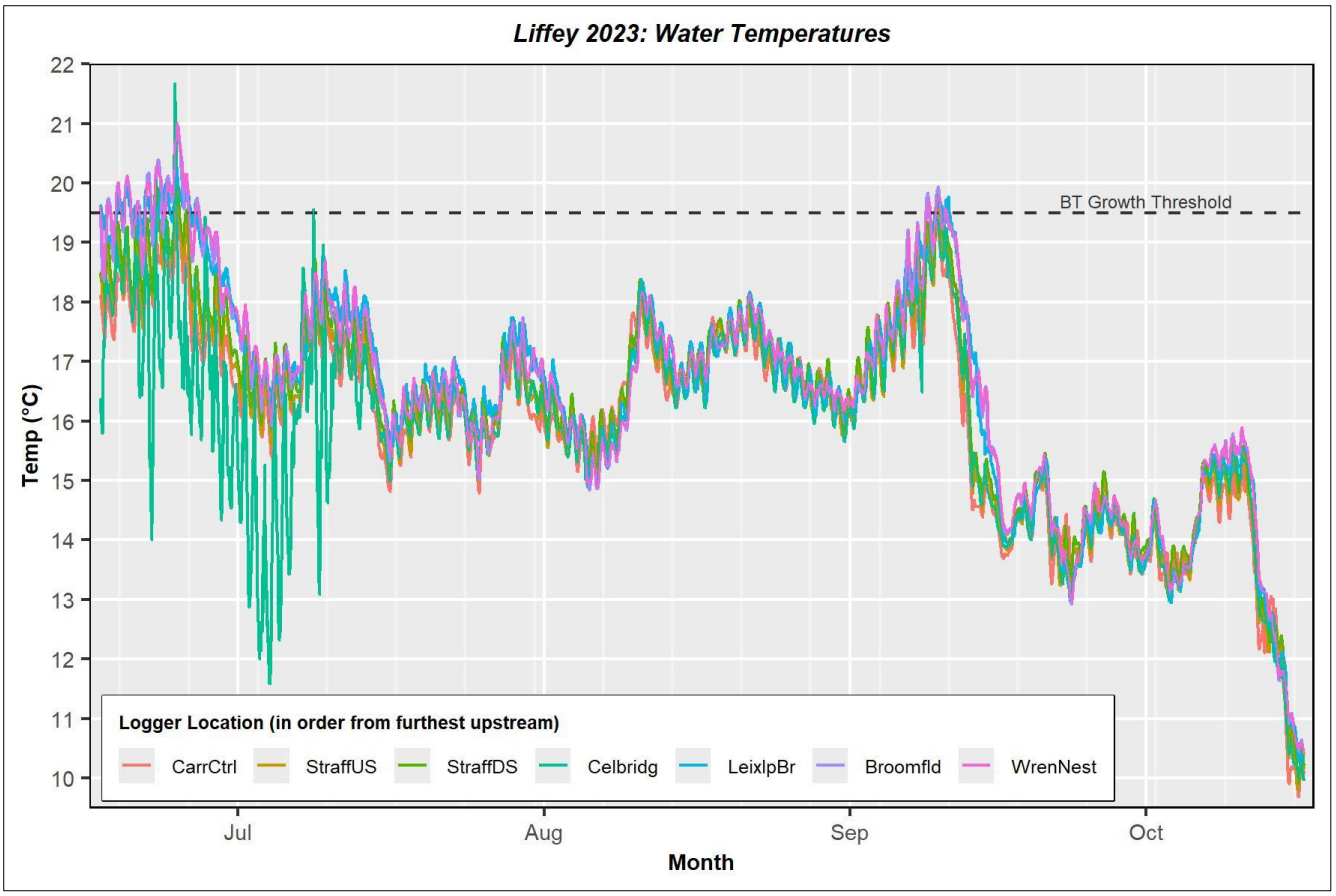

Figure 16. The temperatures recorded at the seven sites where data was able to be retrieved. Logged temperatures are from the 17th June 2023 to the 17th October 2023. BT= Brown Trout.

