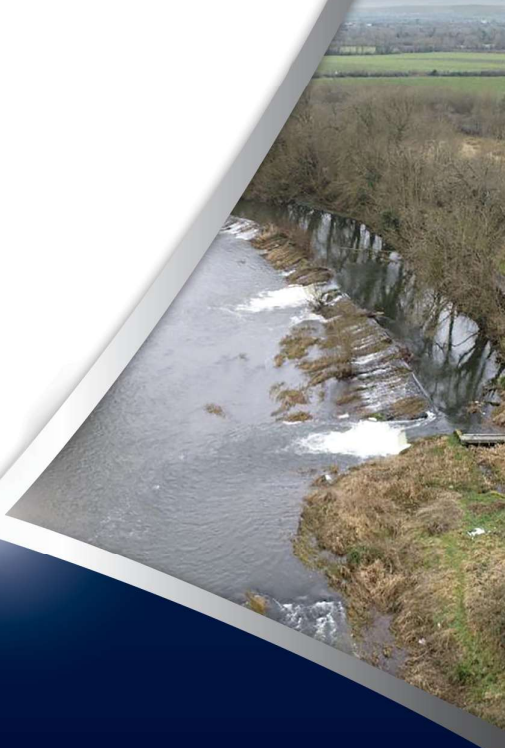


Environmental Drainage Maintenance Research Programme

Catchment-wide Assessment 2024

IFI/2025/1-4755



Iascach Iníre Éireann
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Catchment-wide Assessment 2024

Inland Fisheries Ireland & the Office of Public Works

Environmental Drainage Maintenance Research Programme



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OPW

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Acknowledgments

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The report includes maps which contain data produced by the Environmental Protection Agency (<https://gis.epa.ie/GetData>).

Executive Summary

The 2024 catchment-wide survey was undertaken in the OPW Mague Arterial Drainage Scheme which was commissioned by the OPW as part of the Environmental Drainage Maintenance Research Programme, a collaboration between IFI and OPW. Catchment-wide monitoring uses metrics in line with the Water Framework Directive to assign fish and hydromorphology status to OPW channels, using the EQR (Ecological Quality Ratio) and RHAT (River Hydromorphology Assessment Technique) methodologies respectively.

A total of 39 sites were fished, 37 of which were completed using the ten-minute bank-based electro-fishing method with the remaining 2 sites fished using boat based methods, both aimed to get an understanding of fish density, distribution, and population structure. Regarding classification, the EQR results indicate that 31% of the sites on the Mague meet the minimum requirements of Good status with one site graded High status. The remainder of fishing sites (69%) ranged between Moderate (58%), Poor (8%) and Bad (3%) status.

28 sites were surveyed using the RHAT, and 7% of these were classified as Good with the remainder being classified as Moderate, Poor & Bad status. Floodplain connectivity, riparian land use, channel vegetation and substrate condition were the RHAT attributes with the lowest average score, contributing to the sub-optimal scores.

Each RHAT survey now has recommendations taken from the OPW ten steps that staff can implement, as well as proposed enhancement measures for the IFI Projects Office or other interested groups. Case study examples of where the RHAT Score can be improved are provided. These recommendations may be implemented by other catchment based stakeholders where the opportunity arises.

As part of the hydromorphological investigations, longitudinal connectivity in the catchment was assessed using IFI's Barrier Assessment and Screening Tool. There were 2,087 potential barriers identified during the survey and 85.5% of these were assessed in the field. Of those surveyed, 102 (6.06%) were surveyed as barriers to fish passage, comprising 72 bridge aprons/culverts, 27 weirs, 1 waterfall and 2 Fords. A list of barriers which should be prioritised for mitigation/remediation works was generated. Mitigation measures/works for each structure was not identified as these are case by case items with each structure varying in characteristics posing complexity.

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1 Introduction

1.1 Background

IFI staff have been conducting catchment-wide surveys as part of the IFI-OPW research project since 2017 (see summary in Fleming *et al.*, 2023). These surveys assess selected elements in the Water Framework Directive, namely fish and hydromorphology. These surveys highlight catchment wide pressures that may lend support for a future long-term restoration programme as committed in the Water Action Plan. The end user for this report include but are not limited to the OPW, IFI Projects Office, Lawpro, NGO's.

Catchment-wide monitoring uses metrics in line with the WFD to assign fish and hydromorphology status to OPW channels, using the EQR (Ecological Quality Ratio) and RHAT (River Hydromorphology Assessment Technique) methodologies respectively. This gives the OPW valuable baseline data across their catchment areas. From 2023 onwards, each RHAT result has proposed fishery enhancement measures as well as recommendations for feasible ten steps that OPW drainage maintenance staff could potentially implement where feasible (see Appendices 7.1 and 7.2). It is envisaged that, where feasible, these recommendations could be incorporated into the OPW's arterial drainage maintenance planning and future activities. Catchment-wide surveys in OPW schemes also fulfils data collection requirements for IUCN (International Union for the Conservation of Nature) red list and Habitat Directive species – specifically salmon, sea lamprey, river lamprey and eel.

1.2 Maigne catchment description

The Maigne catchment is located in the IFI Shannon River Basin District and the OPW South-west Region for Arterial Drainage Maintenance. Its total catchment area is 1,156 km², the majority of which is located in county Limerick with small portions of the catchment area encroaching into Cork and Tipperary. It is adjacent to the Deel catchment, surveyed by the IFI team in 2019 (Fleming *et al.*, 2020). The urban areas in the Maigne include Charleville, Kilmallock, Bruff, Hospital, Croom, Patrickswell and Adare (Figure 1.1). The main tributaries in the system include the Loobagh, Morningstar, Camoge/Drumcomoge, Clonshire/Greanagh and Barnakyle.

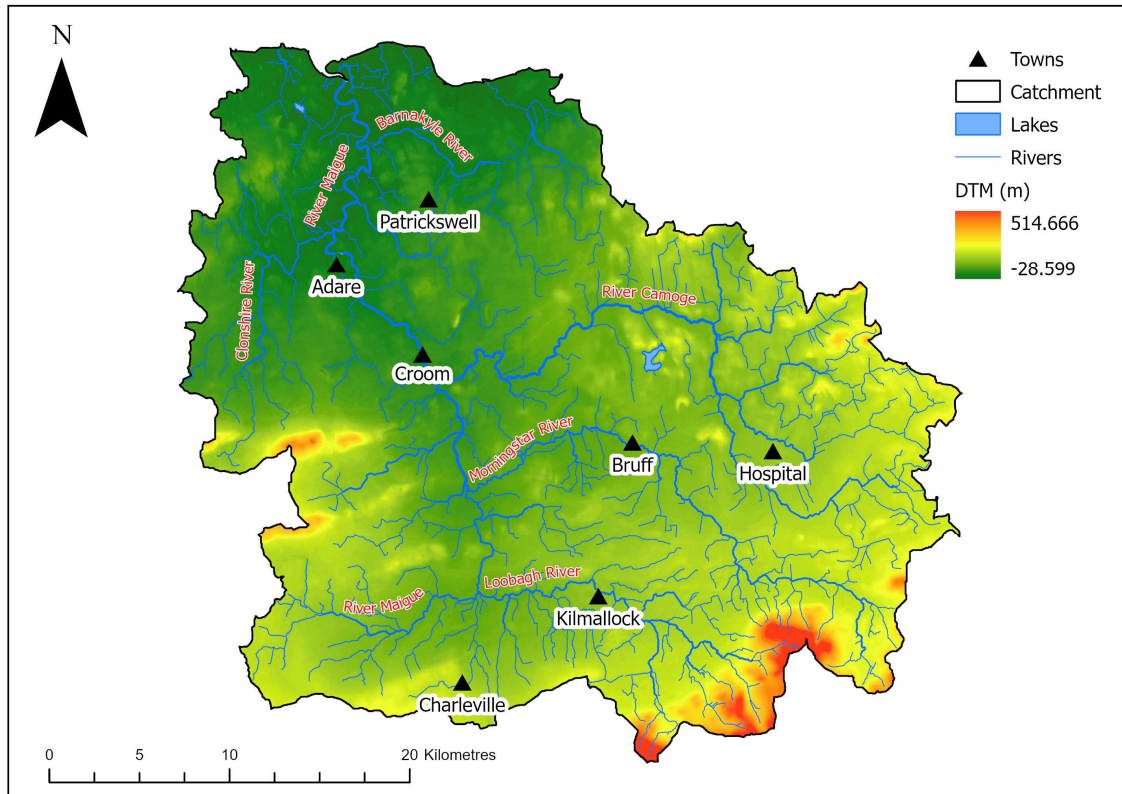


Figure 1.1 Geography of the Mauge catchment showing major tributaries, lakes, towns and elevation.

Large-scale drainage works were undertaken on the Mauge catchment in 1973-1986, benefitting an area of 12,343 hectares (Hanley, 2014b). A large proportion of channels in the catchment come under the remit of the Arterial Drainage Scheme. Out of a total channel length of 1,136 kilometres, 907 kilometres are within the OPW scheme.

The catchment area is underlain by Devonian and Carboniferous-era limestones, shales, mudstones and minor sandstones. The Quaternary geomorphology consists of large areas of tills derived from limestones/sandstones, a corridor of alluvium which widens towards the lower Mauge, north of Adare. These pockets of glacio-fluvial gravels and bedrock outcrop occur at slightly higher elevations in the upper catchment between Charleville and Croom. In the lower catchment, there are small areas of cut over raised peat and karstified bedrock outcrops, with the latter particularly notable around Kildimo, north-west of Adare. Regarding land use in the catchment, Corine 2018 landcover data shows that the vast majority of the catchment is dominated by agriculture, specifically pasture, with very minor amounts of tillage. Minor areas of coniferous forest, heterogenous agricultural areas, transitional woodland/scrub and broad-leaved forest exist throughout the catchment area.

There are six Special Areas of Conservation within the catchment area: Ballyhoura Mountains SAC; Glen Bog SAC; Tory Hill SAC; Askeaton Fen Complex SAC; Curraghchase Woods SAC; and Lower River Shannon SAC. Qualifying Interests include various terrestrial habitats, including alluvial forests as well as specific fauna such as the lesser horseshoe bat. The main freshwater based SAC is the Lower River Shannon SAC. Habitats within the Maigue comprise many of the Qualifying Interests of this SAC, and the main species of interest from a riverine and fisheries perspective are as follows: Freshwater Pearl Mussel (*Margaritifera margaritifera*); Sea Lamprey (*Petromyzon marinus*); Brook Lamprey (*Lampetra planeri*); River Lamprey (*Lampetra fluviatilis*) and Salmon (*Salmo salar*).

2 Fish Population Index

The Maigne catchment was electro-fished on various dates between July and September 2024 with the objective of understanding fish density, distribution, and population structure. This was a collaborative effort between the Environmental Drainage Maintenance Research Programme and the National Research Survey Programme, both programmes within R&D in IFI. Each site was also assessed to identify potential hydromorphological pressures and any other relevant issues.

As shown in Figure 2.1, a total of 39 sites were fished, 37 of which were done using a ten-minute bank-based electro-fishing method with 2 using boat-based methods to understand fish density, distribution, and population. Of the sites fished, all but 2 were located on OPW channels. These two sites were included to complete the catchment wide survey to ensure good coverage and include two 3rd and 4th order tributaries that otherwise would not have been included in the survey if solely focused on OPW channels.

