03 - IRELAND CHANGING THE SCALE OF HEAVILY MODIFIED WATERS BODIES DESIGNATED UNDER THE WATER FRAMEWORK DIRECTIVE

Nathy Gilligan[1] and Emma Quinlan[2]
[1] *Head of Environment, Office Public Works.*
[2] *Catchment Science and Management Unit, Environmental Protection Agency.*

Abstract
Multiple water sector authorities in Ireland are finalising a process to review the Heavily Modified Water Body (HMWB) designation nationally in preparation for the Water Framework Directive (WFD) third cycle of River Basin Management Plan 2022-2027. The largest grouping of waters which have being physically modified for a specified use are the national network of arterial drainage channels, comprising 11,500km of channel. In compliance with the WFD, there is a prescribed process for the designation of water bodies as HMWB which embeds a series of requirements. OPW and EPA working collaboratively are executing this process and are moving to a position of designating arterial drainage a portion of channels as HMWB.

In comparison to other EU member states, Ireland has currently designated low numbers of HMWBs at 0.5%. The re-evaluation of the large network of arterially drained channels and the recommended increased to 4% is closer to the EU norm of circa 15% for rivers. A further batch of river water bodies, while having a significant physical change, are not designated as heavily modified as they may have potential to achieve good ecological status when nutrient issues are resolved. At a later WFD cycle, if these water bodies move to HMWB, this would bring Ireland to 22% of rivers as HMWB. The increase in HMWB designation for rivers is a truer reflection of the scale of physical alteration and associated hydromorphlogical pressures that exist in the State.

The WFD objective for these new HMWBs will become Good Ecological Potential as opposed to Good Ecological Status which inherently recognises that these channels have been substantially changed in character due to physical alteration. In practice on the ground, this will not change the way in which channel maintenance is environmentally managed, as HMWBs are obligated to achieve as high an environmental standard as feasible and implement all compatible restorative/enhancement measures, similar to the current environmental management ethos. However, as the WFD implementation evolves in Ireland with more and more site inspections and monitoring by agencies such as EPA and LAWPRO, pressures such as hydromorphology (physical alteration) and siltation are now understood as much larger than previously thought, in many cases being the main pressure. The focus to reduce these pressures on ecological status will intensity and will bring further change to how authorities environmentally manage activities in rivers.

1. WATER FRAMEWORK DIRECTIVE
The Water Framework Directive (WFD) establishes a legal framework to protect and restore clean water across Europe and to ensure its long-term, sustainable use. It aims to do so by ensuring effective water management based on catchments with the requirement for member states to produce River Basin Management Plans (RBMP). These plans must, amongst other things, assess the environmental pressures causing water bodies not meeting the objectives of the Directive. The Directive sets out six yearly planning cycles: 1st cycle 2009-2015, 2nd cycle 2016-2021, 3rd cycle 2022-2027, during which management measures must be implemented to achieve these quality objectives for all waters. Work

is now underway in Ireland on the preparation of the third cycle RBMP covering the period up to the end of 2027.

The WFD aims at protecting all waters with water bodies being delineated for five primary categories of waters i.e. Rivers, Lakes, Transitional waters (estuaries), Coastal waters and Groundwater. Similarly, waters are classified into five quality classes (status) under the WFD as Figure 1. The overarching aim of the Water Framework Directive is to achieve at least good status for all water bodies which embodies both ecological and chemical standards. Ecological status indicates if a natural water body is being damaged by pollution or habitat degradation. Waters in high and good ecological status show only minor or slight changes from natural conditions whereas waters at less than good status (moderate, poor or bad) range from moderately to severely damaged by pollution or habitat degradation.

Figure 1: *WFD Status classes*

2. CURRENT CONDITION OF WATERS

The WFD looks at ecological quality by examining a range of biological indicators or Quality Elements whose presence and abundance indicate the ecological health of the water body. These quality elements include phytoplankton, macroalgae, aquatic plants, macroinvertebrates and fish with supporting physico-chemical and hydromorphological quality elements, all combined to assess the ecological status or ecological health of the water body.

Overall, 53% of surface water bodies (i.e. rivers, lakes, transitional waters, coastal waters) assessed are in satisfactory ecological health being in either good or high ecological status. The remaining 47% of surface water bodies are in moderate, poor or bad ecological status (Figure 2).

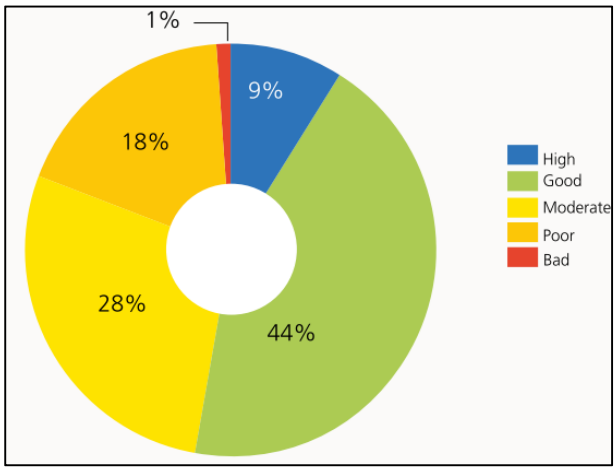

Figure 2: *Surface water ecological status 2013-2018*

In terms of change since the last full assessment in 2010-2015, 68.4% (1,831) of water bodies did not change in status, 18% (481) declined and 13.6% (364) improved. This resulted in an overall net decline in 117 surface water bodies or 4.4%. This was nearly entirely driven by the decline in river water bodies, with a net decline in 128 water bodies or 5.5%.. Combined with a continuing decline in the proportion of high status river water bodies, these findings indicate that river water quality is getting worse after a period of relative stability and improvement. In terms of lakes, the picture is more positive with a number of water bodies having improved in status and the overall picture for lakes being relatively stable since the baseline assessment in 2007-2009.