The initial exploration of the retrieved data revealed that the Celbridge site, upstream of the Leixlip Dam impoundment, exhibited a far wider range of values in June and July when compared to the other sites (Figure 16). The Celbridge values aligned to a greater extent with the remaining locations from the middle of July onwards. The Celbridge values (Celbridg – Figure 16) through July show when the logger was exposed to air, this was due to reservoir drawdown at the Dam Leixlip before it was refilled for the final 3 months of the survey.

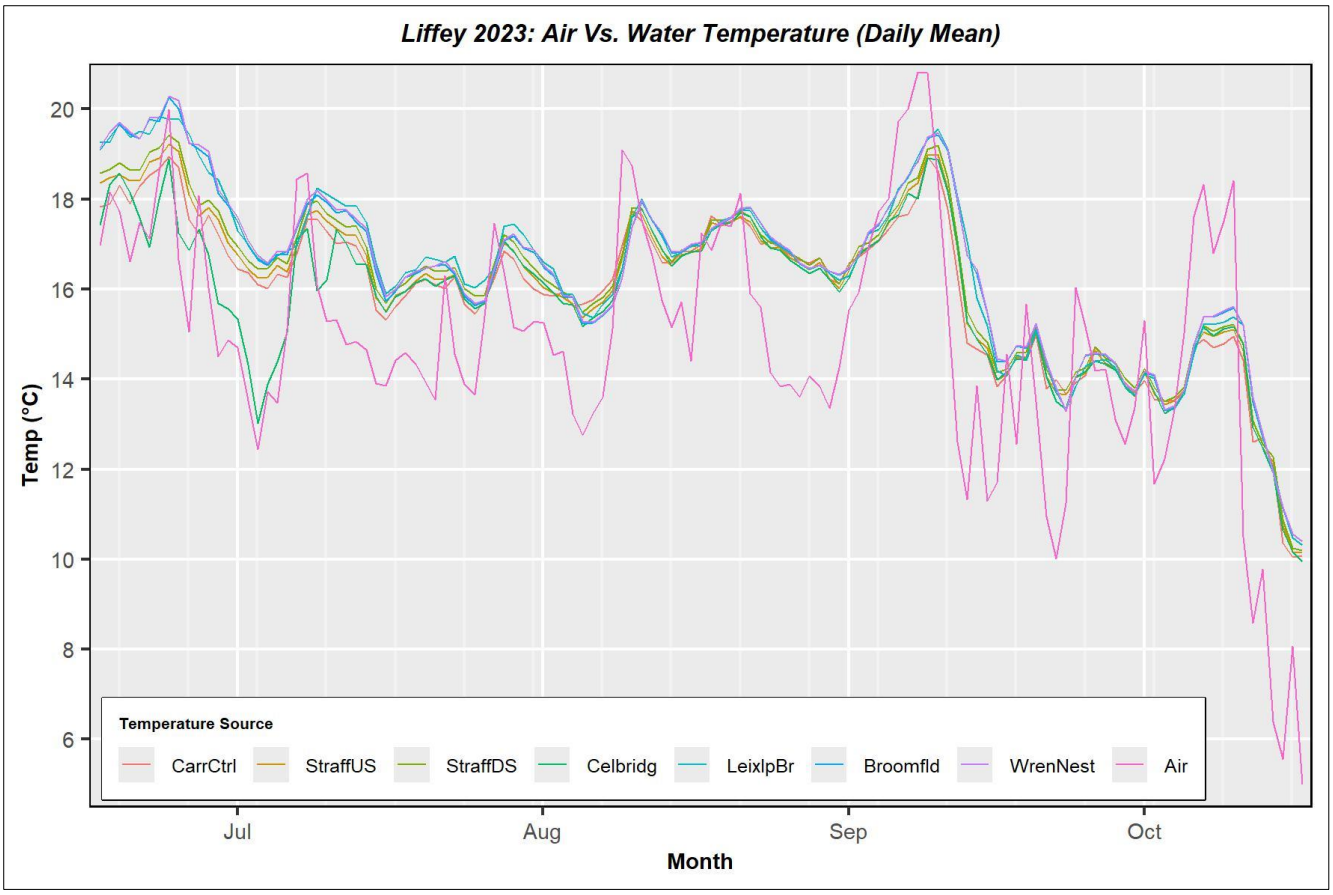

Figure 17. The mean daily water temperature recorded by loggers compared with the mean daily air temperature captured at Dunsany Weather Station.