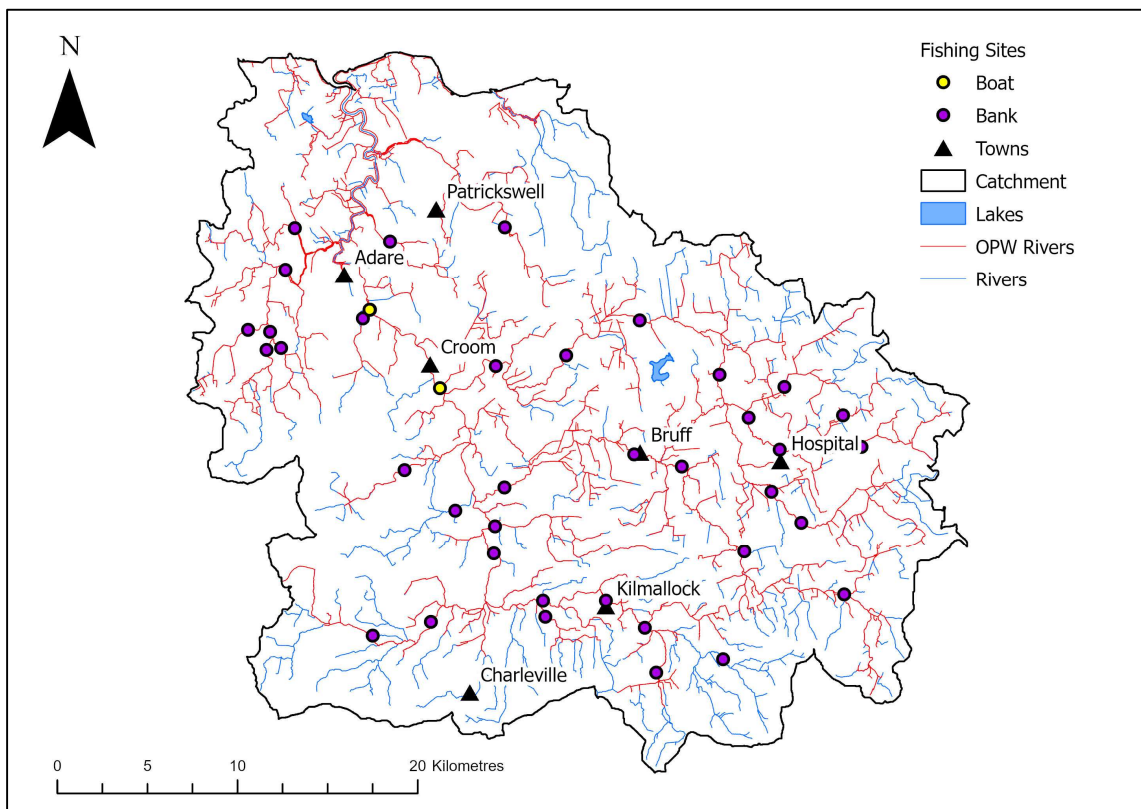


Figure 2.1 Distribution of boat- and bank-based ten-minute electro-fishing sites around the Maigne catchment.

Survey sites were fished using the bank-based timed ten-minute electro-fishing method which targets species present within the survey site at the time of the survey, or a boat-based electro-fishing method using a boat and a generator-powered electrofishing kit. Both electro-fishing methods capture species present within the survey stretch on the date and time in which the survey is conducted. Bank-fishing sites averaged 4.53 metres in wetted width and 23.61 metres in length, while boat-fishing sites averaged 16 metres in wetted width and 200 metres in length.

In total 1,258 fish were captured via both bank and boat based fishing methods and returned during the overall Fish Population Index (FPI) survey. Brown trout (n=360) were the most abundant species present, followed by minnow (n=343), stone loach (n=215), salmon (n=190), stickleback (n=87), eel (n=31), lamprey (n=27), flounder (n=5), and crayfish (n=1). The composition of fish species captured during both the bank and boat based surveys is shown in Figure 2.2.

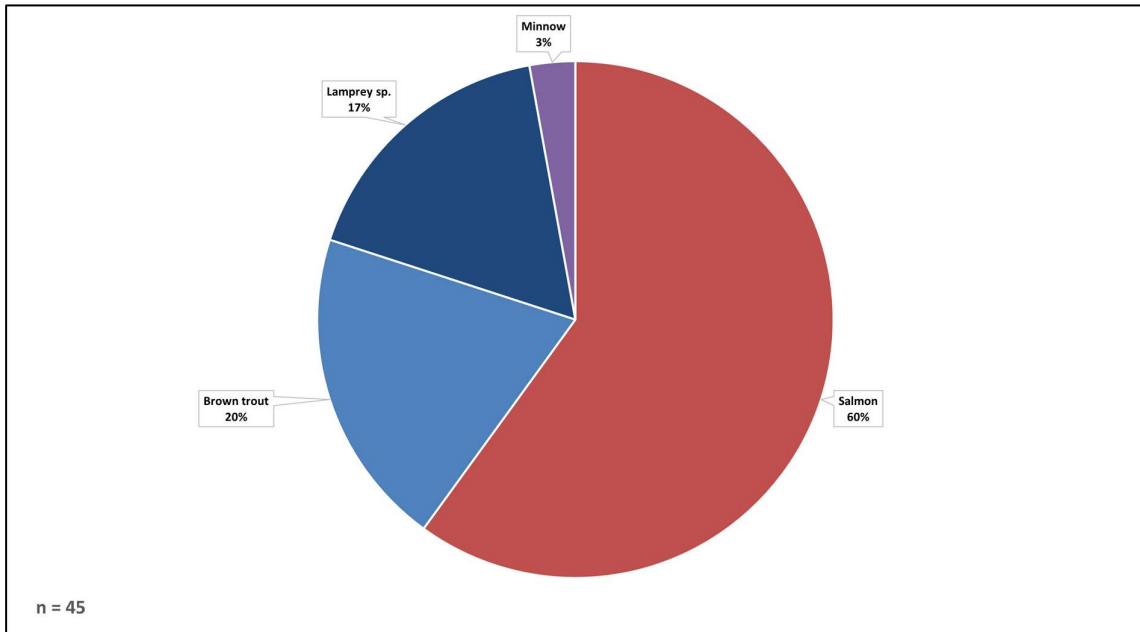
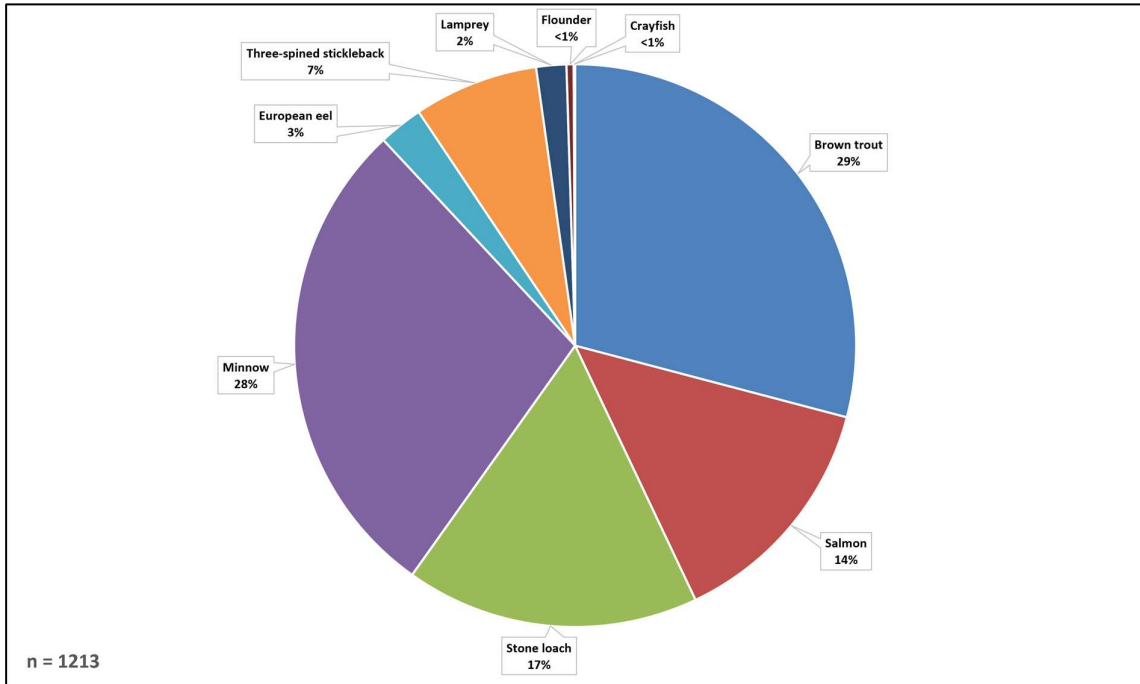


Figure 2.2 Pie charts showing composition of fish species captured during the bank (top) and boat (bottom) electrofishing surveys.

Data collected via bank-based fishing revealed that minnow, salmon, and brown trout are widely distributed around the Maigne catchment. Salmon were present in 23 of the 37 bank-fishing sites and brown trout in 30 of the fishing sites. There was one fishing site, located on OPW channel reference C1/34, where salmon were present in numbers exceeding 20; meanwhile, brown trout numbers exceeded 20 in 25 of the sites and were present in 35 sites. Minnow were present in 20 of the counted sites, and in numbers exceeding 20 at 9 of the sites.

Data collected via boat-based fishing revealed slightly different results due to naturally occurring differences in fish distribution patterns at different depths. Salmon and brown trout were each present in both sites fished by boat, with a total of 21 salmon and 7 brown trout present. 10 stone loach, 6 lamprey, and 1 minnow were also present. European eel were present at 8 sites mostly located in the lower catchment area.

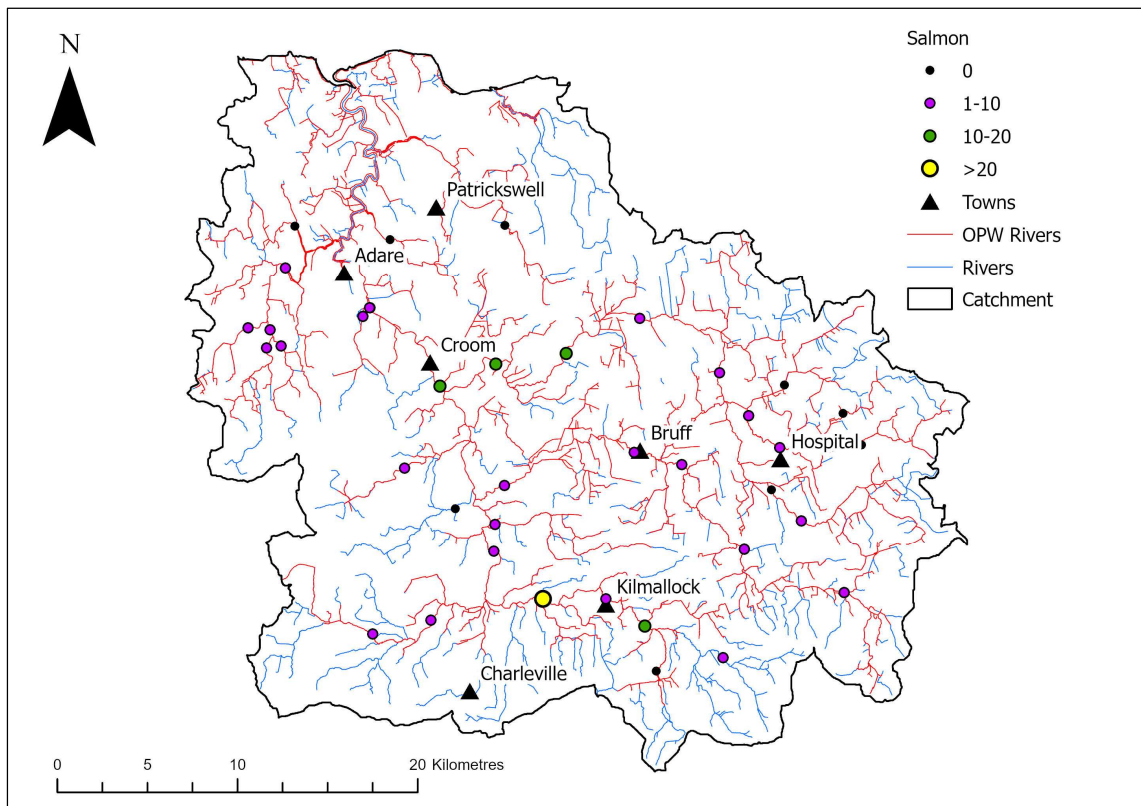


Figure 2.3 Distribution and abundance of salmon.

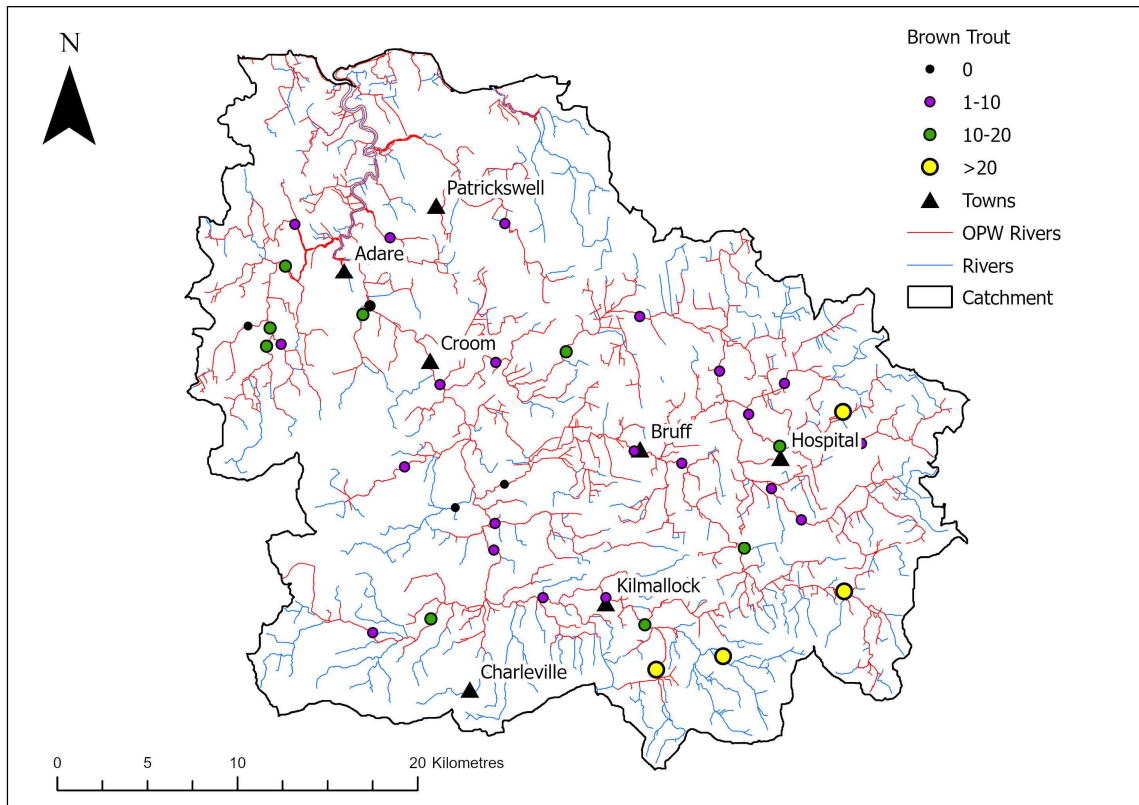


Figure 2.4 Distribution and abundance of brown trout.

Brown trout captured ranged from 4-32 cm in length (Figure 2.5). The first and largest modal peak consisted of fish measuring 4-11 cm and these were classified as 0+ fish. The next modal group 12-23 cm inclusive were categorised as 1+ fish and those greater than 23 cm classed as 2+. Numbers of 1+ fish were relatively lower than 0+ age class but more abundant than 2+ and older fish.

Salmon numbers were recorded in lower numbers than brown trout (n=168). Salmon displayed two age classes predominantly 0+ ranging from 5–11 cm. 1+ age classes were present in lower numbers ranging from 12-19 cm.

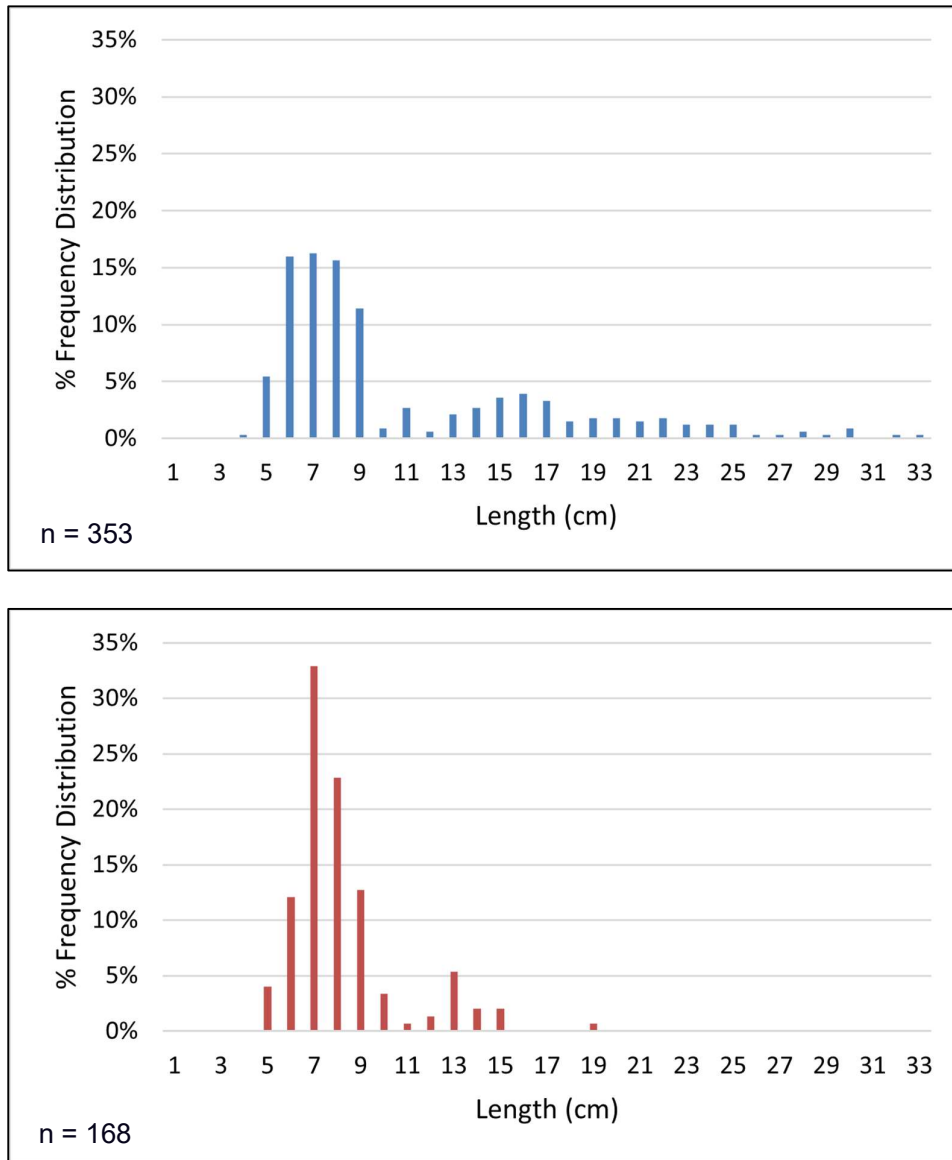


Figure 2.5 Length frequency distribution of brown trout (top) and salmon (bottom) captured by bank-based electro-fishing in the Maigue.

2.1 Ecological Quality Ratio (EQR)

The EQR is a WFD-compliant method used to determine fish status with respect to reference conditions. Presence and absence of salmonids influence the EQR scores given to a water body. When calculating an EQR score for any waterbody, salmonids are scored by presence and abundance of both age classes (0+ and 1+ fish). This plays a significant role in the model output. If both 0+ and 1+ salmon/trout are recorded during the fishing survey the waterbody will achieve a higher EQR score, whereas if only one age class was present the riverine

system would achieve a lower EQR score. Presence of both classes of salmonids at a given site is an indication of recruitment within the riverine system.

EQR scores for fish were generated for 39 of the sites fished in 2024 (Figure 2.6). For comparison, EQRs were also generated for the 25 sites which were fished as part of a catchment wide survey by EREP in 2013 that overlapped with the 2024 Survey (Figure 2.7).

Focusing solely on the 2024 EQR results, 3% of sites graded as Bad status, 8% Poor status, 58% scored Moderate status, 28% scored Good status and the remaining 3% classified as High status. The WFD requirement is Good status and above, therefore 31% (n=12) of the sites from the Mague catchment-wide fishing survey are meeting WFD standards for fish.

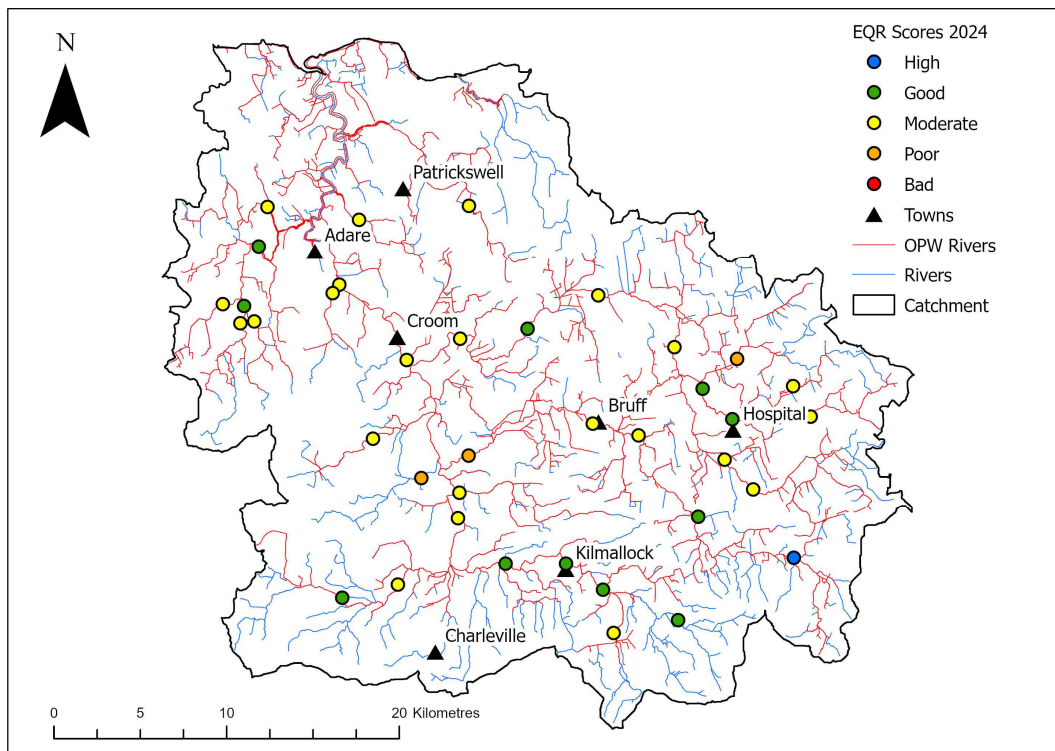


Figure 2.6 Fishing locations surveyed in 2024 with Ecological Quality Ratio (EQR) scores generated for each site.

See Figure 2.7 & Figure 2.8 where over the 11-year period EQR status of 5 sites deteriorated, 11 remained the same and 9 sites improved. 3 sites downgraded from Good Status to Moderate, 1 site from Good to Poor and 1 site went from Poor down to Bad. From the improved sites, 5 sites went from Poor status to Moderate status, 3 went from Moderate Status to Good and another from Poor to Good.