A comparison of the mean daily air and water temperatures showed that the Celbridge site mimicked the air temperature patterns closely for June and the beginning of July. As the temperatures followed a similar pattern to the remaining sites for the rest of the study period, it is possible that this logger was exposed to the ambient air temperature for the duration of this wide temperature range.

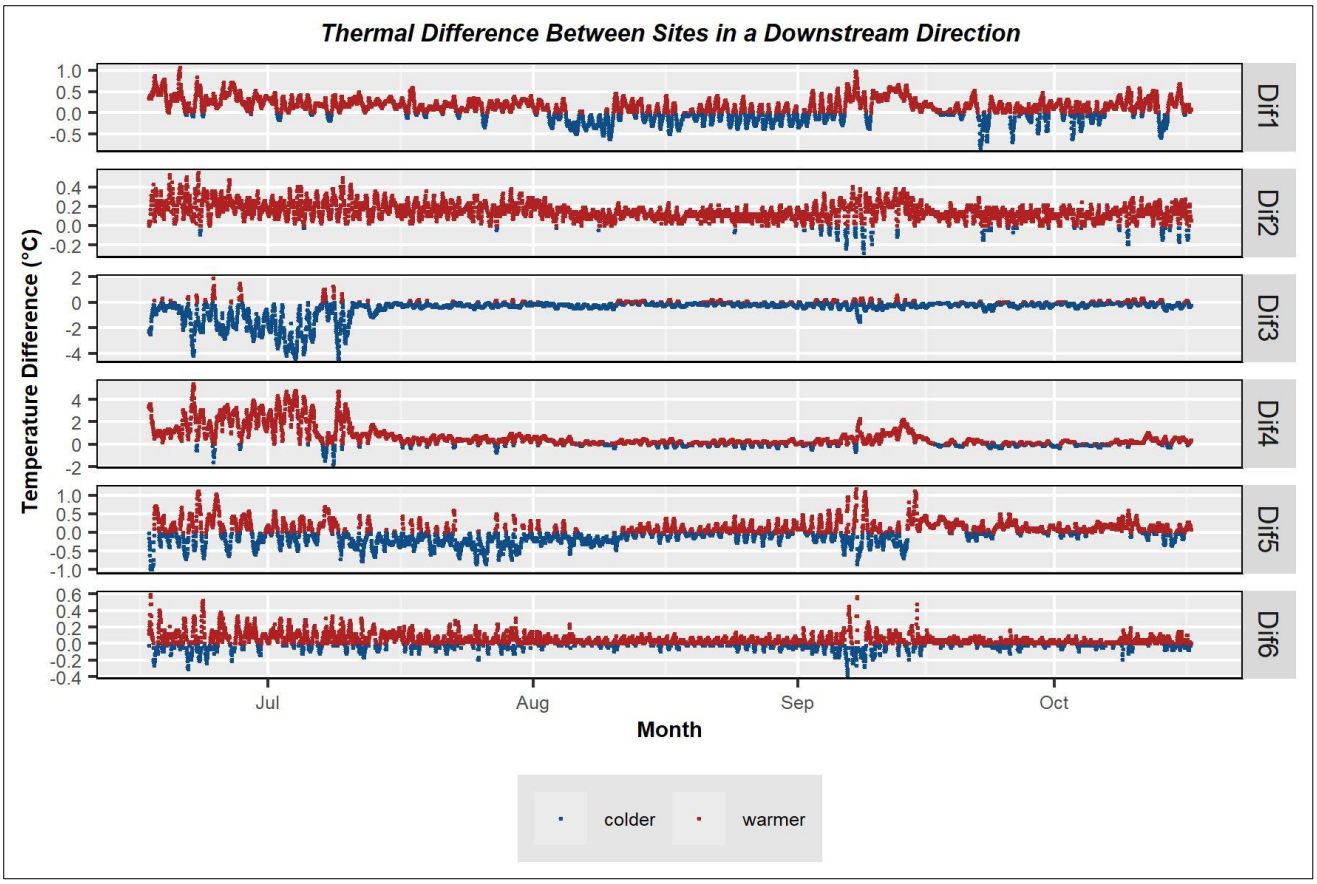

Figure 18. The temperature difference, in degrees Celsius, between the seven logger sites and their upstream neighbour. Dif1= US Straffan - Carragh Bridge, Dif2= Straffan - US Straffan, Dif3= Celbridge -Straffan, Dif4= Leixlip Bridge - Celbridge, Dif5 = Broomfield - LeixlipBridge, Dif6= Wren's Nest - Broomfield.

The greatest difference in temperature between a logger and its nearest upstream counterpart was apparent in June and early September (Figure 18). This corresponds to spikes in air temperature. The Dif2, Dif4, and Dif6 graphs display the thermal discrepancy between loggers located immediately downstream of an impoundment and the closest logger installed upstream of the impoundment. Temperatures are predominantly warmer downstream of the impoundments.

The summer of 2023 was cool, with a max July air temperature of 23.1°C recorded in the Phoenix park (Met Éireann, weather Station), compared to 32.5°C in 2022 and 27.7°C in 2021. However, even in these cooler conditions data shows that loggers deployed downstream of impoundments record warmer water temperatures than loggers deployed upstream of impoundments and control loggers, indicating that the impounding waters are warming up to a greater degree than 'natural free flowing rivers'. Data also shows that this effect can be cumulative given multiple impounding structures on a river. This research is continuing for 2024.

Environmental Flows East Coast Reservoirs

In Ireland, large artificial lakes or reservoirs have been predominantly developed to supply drinking water to the greater Dublin area and surrounding counties. The NBP in collaboration with the Eastern River Basin District (ERBD) are undertaking data collection downstream of these reservoirs. These structures act as major impoundments, barriers to fish passage and regulators of discharge that can degrade hydromorphology in affected systems.