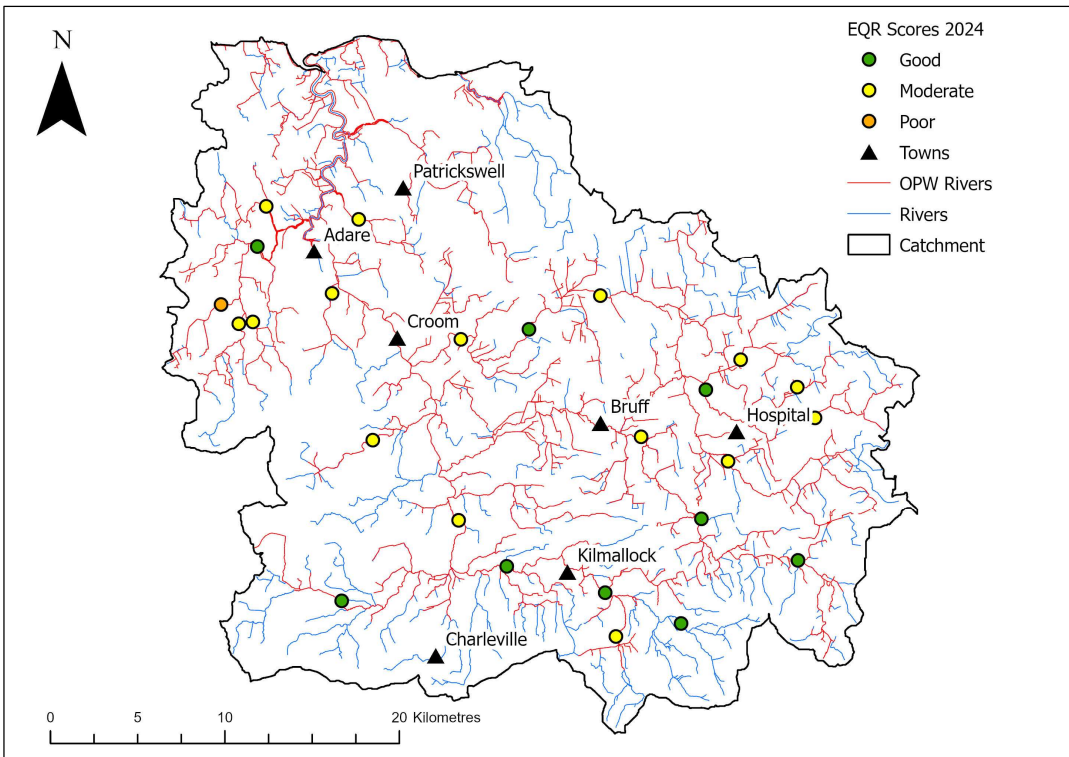
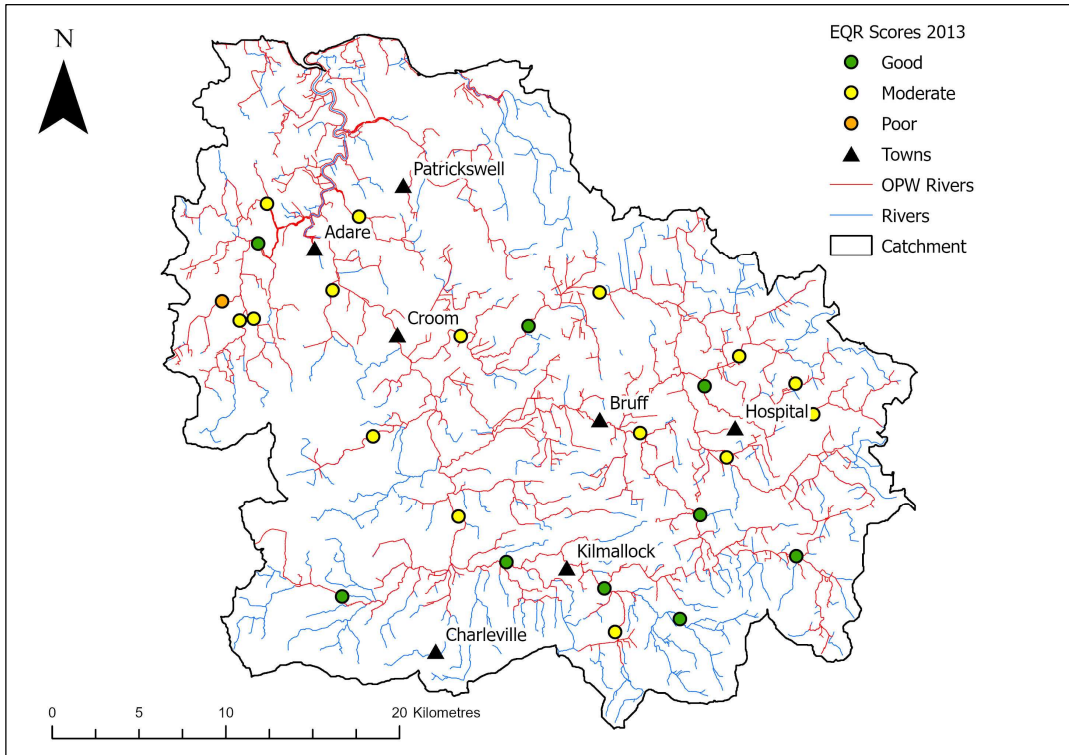


Figure 2.7 Ecological Quality Ratio (EQR) scores generated for 25 sites fished in 2013 (top) and 2024 (bottom).

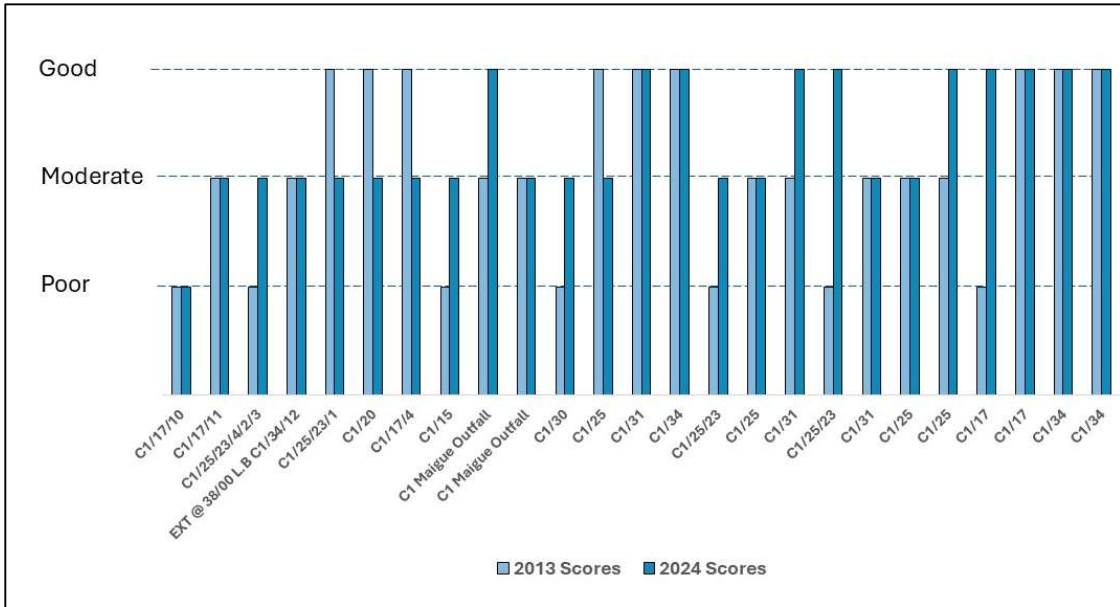


Figure 2.8 Bar Chart displaying changes in EQR Scores for each site repeated, generated from fishing results in 2013 and 2024.

3 River Hydromorphological Assessment Technique

3.1 Results

Using the River Hydromorphology Assessment Technique (Murphy & Toland, 2014), a total of 28 sites were assessed for hydromorphological status in the Maigue catchment (Figure 3.1). The RHAT is the standard assessment for assessing hydromorphology for the WFD nationally at a field site scale. Visual field observations are recorded every 50 metres over a 500-metre walkover and an overall score assigned at the conclusion of the survey. All of the sites on the Maigue were surveyed between May and June in 2024. The OPW Arterial Drainage Scheme in the Maigue is quite extensive, so just one site was located on a non-drained channel leaving 27 sites located on OPW scheme channels. Just 2 sites (7%) of the 28 scored Good status, the minimum WFD requirement. The remainder of the sites failed for hydromorphology, with the scores ranging from 68% Moderate (n=19) to 18% Poor (n=5) and 7% Bad (n=2).

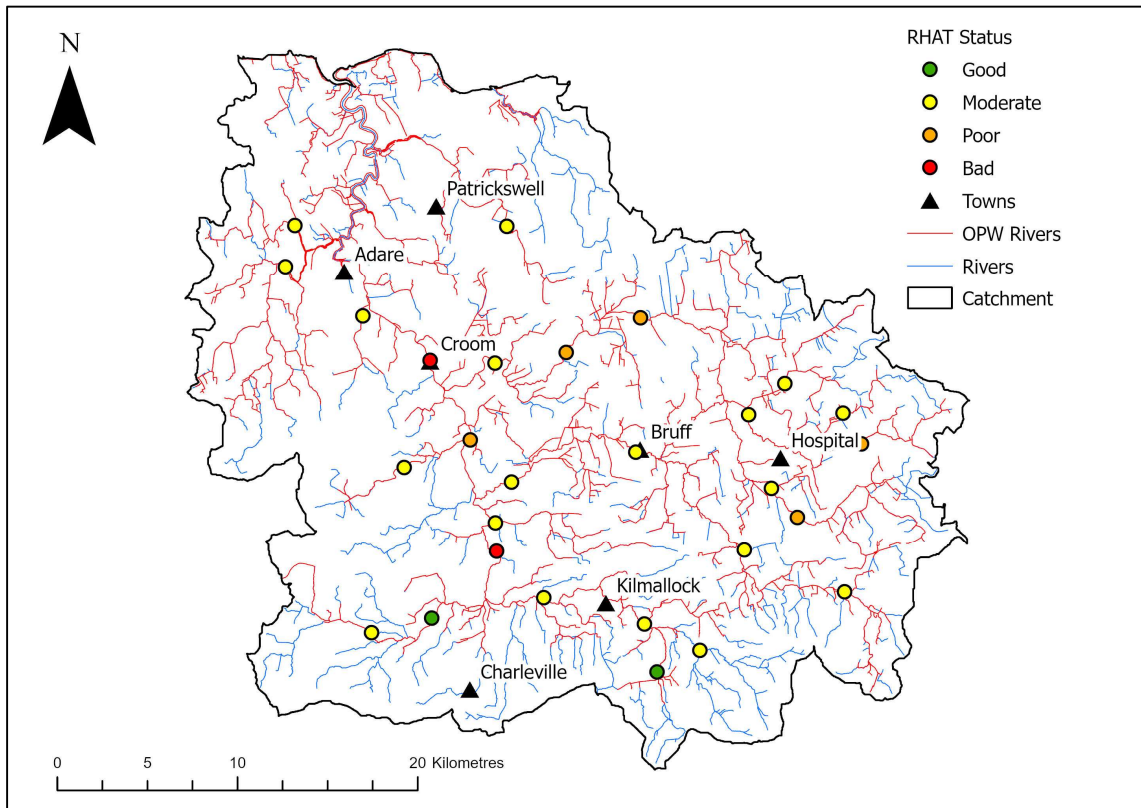


Figure 3.1 RHAT Scores for sites surveyed in the Maigue Catchment (n=28).

When RHAT scores are averaged, they range from 0.89 (Floodplain Connectivity) to 2.21 (Barriers to Continuity). Riparian Land Use averages out at a relatively low score of 1.45. Channel Vegetation and Substrate Condition are also among the lower scoring attributes, on average (Figure 3.2).

The first 4 attributes (channel form and flow, vegetation, substrate and barriers) are scored independently between 0 - 4, whereas the remaining attributes (bank structure and stability, bank vegetation, land use and floodplain connection) are scored for each bank, with both left and right bank scored between 0 – 2.

Floodplain connectivity scored very low (0.89) indicating the significance of historic over-deepening and widening of all channels surveyed. Riparian land use was the next attribute scoring poorly and land management influences these scores. Channel vegetation and substrate condition scored relatively low for this catchment, both averaging less than 2.

Correct application of the OPW 10 steps during maintenance can positively influence attributes 1, 2, 3, 5 and 6 namely left to right.