The Reservoirs disrupts the flow, sediment and temperature regime in rivers. These are critical habitat components that interact with ecological processes to sustain fish populations. In this context, the data gathered from the Water Level/Temperature Data loggers will be used to develop management recommendations for 'environmental flows' that satisfy the ecological requirements of biological communities. Environmental flows are described as the quantity, timing, and quality of water in a river that is required to maintain flow and temperature conditions that are hospitable for fish species populations.

These types of measures are increasingly necessary to mitigate hydromorphological impacts and sustain stream biota as water resource management comes progressively more important (WFD Compliance). As such, quantifying the impact of flow disruption on stream habitat caused by major barriers and developing guidelines around flow standards is a priority for Inland fisheries Ireland and the National Barriers Programme. Research generated from this study will deliver data that will help mitigate barrier impacts and inform flow requirements that are essential to future proofing of affected rivers.

Pilot study

In Ireland, little is known about ecological (flow and thermal ecology) and hydromorphological impact of flow regulation associated with major barrier structures such as hydro-electric schemes and reservoirs, despite their presence in large waterbodies such as the Erne, Liffey, Lee and Shannon catchments among others. To help address this knowledge gap, IFI has commenced a pilot study that takes in the Dodder, Liffey and Vartry reservoirs and other free-flowing rivers (Dargle, Slaney, Avoca) within the Dublin/Wicklow mountains for reference. These catchments all support species listed under the Habitat Directive, including Atlantic salmon, lamprey spp. and Sea trout that are considered particularly vulnerable to altered flow and thermal disruption. This study involves collecting Water Level/Temperature Data, using remote loggers that generate high resolution temporal data. In addition, discharge related data is collected at sampling locations downstream of the reservoirs using an Acoustic Doppler Current Profiler (ADCP). This this will be used in conjunction with the water level data to generate discharge curves and investigate the relationship between water temperature and discharge management in the context of environmental flows.

Data being collected:

- Temperature (Figure 16)/ Water Level (Figure 17) Data loggers are deployed at and downstream (>3.5 km) of the reservoir discharge points.
- An acoustic Doppler current profiler (ADCP) is being used to collected discharge data at select sampling locations and this will be used in conjunction with the water level data to calculate continuous discharge curves for each sample point

- Site orthomosaic will be collected using drone technology to provide a site specific visual record

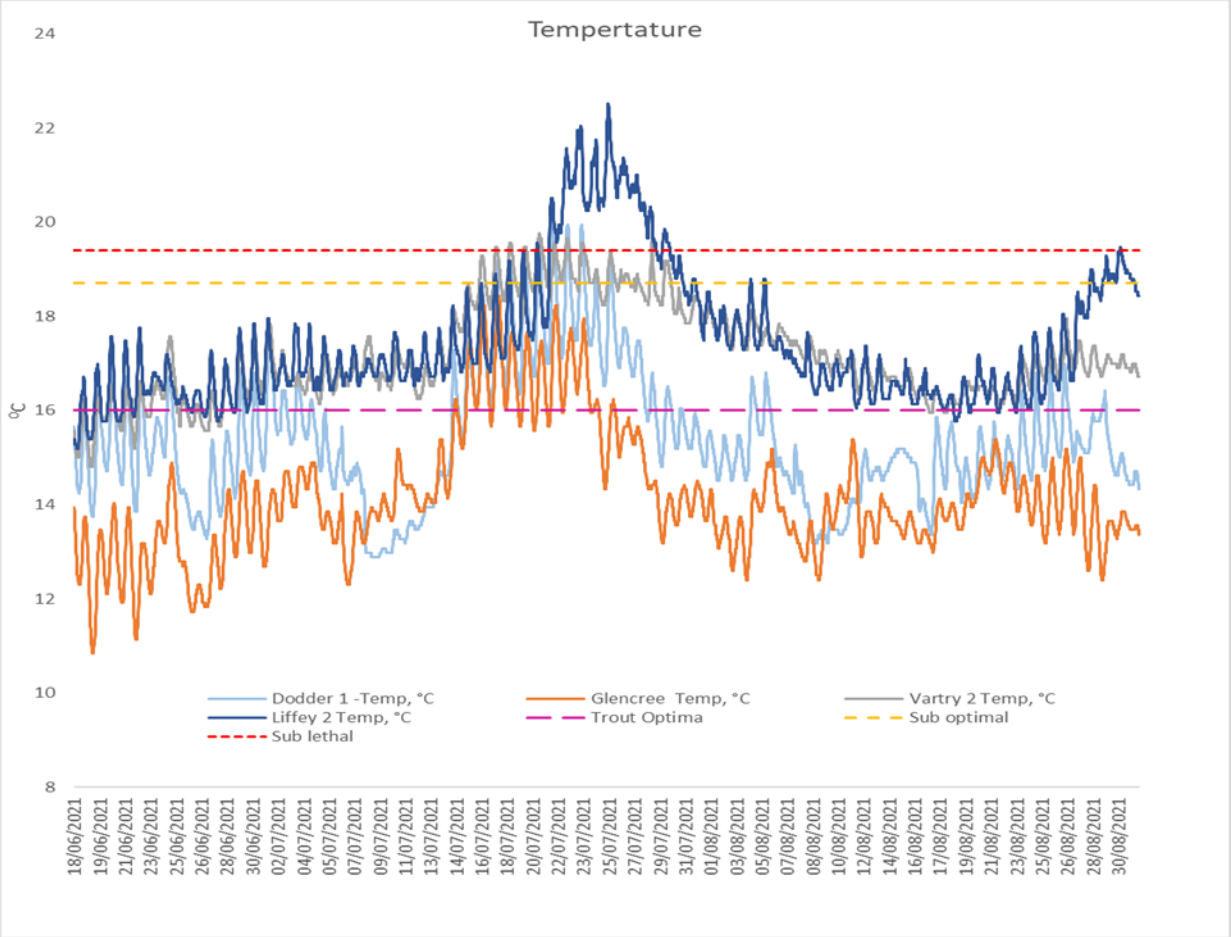

Figure 16. Temperature data from one sample location in each of the dammed/regulated rivers (Dodder, Vartry, Liffey) and a free-flowing river (Glencree) from mid-June to August 2021. Optimal thermal habitat conditions for brown/sea trout (<16 0C), sub-optimal (16-18.70C and sub lethal (>19.40C) are also shown as horizontal threshold lines.