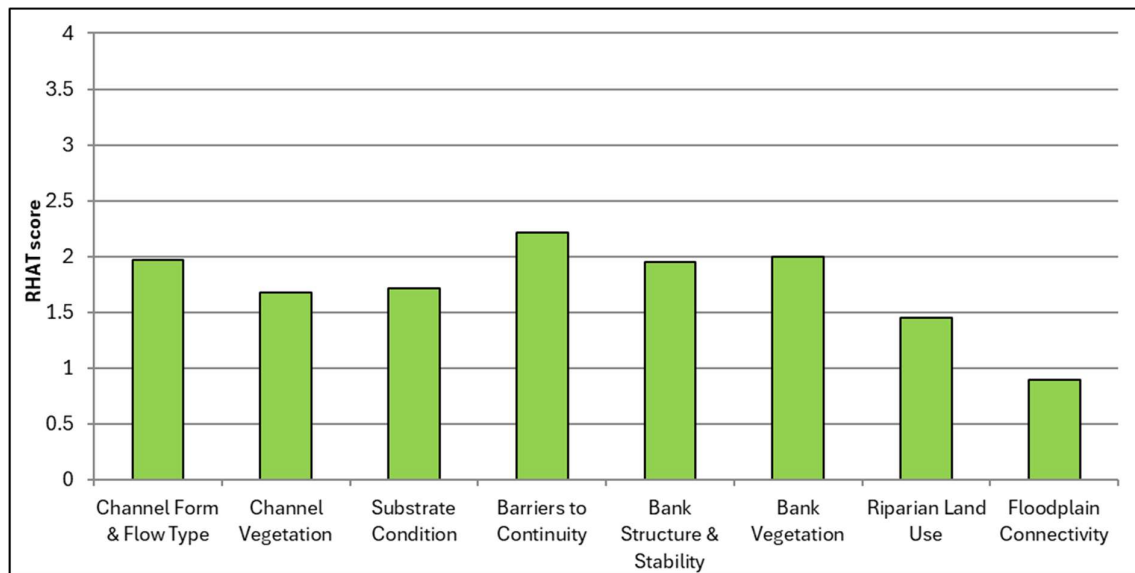


Figure 3.2 Mean RHAT scores for sites surveyed in the Mague (n=28)

3.2 Case studies

The following section details sites scored in the Maigue system using the RHAT. All of the examples are on OPW scheme channels within the Maigue Arterial Drainage scheme. The range of scores presented is from Bad to Good. No sites scored High within the survey.

3.2.1 Bad status

Two sites in the surveyed area scored Bad status for hydromorphology and both were on the main channel of the Maigue, both in urban areas in Bruree (Figure 3.3) and Croom (Figure 3.4). At Bruree, the site covers an area with a very large weir and a waterfall (see Figure 4.7 middle & right). Overall, it achieved a score of just 4. The channel was over-widened extensively to accommodate the positioning of the weir historically. The land is managed locally as far as the bank top as an amenity area. However, due to such management, it is evident that there are problems with large amounts of invasive and disturbance species, including Giant Hogweed, developing in the area. Both banks are reinforced to varying degrees along their length. The channel has a significant impoundment due to the presence of the weir, which affects the score for channel vegetation negatively. The substrate condition was not visible due to the impoundment and applying the survey methodology, it was assigned a moderate score.



Figure 3.3 Impounded area upstream of the weir at Bruree (C1 Maigue Outfall).

The site at Croom (C1 Maigue Outfall) also scored Bad for similar reasons. Although there was no weir present at the site surveyed, the channel is extensively over-widened with two large weirs present upstream. There are a series of small, stepped structures upstream

between the survey site and the main weir. The extensive over-widening has left very shallow flows in places and allows excessive homogenous vegetation to thrive. Reinforcement along both banks and the lack of floodplain connectivity contributes to the Bad score.



Figure 3.4 The River Maigne (C1 Maigne Outfall) at Croom.

3.2.2 Poor status

One site surveyed in the upper catchment area was on the Mahore river (C1/25/23, stream order 2) outside the village of Emly (Figure 3.5). The channel was assigned an overall score of 9, in the middle of the range for Poor status. A number of factors contributed to the low score, with the key one being the lack of riparian cover and fencing. The channel is over-widened from historical drainage. It is not over-deepened and has no fence for the majority of the stretch, leaving it accessible to livestock. It is heavily poached from both banks and cattle freely access the instream area. Due to the lack of riparian cover and a buffer strip, algae was excessive on the day of the survey and hence the channel vegetation attribute scored badly.

The substrate condition scored poorly with an excessive amount of fine sediment within the wetted area. The bank structure and stability as well as the bank vegetation scored bad for both banks, due to the heavy poaching and patches of bare ground evident along the stretch. Instream vegetation indicated the channel was over-widened with shallow flows in places. Improved management of this stretch which include halting livestock access to the channel would easily improve the RHAT score in numerous attributes.



Figure 3.5 The Mahore River (C1/25/23) is heavily poached with unstable banks, large patches of closely cropped or bare ground and an absence of riparian cover. Vegetation is colonising the wetted area instream (right) demonstrating evidence the channel is over-widened.

A higher order river (stream order 5), which also scored Poor status at one site, was the Camoge River (C1/25) outside Meanus (Figure 3.6). It scored 9.5 overall, also keeping it in the mid-range of the Poor scores. The site was significantly over-widened and over-deepened with reinforcement to varying degrees along both banks, with rip-rap particularly evident along the right hand bank. Instream works were completed along this stretch of river between 2008 and 2010. A series of deflectors made of stone are evident instream, and they have not naturalised since being installed. There is also an intermediate weir recorded in the channel at this site. The deflectors do improve the flows in some parts of the river where it is over-widened but the artificial alterations to the channel form are quite evident throughout the stretch. The channel suffers with a lack of riparian shading as the riparian cover is mostly simple grasses and nettles. Along with the over-widening this has created an environment for

algae to thrive and it out-competes other instream vegetation types. Correspondingly the channel vegetation scored bad for this site. There is a large amount of silt on substrate throughout the reach so that attribute scored poorly.



Figure 3.6 Site on the Camoge River (C1/25). Artificial deflectors have not naturalised since installation (top). Bank reinforcement evident on over-widened channel and algae is dominant in the instream area (bottom).

3.2.3 Moderate status

The majority of sites (n=19, 68%) surveyed in the Mague catchment area were graded with Moderate status for hydromorphology. One of the sites which was classified as Moderate is on the River Clonshire (C1/17) which is one of the main tributaries of the Mague system (Figure 3.7). It achieved an overall score of 13, meaning that is it just within the threshold of Moderate, any lower and it would have been classified as Poor. The river demonstrates a trapezoidal shape from the drainage scheme and it is over-widened and over-deepened with respect to its discharge. Channel form and flow along with substrate condition both scored moderately. Algae dominated the wetted area along with minor amounts of invasive species so channel vegetation scored poorly. Minor reinforcement and poaching detracted from the bank structure and stability scores for both banks. Riparian vegetation was limited and it was heavily managed to the top of the right hand bank. An embankment was present along the majority of the left bank, reducing the floodplain connectivity to bad. Invasive species management along with water quality would need addressing at this site before other interventions could be implemented.



Figure 3.7 The River Clonshire (C1/17) showing minor reinforcement as well as management to the bank top (left). Ford on the Clonshire (right) showing very low water levels due to over-widening as well as algal growth.

A site with a mid-range moderate score was on the River Camoge (C1/25) at Monaster (Figure 3.8) with a score of 15. The extensive grazing by livestock and free access to the channel meant that this site was downgraded on the right-hand bank. Removing such unhindered access would improve the scores in various RHAT attributes. The channel is significantly over-widened and over-deepened from drainage works. There is evidence of previous instream works done along the stretch with sets of stone deflectors and large pools downstream. Most of the stone deflectors have not naturalised since installation. Channel form and flow is improved by the deflectors but flows and depths are still limited in parts, leaving this attribute with a moderate score. Algal growth in the wide shallow sections is extensive and it out-competes other flora along the stretch. In parts, vegetation is narrowing the over-widened channel. The bank structure/stability along with the bank vegetation score poorly for the right-hand bank due to the over-grazing. The left-hand bank scores moderately for vegetation as it is fenced and has some complex patches of shading. Fencing both banks would allow vegetation recovery both in the riparian zone as well as the instream wetted area.



Figure 3.8 Survey site on the River Camoge (C1/25) showing instream deflectors (left), grazing to the bank top and vegetation narrowing the channel (right).

In contrast to the previous two examples, the site on the River Drumcomoge outside Knocklong (C1/25, a tributary of the Camoge River) scores a lot higher, near the threshold of Good with a score of 18 (Figure 3.9). To achieve a good status for hydromorphology, the score would need to be improved by 1.5 overall. This channel was recently subjected to drainage maintenance by the OPW which encompassed good implementation of the 10-steps protocol. The channel scores good for channel form and flow types, channel vegetation as well as substrate condition. There are a variety of bedforms in the instream area including berms and mid-channel islands providing good heterogeneity in flows and depths. Some are established and vegetated whereas others are pioneer berms or islands in the process of establishing their form. The channel was over-widened and over-deepened and now it is trying to narrow its base width in line with its discharge through deposition of sediment and subsequent establishment of vegetation.



Figure 3.9 Drumcomoge River (C1/25) with established gravel bedforms and pioneer vegetation.

For both banks, bank structure and stability scores moderate – some sections are slumping and falling into the channel in places this is as a result of poor land management. . the left-hand bank is grazed to the bank top and there are only uniform grasses, so there is a lack of riparian shading and heterogeneity (Figure 3.10). With changes to land management and the management of the banks and riparian vegetation, the hydromorphology score could improve to good status.



Figure 3.10 Grazing to the bank top and an absence of riparian canopy cover on the Drumcomoge River (C1/25).



Figure 3.11 Poor land management where a small soil embankment was installed on the Drumcomoge River (C1/25) recently.

3.2.4 Good status

This site on the Flemingstown stream (C1/34/12, stream order 3) is located on the upper reaches of the Maigne system near Ardpatrik (Figure 3.12). Overall, the site scored Good status with a score of 19.5, meaning it is just within the range for Good status. The river is over-deepened and over-widened at this location due to historic drainage works but there is extensive recovery from re-sectioning evident throughout the stretch walked. The instream vegetation and substrate condition attributes both scored well. There is a nice mixture of coarse bedload with little fine sediment deposited, which would be expected for a channel in the upper reaches of the catchment. The channel has good riparian canopy cover and this also limits livestock access to the river, with only minor poaching evident in spots. The extensive canopy along the stretch contributes positively to the score for bank structure and stability. The stretch scored moderately for channel form and flow types. There is a homogenous channel shape due to the over-widening and over-deepening which in turn creates homogenous flows through the stretch. More diversity in flows and forms would be expected in an unmanaged channel of this type.



Figure 3.12 Good substrate condition, vegetation and riparian cover on the Flemingstown stream (C1/34/12). The channel trapezoidal-shaped channel has a limited range of depths and flows.

4 Barrier Screening and Assessment

The Maigne catchment has been surveyed for barriers using the Barrier Assessment and Screening Tool (i-BAST) developed by IFI's National Barrier Programme.

It was identified that the Maigne catchment consisted of 2,087 potential barriers which required assessment during this catchment wide survey. 1,682 potential barriers were visited and surveyed with a further 103 sites visited but not surveyed due to lack of access or safety issues, these are logged as 'No Access'. 302 of the potential barriers were located within the embankment zone of the Maigne which weren't visited as part of this survey. These structures are located in the lower reaches of the catchment within a 'flood protection zone'. To survey these structures was deemed overly time-consuming due to the inaccessibility and a safety issue and so they were excluded from this particular survey. These structures will be assessed at a later date by the National Barriers Programme. Barrier data is available on the IFI Open Data Portal (IFI (2025)).

A total of 102 barriers obstructing fish passage were identified throughout the catchment. Of these 102 structures identified, at least 40 are within OPW ownership and fall within the classification of culvert / bridge apron (n=39) and weir / sediment trap (n=1). Table 4.1 provides a breakdown of barrier numbers and Table 4.2 provides a breakdown of barrier types identified.

Table 4.1 Breakdown of barrier numbers

Structure type	Number
Potential points	2,087
No access	103
No barrier	1,580
Embankment Barriers (not surveyed)	302
Barrier	102
Total surveyed (barrier + no barrier)	1,682
Barrier % (barriers/ total surveyed)	6.06%

Table 4.2 Barriers identified and assessed in the Mague survey.

Structure type	Number
Culvert / bridge apron	72
Weir	27
Waterfall	1
Ford	2
Total	102

As seen in Table 4.1, culvert/bridge apron is the most abundant barrier type identified in the Mague Catchment. Structures assessed as barriers varied in size and were located on all stream orders. Exploring all barriers classified as a culvert/bridge apron, structure width ranged from 0.3–20 metres and structure length ranged from 3.5–40 metres.