Initial temperature investigations (Figure 16) shows that all rivers experienced temperatures above the optimum for trout in July 2021 during a heatwave/drought event. However, the free flowing Glencree experienced this for much shorter period relative to the regulated rivers. Notably, Liffey and Vartry rivers experienced temperatures above the optimum for trout for most/all the summer period, including temperatures that exceeded the sub lethal thresholds.

Water level data collect below the Dodder, Liffey and Vartry reservoirs rivers have been used to plot predicted natural flows, simulated by three uncalibrated hydrological models versus observations for the Liffey, Vartry and Dodder catchments. Figure 17 shows the observed versus predicted flow regimes in the Liffey at golden falls between October 2022 to September 2023. Measured precipitation is also shown. The deviation between the observed (grey line) and predicted flows (red line) are evident and represent significant hydropeaking and deviation from the natural flow regimes.

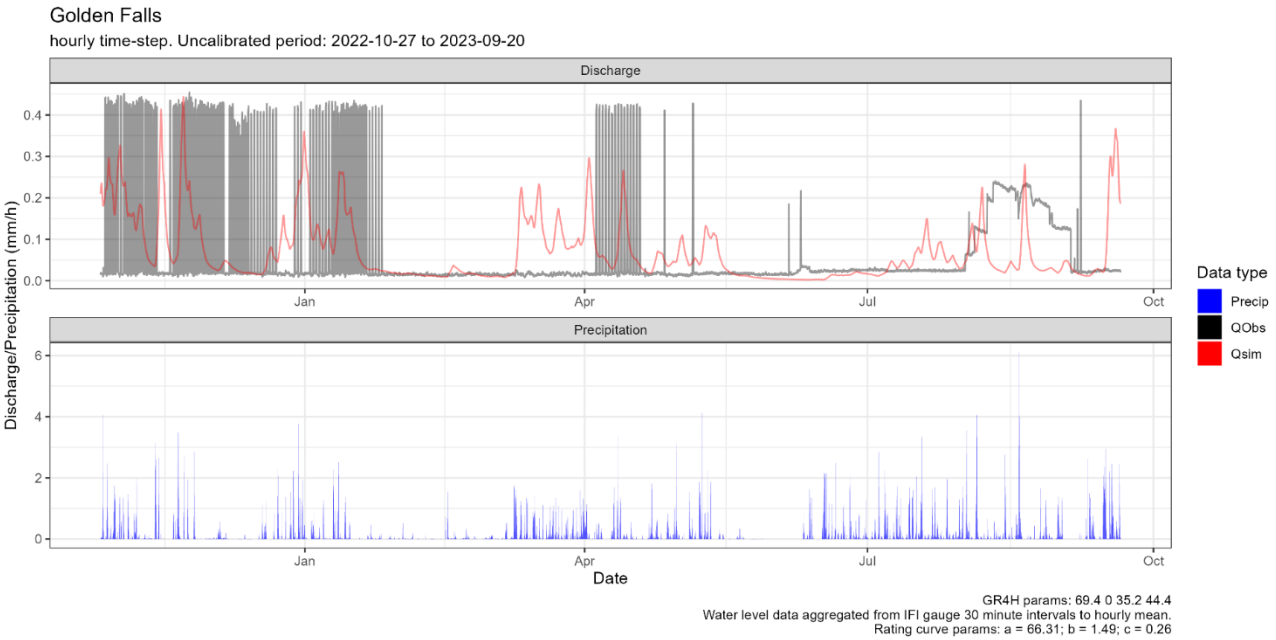

Figure 17. Predicted natural flows, simulated by three uncalibrated hydrological models versus observed flows for the Liffey at Golden Falls (October 2022 to September 2023)

The broad goals of the study are to:

- Advance understanding of dam-induced impacts to riverine thermal regimes
- Advance understanding of the ecological consequences of altered thermal regimes
- Demonstrate the potential availability and success of temperature management strategies
- Develop/ integrate thermal-criteria into environmental flow assessments
- Support the design of temperature-enlightened environmental flow assessments and management in a changing climate

5. Coordinate with local authorities and State Agencies on supporting barrier assessment with data or incorporating barrier assessments into their maintenance cycles

Uisce Éireann (UÉ)

In August 2023 IFI and UÉ met in Portlaoise to discuss overlap between IFI's Barrier programme and UÉ's instream infrastructure. UÉ outlined a dedicated Fish Pass Programme included in their infrastructure investment plan to 2029 of ~ €14m. Public consultation will form part of programme. UÉ to notify IFI when at consultation stage

- The NBP to utilise their prioritization matrix on supplied Fish Pass Programme list
- IFI suggested that when designing a solution, consider measures to address the temperature effects of impounding structures i.e. tree cover.
- UÉ to keep IFI informed of Fish Pass Programme progress at a high level.
- IFI to provide information regarding survey methodologies for UÉ to include in TOR competition documents

After this meeting UÉ supplied its Fish Pass Programme list. This list of 138 structures is currently being passed through the NBP Prioritization matrix (section 3) as trial data. Results will be discussed with UÉ when prioritization is complete.

Coillte

The NBP has been liaising with Coillte on a number of barrier and barrier/habitat related issues. A SNIFFER report was delivered for a Coillte culvert in the Derryclare Nature Reserve in the Inagh Valley, Co. Galway. It is hoped that a culvert replacement will aid in fish migration through this site.

The NBP has also been involved in the Coillte's Devil's Glen project which is holistically attempting to restore biodiversity at this site. The Vartry river flows through devils Glen downstream of the Vartry reservoir. The NBP is involved due to the modified flow, sediment and temperature regime due to the Vartry reservoir. It is hoped through installation of large woody and gravel addition instream fish habitat can be improved and fish response measured.

6. Dissemination– Raising awareness/ Story Maps

Annacotty fish passage project

The Annacotty fish passage project is being led by IFI as the state agency with responsibility for fish in rivers, such as the Mulkear. The project is encouraging pro-active engagement from stakeholders across the community including key state agencies, special interest groups, voluntary, public and private sectors.

The ultimate goal of this pilot project is to improve fish passage at Annacotty Weir on the River Mulkear for species such as Atlantic salmon, sea lamprey, river lamprey, eels and trout, helping them migrate both up and downstream. Annacotty Weir has been identified as a significant barrier to the free movement of fish and it is located within the Lower River Shannon 'Special Area of Conservation'. To progress the project, an Interagency Group for the Annacotty Fish Passage Project has been set-up, which includes representatives from Inland Fisheries Ireland, the Department of the Environment, Climate and Communications, the Department of Housing, Local Government and Heritage, Limerick City and County Council, the Office of Public Works (OPW), the National Parks and Wildlife Service (NPWS), the Local Authority Waters Programme (LAWPRO) and the ESB.

Project Milestones 2023/ Spring 2024

- January 2023 – Start of tender process to appoint consultants to prepare an options report for fish passage improvement works at the Annacotty Weir in Limerick
- Summer 2023 - Following a competitive tender process O'Connor Sutton Cronin (OCSC) were appointed as the consulting engineers to undertake a range of technical assessments and prepare an options report for fish passage improvement works at Annacotty Weir in Limerick.
- October 2023 – Survey Reports received from OCSC (Archaeology, Architectural heritage, Freshwater pearl mussel, hydrology, Topographic/bathymetric, NIS, EcLA, AA and Underwater archology)
- Spring 2024 -Consultants engaged on preliminary options report
-

Online and in Person Dissemination events

NBP Dissemination Activities

Presentations on barriers to fish migration and conferences attended were:

- River Restoration Annual Conference 2023, 24th RRC Annual Network Conference, 'An action strategy for river restoration, Birmingham, 19th & 20th April 2023
- UK Dam Removal Conference, Manchester, May 2024
- Free Flow Webinar vol.2 – barrier removal for river restoration in the river basins of the Rhine, Scheldt, Meuse and Ems (online Webinar)
- Nore Vision Heritage Week, Inistioge Talk – Barriers on the River Nore
- River Restoration Centre Scientific Conference, Scientific Advances in River Restoration (SARR). Incorporating hydro-thermal regimes into environmental flows assessments and river management R. Ó'Briain, C. O'leary, B. Coghlan
- Irish National Hydrology Conference, 2023, Climate Change and Water Resources Management