Notable steps/drops off these structures are visible in Figure 4.2 with the drop heights varying between 0.1–0.68 metres. These obstacles situated at the foot of such structures present a jump barrier to fish movement longitudinally within the channel, and especially during lower flows. These elevated bridge apron/culverts often have shallow depths of water (0.01–0.20 metres) flowing over the floor of the structure which presents a possible swim barrier to migratory fish species. For context, depths of 0.15 metres or less present a swim barrier to fish, with the required swim depth varying according to the species in question.

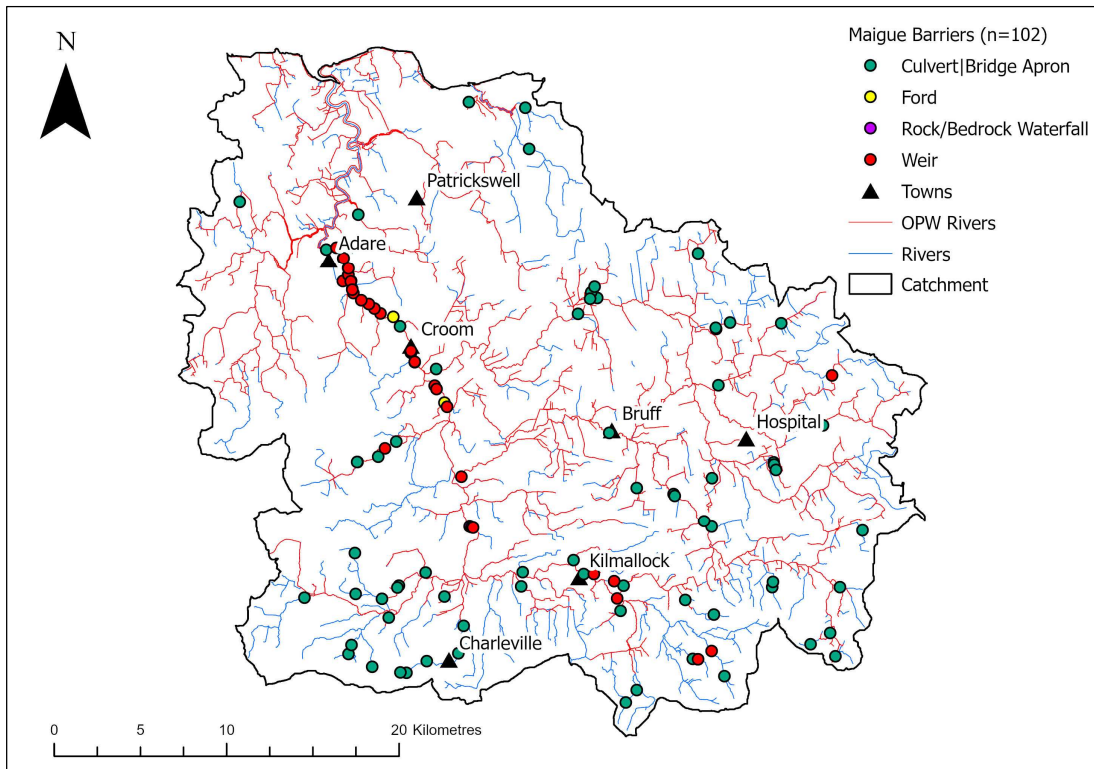
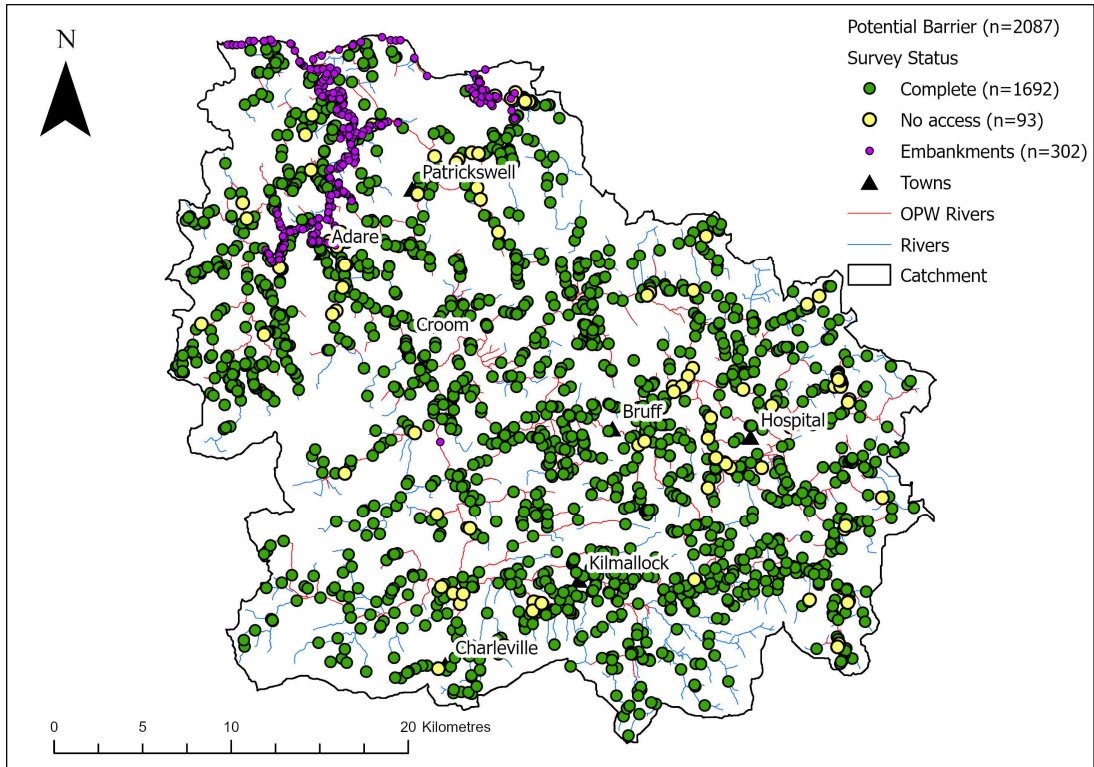


Figure 4.1 Potential barriers and survey status (top) and barriers identified and surveyed to date (bottom).



Figure 4.2 Examples of barriers classified as culvert / bridge apron. (a. 24_9_3; b. 24_9_6; c. 24_1688_46a; d. 24_795_76).

Taking a look at the main tributaries of the Maigue, focussing firstly on the Camoge; of the 20 bridge crossings on the channel, 3 bridges were flagged as issues for migratory fish species.

All of the bridges display similar characteristics which consists of a shallow bridge apron with a drop (Figure 4.3).



Figure 4.3 Problematic bridge aprons identified on the main stem of the Camoge (C1/25) (left: 24_711_42; right: 24_711_46).

Five barriers deemed to impede fish passage were located on the Morningstar, of which four were categorised as culvert/bridge apron. The other was a stone weir constructed in the lower reaches of the channel approximately 650 metres upstream from the confluence of the main Mague channel (Figure 4.4).



Figure 4.4 Top: Shallow bridge aprons posing both a jump and swim barrier to migratory species present on the Morningstar (C1/31) within 200m of each other (left: 24_792_26; right: 24_792_19). Bottom: stone weir present in the lower reaches of the channel.

On the Loobagh, four barriers were identified, of which two are classified as culvert/bridge aprons and two as weirs. One of the weir structures is an OPW owned Sediment Trap (ST12) and the other is a gauging station (Figure 4.5). The weirs identified on the Loobagh are at a much smaller scale than those on the main channel.



Figure 4.5 Weirs identified on the main stem of the Loobagh (C1/34). (Top: Sediment Trap [ST12]; Bottom: Gauging Station (24_729_24)).

4.1 Main stem barriers

27 existing weirs have been identified within this catchment, each varying in size and characteristics. 20 of these structures are found on the main Maigue on the 30 kilometre stretch of channel which flows from Bruree to Adare. This is a significant number of structures in a short distance hindering fish passage in the lower reaches of the Maigue. Although passable by salmonids as evident from fish distribution (see Figure 2.3 and Figure 2.4) navigating these abundant structures requires time and depletes energy which can have negative impacts on migratory species.

Of these 27 weirs, 18 of the larger structures have been surveyed using the WFD111 methodology developed by SNIFFER (Scotland and Northern Ireland Forum for Environmental Research, 2010) undertaken by the National Barrier Programme team. This method divides each structure into transects of similar hydraulic properties and surveys each representative transversal. Depending on each transversal type, various measurements are taken which include head height and dimensions. Flow and water depth is recorded at each transect at the inlet, mid-point and outlet with velocities recorded at 0.6 of the of depth reading. Based on the recorded measurements, each passing option is assessed for passability for a given target fish species and subsequently the structure is assigned a passability score.



Figure 4.6 Examples of structures present on the main stem of the Maigue River, all displaying similar characteristics.

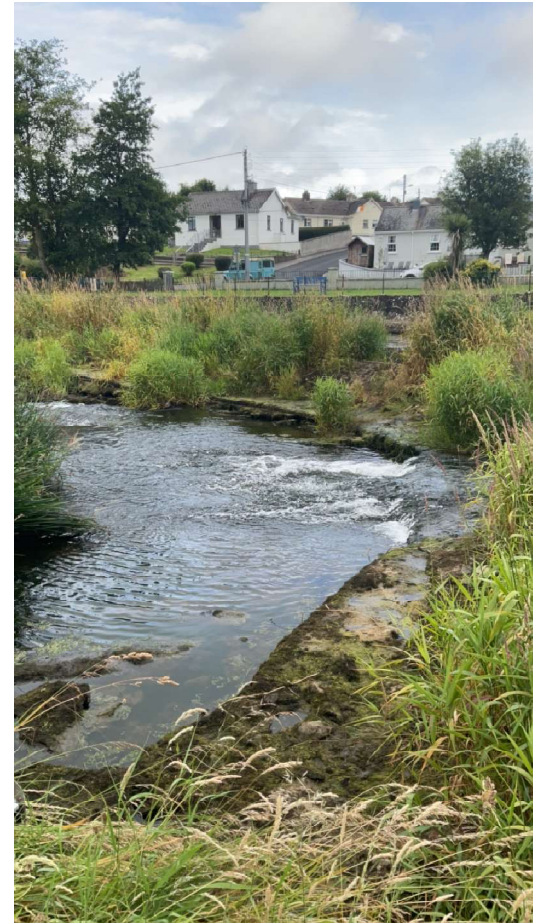


Figure 4.7 Examples of large structures on the main stem which were surveyed using the SNIFFER methodology (Left: Ford 24_216_7; Middle: Waterfall 24_191_36; Right: Weir 24_191_31).

Of the variety of structures surveyed on the main stem of the Mague, hydraulic head height ranges from 0.31-2.16 metres. The structure with the largest head height was the waterfall in Bruree (Figure 4.7) followed by the large weir located upstream of Croom (Figure 4.8). The majority of structures surveyed fell into the bracket of 0.5-0.9 metres which is representative of 12 weirs on the main stem. All structures present similar characteristics of a weir with a relatively low hydraulic head and a single fish pass in the centre. Weirs present on the main channel varied in width from 12-123 metres. The structure displaying a crest width of 123 metres was located upstream of Croom (Figure 4.8).



Figure 4.8 Drone imagery of the weir upstream of Croom. The weir has a crest width of 123 metres and a head height of 1.1 metres.

5 Catchment context

5.1 Water quality

Water quality can be accessed on the Environmental Protection Agency website. For the Maigne Catchment, it was assessed in 2023, the year previous to this catchment wide survey. Similar to other WFD metrics, Good status is the requirement. 30 sites were monitored for water quality in 2022. 20% (n=6) of the sites passed the minimum requirement and received a classification of Good status. The remainder of the sites (80%) failed to pass WFD standards, of which 17 sites (57%) scored Moderate and 7 sites (23%) were classified as Poor (Figure 5.1).

Exploring water quality scores from the 2023 assessment, it is noted that the main tributaries of the catchment mostly score Moderate status. All four of the sampling sites on the Camoge scored Moderate as well as some sites on the Morningstar and the Loobagh. The upper sections of the Morningstar and the Loobagh scored a higher classification of Good. Sites scoring poor are located within the Clonshire watershed and on the upper reaches of the Barnakyle. Salmonids generally fare better at sites with Q3 and above i.e. Moderate, Good and High (Kelly *et al.*, 2007).

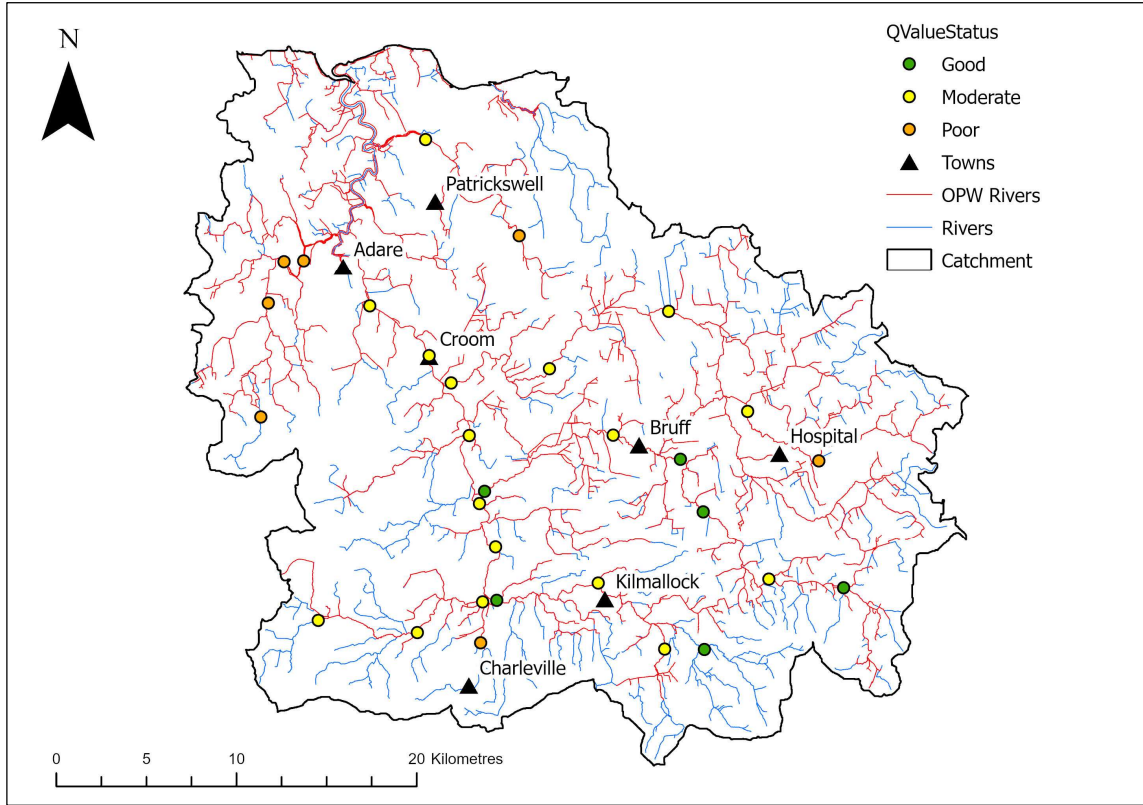


Figure 5.1 Water quality assessments undertaken by the EPA in 2023.

5.2 Pressures

There are ten sub-catchment units within the survey area, following the EPA WFD regions (Figure 5.2). Their mainland uses and pressures are summarised in Table 5.1 using data from the Water Framework Directive Application (EPA, 2025b) and an online map portal (EPA, 2025a). Pasture is the main land use across all of the sub-catchment regions and correspondingly agriculture is a significant pressure across 9 of the 10 regions. There is a large amount of urban areas within the Maigne catchment area, with urban waste water being a pressure in 7 of the 10 sub-catchment areas.

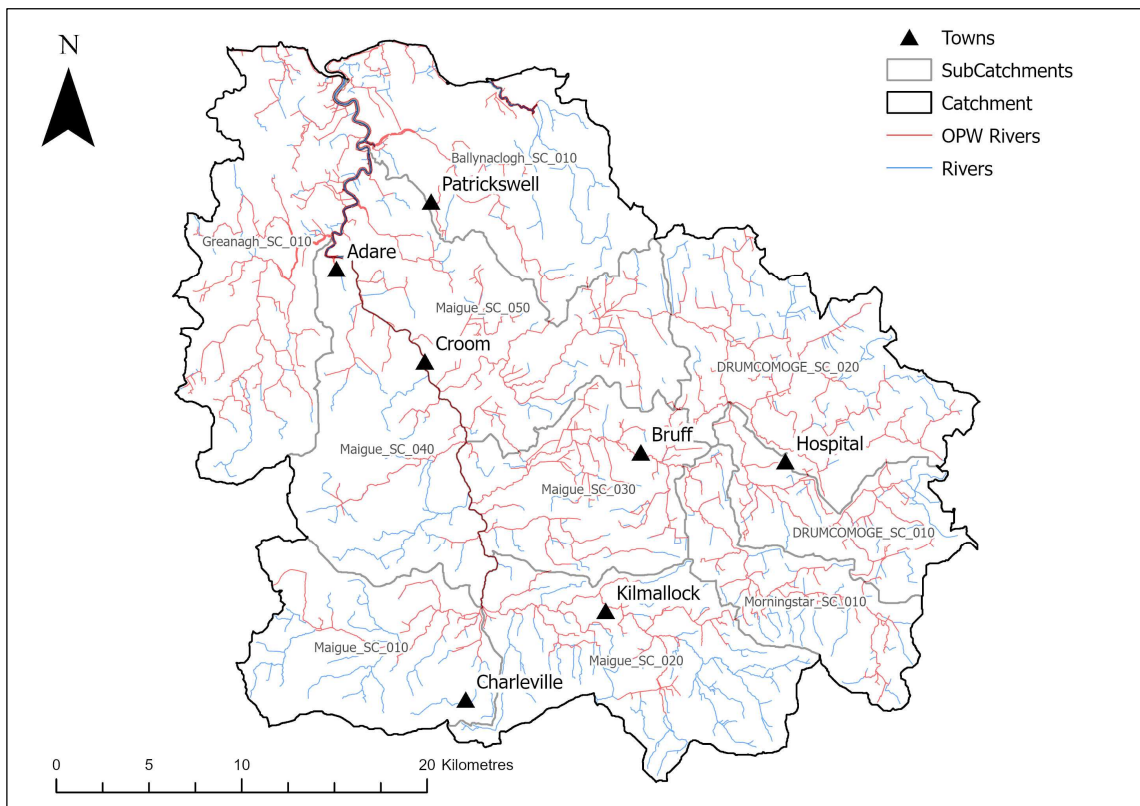


Figure 5.2 Sub catchments within the Maigne Catchment.

Hydromorphology is a pressure in four of the sub-catchment regions, sub-categorised into drainage and channelisation: Ballynaclogh_SC_010 (channelisation); Drumcomoge_SC_010 (channelisation); Maigue_SC_030 (drainage); Maigue_SC_050 (drainage and channelisation). Arterial Drainage Maintenance has the potential to adversely affect hydromorphology. There were nine RHAT surveys completed in these sub-catchments where hydromorphology is a significant pressure and all sites scored Moderate or Poor. For the Ballynaclogh_SC_010 sub-catchment where channelisation is an issue, there was one RHAT survey on the Barnakyle

River (C1/10) with a Moderate status (overall score 13) which was straightened and deepened with some recovery from those historic alterations. There were two sites on the Drumcomoge_SC_010 sub-catchment where channelisation is a pressure, and both were on the Drumcomoge River (C1/25). One site at Knocklong scored Poor (overall score 9) with evidence of extensive interference and minimal recovery from historic alterations. In contrast, the other site on the Drumcomoge River scored a high Moderate (overall score 18) and has potential to achieve Good status. Natural features such as boulders, woody habitat and meanders were present in the channel (see Figure 3.9, Figure 3.10, Figure 3.11). Three sites were located in the Maigne_SC_030 sub-catchment where drainage is listed as the pressure. All sites scored Moderate status and over-widening was one of the main issues. Two sites were on the Morningstar River (C1/31) at Bruff (overall score 13.5) and Athlacca (overall score 14) and both were subject to extensive over-widening. Another was on a small tributary of the Maigne, the Ballyania stream (C1/32) where extensive over-widening was also evident (overall score 16.5). These historic alterations have negative impacts on the channel form and flows. In the Maigne_SC_050 sub-catchment, both drainage and channelisation were listed as pressures. Three RHAT surveys were completed on the River Camoge (C1/25), with two scoring Poor and one Moderate. Extensive over-widening was evident on all three channels with negative implications for velocities and depths. The most upstream site near Holycross scored Poor (overall score 12.5), with the second closer to Meanus also scoring Poor (overall score 9.5, see Figure 3.6). Artificial deflectors were used at the site to improve flows in areas of over-widened channel but overall, alterations were too extensive. The final site on the Camoge was at Monaster and it scored Moderate (overall score 15, see Figure 3.8). With extensive over-widening, artificial deflectors had been used to improve flows in the over-widened river and there was some evidence of recovery to the channel.

Table 5.1 Land use and pressures per sub-catchment

Subcatchment	Urban Area	Land use (*main)	Significant pressures
Ballynaclogh_SC_010	Limerick Mungret	Pasture* Urban areas	Agriculture Anthropogenic pressures Domestic waste water Hydromorphology Industry
DRUMCOMOGE_SC_010	Knocklong Hospital Emly Knockainy	Pasture* Cut Peat	Agriculture Hydromorphology Urban waste water
DRUMCOMOGE_SC_020	Herbertstown Kilteely Hospital	Mixed cultivation Pasture* Peat	Agriculture Anthropogenic pressures Domestic waste water Urban waste water
Greanagh_SC_010	Pallaskenry New Kildimo Ballingarry	Pasture* Forestry Marsh Other agricultural land Urban areas	Agriculture Anthropogenic pressures Domestic waste water Urban waste water
Maigue_SC_010	Charleville Ballyagran Milford	Pasture* Other agricultural land Forestry Urban areas	Agriculture Domestic waste water Industry Urban waste water
Maigue_SC_020	Kilmallock Kilfinane Ardpatrick Bruree	Pasture* Forestry	Agriculture Anthropogenic pressures Industry
Maigue_SC_030	Bruff Athlacca	Arable land Pasture* Urban area	Agriculture Domestic waste water Hydromorphology Industry Urban run-off Urban waste water

Subcatchment	Urban Area	Land use (*main)	Significant pressures
Maigue_SC_040	Adare Croom Bruree Rockhill	Pasture* Other agricultural land Forestry Urban areas	Agriculture Anthropogenic pressures Industry Urban waste water
Maigue_SC_050	Holycross Meanus Fedamore Croom	Pasture* Arable land Transitional woodland scrub Urban areas	Agriculture Anthropogenic pressures Domestic waste water Hydromorphology Industry Urban waste water
Morningstar_SC_010	Ballylanders Elton	Pasture* Forestry Other agricultural land	No significant issues, waterbodies not at risk

6 Conclusion

39 sites were surveyed for fish status, 37 of which using a ten-minute bank-based electro-fishing method and 2 using boat based methods (CEN, 2003). The Ecological Quality Ratio results indicate that 31% of the sites on the Maigue meet the minimum requirements of Good status with 1 out of these 12 sites achieving High status. 28 sites were surveyed using the River Hydromorphology Assessment Technique. 7% of sites were classed as Good, with the remainder failing to achieve the required standard. Of the averaged attributes, floodplain connectivity, riparian land use scored the lowest followed by channel vegetation and substrate condition. Water quality data accessible on the Environmental Protection Agency website (EPA 2025a) demonstrates that in 2022, 20% (n=6) of sites passed the minimum requirement of Good status. 57% (n=17) of sites were categorised as Moderate and 23% (n=7) scored as Poor. These results are all summarised in catchment maps in Appendix 7.4. A total of 102 barriers to fish passage were identified and measured in the Maigue catchment overall, which is a proportion of 6%, relatively low in comparison to recent catchment-wide surveys (Fleming *et al.*, 2023). That said, there is a high number of large weirs on the Maigue main channel. Pasture is the dominant land uses in the catchment. Much of the catchment is poorly – moderately draining soils and agriculture is a significant pressure on water quality.