- IFI River Habitat Forum 2023. IFI Community of Practice on river habitats with the theme of 'Making space for rivers'
- Engineers Ireland online presentation - Role of Fish Passes in Barrier Mitigation – Not just Fish Passage in the Directives https://www.youtube.com/watch?v=KSNHlBAen4k
- Geomorphology Association of Ireland 9th Annual Workshop, Galway April 2024

NBP Story maps

The NBP Team developed a National Barriers Programme Story Map utilizing ESRI's Storymaps tool for reporting purposes. The objective was to enhance understanding regarding barriers, their impact on fish migration, and the critical necessity for mitigation measures. The Story Map consists of two narratives: 'Barrier Explained' and 'Barrier Mitigation' (Figure 18). Additionally, it integrates the National Barriers Programme App and an openly sourced Dashboard sourced from IFI's open data hub and data.gov.ie, providing comprehensive insights and real-time data visualization (Figure XXXX).

https://storymaps.arcgis.com/collections/135006aa660c494f8d2047eca5bdf507

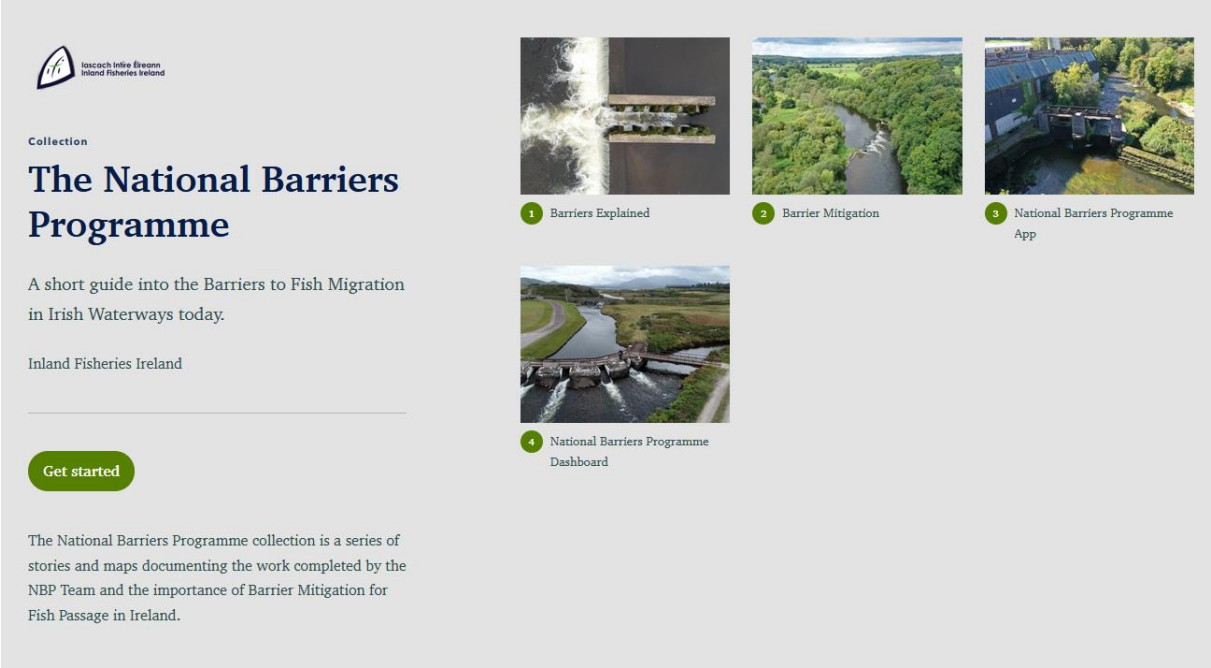

Figure 18. Story Map Collection presenting a short guide into barriers to fish migration in Irish Waterways. Integrating NBP explainers, dashboards and Geo-databases.

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