The RHAT attribute substrate condition is on average Poor in the Maigue compared to other catchment-wide surveys (Fleming *et al.*, 2023). Good clean substrate provides important spawning habitat for fish. The lowest scoring attributes include Channel Vegetation and Substrate Condition.

Hydromorphology and anthropogenic pressures also feature as potential threats to water quality. The water quality is quite poor across the catchment area, with problem sites related to specific local pressures.

Water quality is a downfall for the Maigue catchment, with only 7 of the 30 monitoring sites passing the minimum requirement of Good Status. Majority of sites scored moderate including the main tributaries such as the Camoge, Loobagh and the Morningstar. Poor water quality was graded in the Clonshire watershed and the upper reaches of the Barnakyle. With that said, gains can be made with regards to habitat quality (see appendix 7.1) and some of these recommendations would also facilitate protecting good water quality. Recommendations include fencing, planting and retaining buffer strips.

Implementation of any recommendations proposed in this report is subject to staff availability and monetary resources and such works are in no respect obligatory.

It is worth noting that when undertaking catchment wide assessments over a large study areas numerous pressures are identified as a result of the impact of non-compliance mannerisms by numerous stakeholders. These actions can be an issue on their own or in-combination with other pressures to have a significant impact. The recommendations in this report should be circulated to relevant stakeholders who may have the resources and capability to incorporate restoration and or improvement measures into their own plans/programmes as some of these recommendations lie outside of the OPWs remit.

7 Appendix

7.1 RHAT: habitat works recommendations

Latitude	Longitude	Site Code	Channel reference	River	Sum of attribute scores	WFD class	Pool Riffle	Gravel	Deflectors	Stepped Structures	Random Boulder	Berm Management	Thalweg	LWD Introduced	Barrier Removal /Mitigation	Bank Protection	Offline Drinkers	Fencing	Tree Management	Planting
-8.662809	52.424007	Site 25	C1 Maigne Outfall	Maigne	4	Bad									✓					
-8.718559	52.5189	Site 49	C1 Maigne Outfall	Maigne	5	Bad								✓	✓					
-8.365518	52.478909	Site 41	C1/25/23	Mahore	9	Poor			✓				✓	✓			✓	✓		✓
-8.417448	52.442151	Knocklong	C1/25	DRUMCOMOGE	9	Poor	✓		✓					✓	✓			✓		✓
-8.685257	52.479471	Extra site	C1 Maigne Outfall	Maigne	9	Poor			✓				✓	✓						
-8.607245	52.523491	Site 47	C1/25	Camoge	9.5	Poor	✓							✓	✓					✓
-8.546846	52.54101	Site 36	C1/25	Camoge	12.5	Poor		✓	✓				✓	✓						
-8.656936	52.586472	Site 2a	C1/10	Barnakyle	13	Moderate		✓							✓		✓	✓		
-8.830369	52.585729	Site 16	C1/17/4	CURRAHCHASE	13	Moderate											✓			✓
-8.837712	52.56502	Site 50	C1/17	Clonshire	13	Moderate	✓	✓	✓					✓						✓
-8.773915	52.540761	Site 14	C1/20	Dunnaman	13.5	Moderate	✓	✓						✓			✓	✓	✓	✓
-8.54972	52.474106	Morningstar	C1/31	Morningstar	13.5	Moderate	✓	✓	✓				✓	✓						
-8.651017	52.458744	Site 52a	C1/31	Morningstar	14	Moderate		✓					✓	✓						
-8.665511	52.517863	Site 46	C1/25	Camoge	15	Moderate								✓			✓	✓		✓
-8.428614	52.508806	Site 9	C1/25/23/1	BALLYNAMONA	15	Moderate	✓		✓					✓			✓			✓

Latitude	Longitude	Site Code	Channel reference	River	Sum of attribute scores	WFD class	Pool Riffle	Gravel	Deflectors	Stepped Structures	Random Boulder	Berm Management	Thalweg	LWD introduced	Barrier Removal /Mitigation	Bank Protection	Offline Drinkers	Fencing	Tree Management	Planting
-8.380756	52.494318	Site 7	C1/25/23/4/2	KILLEENNAGALLIVE	15.5	Moderate	✓							✓			✓			✓
-8.457815	52.493136	Site 44	C1/25/23	Mahore	15.5	Moderate	✓		✓					✓		✓	✓	✓		✓
-8.738959	52.465402	Site 30	C1/30	West Liskennett	15.5	Moderate	✓	✓					✓	✓						
-8.460829	52.425425	Site 43	C1/31	Morningstar	15.5	Moderate	✓	✓	✓				✓	✓						✓
-8.496375	52.375167	Site 53	n/a	Loobagh	15.5	Moderate													✓	✓
-8.764204	52.382482	Site 20	C1 Mague Outfall	Maigue	16	Moderate	✓	✓					✓	✓						
-8.663863	52.438185	Site 34a	C1/32	Ballyania stream	16.5	Moderate	✓	✓					✓	✓			✓	✓		
-8.378733	52.404781	Site 37	C1/31	Morningstar	17	Moderate								✓						✓
-8.623974	52.400899	Site 51	C1/34	Loobagh	17.5	Moderate	✓		✓				✓	✓						
-8.43889	52.456481	Site 42	C1/25	DRUMCOMOGE	18	Moderate								✓		✓	✓	✓		✓
-8.541872	52.388046	Site 38	C1/34	Loobagh	18.5	Moderate								✓						✓
-8.715063	52.39002	Site 18	C1 Mague Outfall	Maigue	19.5	Good	None required/feasible here													
-8.531206	52.36423	Site 8	EXT @ 38/00 L.B C1/34/12	Flemingstown (Stream)	19.5	Good	✓						✓	✓			✓	✓		

RHAT WFD class and associated score:

WFD Class	Sum of attribute scores
High	≥ 26
Good	≥ 19.5 to < 26
Moderate	≥ 13 to < 19.5
Poor	≥ 6.5 to < 13
Bad	< 6.5

7.2 RHAT: 10 steps recommendations*

*following Brew & Gilligan (2019)

Latitude	Longitude	Site Code	Channel reference	River	Sum of attribute scores	WFD class	Protect Bank Slopes	Restrict Maintenance	Spoil Management	Selective Vegetation Removal	Leave Section Untouched	Management of Trees	Berm Management	Replace Stones and Boulders	Loosen Gravel Beds	Re-profile Channel Bed
-8.662809	52.424007	Site 25	C1 Mague Outfall	Mague	4	Bad					✓					
-8.718559	52.5189	Site 49	C1 Mague Outfall	Mague	5	Bad					✓					
-8.365518	52.478909	Site 41	C1/25/23	Mahore	9	Poor	✓						✓			✓
-8.417448	52.442151	Knocklong	C1/25	DRUMCOMOGE	9	Poor					✓	✓				
-8.685257	52.479471	Extra site	C1 Mague Outfall	Mague	9	Poor										✓
-8.607245	52.523491	Site 47	C1/25	Camoge	9.5	Poor						✓				
-8.546846	52.54101	Site 36	C1/25	Camoge	12.5	Poor										✓
-8.656936	52.586472	Site 2a	C1/10	Barnakyle	13	Moderate					✓					

Latitude	Longitude	Site Code	Channel reference	River	Sum of attribute scores	WFD class	Protect Bank Slopes	Restrict Maintenance	Spoil Management	Selective Vegetation Removal	Leave Section Untouched	Management of Trees	Berm Management	Replace Stones and Boulders	Loosen Gravel Beds	Re-profile Channel Bed
-8.830369	52.585729	Site 16	C1/17/4	CURRAHCHASE	13	Moderate					✓					
-8.837712	52.56502	Site 50	C1/17	Clonshire	13	Moderate					✓					
-8.773915	52.540761	Site 14	C1/20	Dunnaman	13.5	Moderate	✓	✓			✓	✓			✓	✓
-8.54972	52.474106	Morningstar	C1/31	Morningstar	13.5	Moderate	✓	✓			✓					✓
-8.651017	52.458744	Site 52a	C1/31	Morningstar	14	Moderate		✓								
-8.665511	52.517863	Site 46	C1/25	Camoge	15	Moderate		✓		✓	✓					
-8.428614	52.508806	Site 9	C1/25/23/1	BALLYNAMONA	15	Moderate	✓	✓			✓					✓
-8.380756	52.494318	Site 7	C1/25/23/4/2	KILLEENNAGALLIVE	15.5	Moderate	✓	✓			✓	✓				
-8.457815	52.493136	Site 44	C1/25/23	Mahore	15.5	Moderate	✓				✓	✓				
-8.738959	52.465402	Site 30	C1/30	West Liskennett	15.5	Moderate					✓					
-8.460829	52.425425	Site 43	C1/31	Morningstar	15.5	Moderate	✓				✓	✓				✓
-8.496375	52.375167	Site 53	n/a	Loobagh	15.5	Moderate					✓					
-8.764204	52.382482	Site 20	C1 Mague Outfall	Maigue	16	Moderate					✓	✓				✓
-8.663863	52.438185	Site 34a	C1/32	Ballyania stream	16.5	Moderate					✓	✓				✓
-8.378733	52.404781	Site 37	C1/31	Morningstar	17	Moderate		✓			✓					
-8.623974	52.400899	Site 51	C1/34	Loobagh	17.5	Moderate										✓
-8.43889	52.456481	Site 42	C1/25	DRUMCOMOGE	18	Moderate					✓					
-8.541872	52.388046	Site 38	C1/34	Loobagh	18.5	Moderate					✓					
-8.715063	52.390021	Site 18	C1 Mague Outfall	Maigue	19.5	Good					✓	✓				
-8.531206	52.364227	Site 8	EXT @ 38/00 L.B C1/34/12	Flemingstown (Stream)	19.5	Good					✓					✓

7.3 Barrier identification and prioritisation

Longitude	Latitude	Relative project size	U28 ID *	OPW channel reference	River	Nature of Obstruction	Photo page number
-8.7646489	52.5866843	small	24_1688_46a	C1/15	Mondellihy	900m pipe culvert too high creating a small drop	-
-8.696918	52.5065135	medium	24_796_35	C1/25 [B2]	Camogue	historic bridge with shallow apron and a minor drop	-
-8.5658193	52.5437294	medium	24_711_46	C1/25 [B11]	Camogue	3 eyed bridge with drop off apron	32
-8.559813	52.5441352	medium	24_711_42	C1/25 [B12]	Camogue	3 eyed bridge with drop off apron, evidence of some remediation attempted	32
-8.3661754	52.4787179	medium	24_764_59	C1/25/23 [B8]	Mahore	shallow apron with minor drop; access hindered so measurements taken from bridge	-
-8.4557179	52.4992114	small	24_157_11	C1/25/23/1 [B1]	Ballynamona	shallow apron with minor drop	-
-8.6743728	52.4507161	small	24_838_250	C1/31	Morningstar	small stone weir ds of railway bridge, creating impoundment	-
-8.5484697	52.4740985	large	24_795_76	C1/31 [B9]	Morningstar	4 eyed bridge with water only flowing through 3 eyes; sloping bedrock apron with shallow depths and drops out of three eyes	31
-8.4922997	52.4415815	medium	24_792_19	C1/31 [BX]	Morningstar	shallow apron with a drop	33
-8.4672246	52.4284372	small	24_1131_154	C1/31/17 [B1]	Morningstar Trib	shallow apron with a drop	-
-8.5608655	52.400136	large	24_754_27	C1/34 [ST12]	Loobagh	sediment trap	-
-8.540831	52.387539	medium	24_729_24	C1/34	Loobagh	gauging/water abstraction station, concrete weir face	34
-8.7302876	52.4686329	medium	24_423_324	C1/30 [BX]	West Liskennett	shallow apron with a drop	-
-8.7399045	52.4650165	large	24_423_273	C1/30 [B5]	West Liskennett	large shallow apron with a significant drop	-
-8.7397247	52.4650818	large	24_423_274	C1/30	West Liskennett	stone weir located ds of bridge creating an impoundment	-
-8.7631316	52.4579313	small	24_423_125	C1/30	West Liskennett	shallow apron with a minor drop	-

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