This trend of deterioration is also reflected in the wider environment as reported under the Habitats Directive. The overall national status of habitats is that 85% of habitats are in Unfavourable (i.e. Inadequate or Bad) status, with 46% of habitats demonstrating ongoing decline, comprising a diversity of habitat types, both aquatic and terrestrial. Species show slower loss trends with 30% in Unfavourable status (i.e. Inadequate or Bad) and 15% demonstrating ongoing decline.

3. PRESSURES ON WATER ENVIRONMENT

The aquatic environment in Ireland is subjected to impacts from many different human activities. As Figure 3, the top four significant pressures impacting water quality in Ireland include agriculture, waste water discharges, impacts to the physical habitat conditions including excess fine sediment (hydromorphology), and pressures from forestry activities. Other significant pressures include pollution from diffuse urban run-off and industry and pressures caused by peat extraction, mining and quarrying. Over half of water bodies that are impacted, are impacted by more than one pressure type.

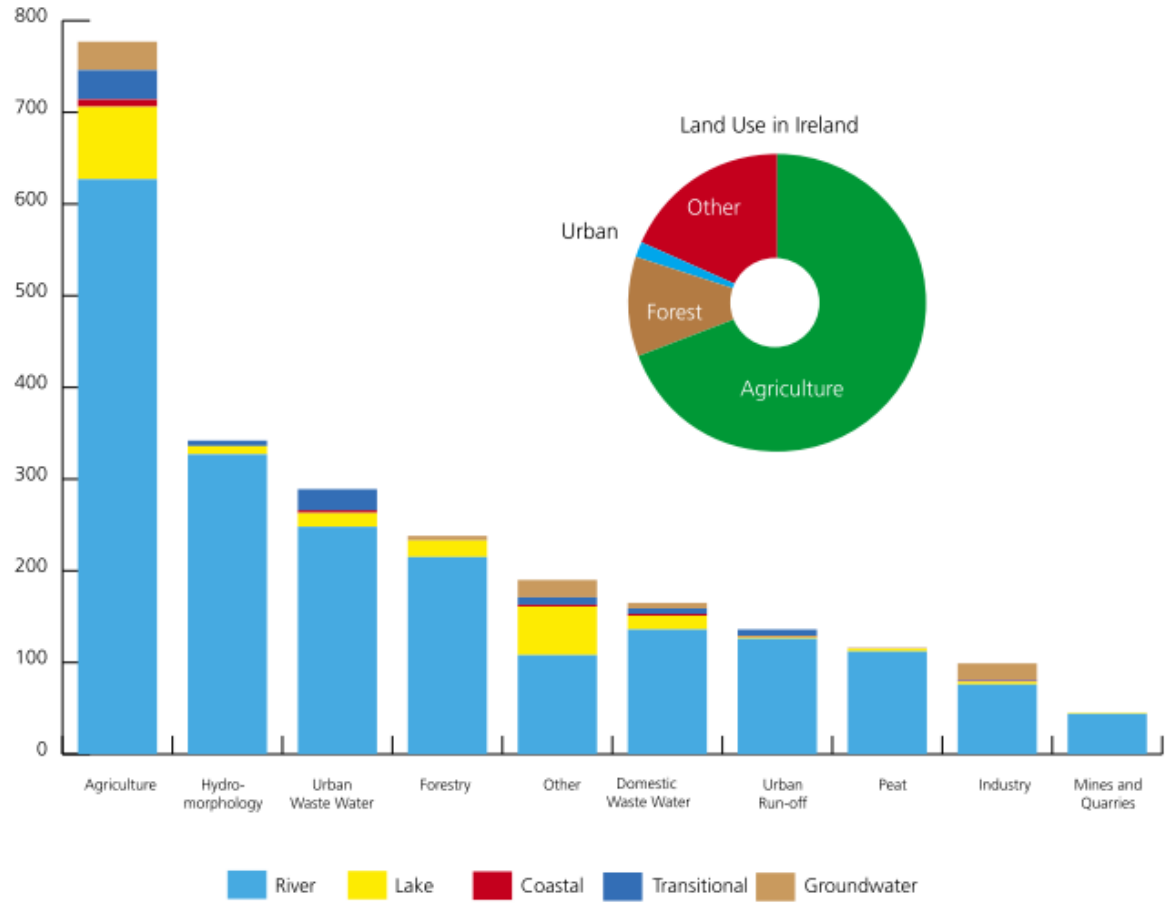

Figure 3: *Significant pressures on Ireland's aquatic environment*

The deterioration in water quality, and in particular river water quality, seen since 2015 indicates an increase in pressures coming from human activities. The most significant pressure impacting waters is nutrient pollution (nitrogen and phosphorus) with agriculture and wastewater being the main sources of nutrient losses to waters. However, alteration of hydromorphological conditions is ranked as the 3rd most significant pressure for surface waters overall but raises to the 2nd most significant pressure for river water bodies only.

4. HYDROMORPHOLOGY

The physical condition (hydromorphology) of surface water bodies provides the habitat and natural processes to support and maintain healthy aquatic ecosystems. Pressures impacting natural flow and silt transport processes can alter the structure of ecosystems, leading to habitat degradation. While silt plays an important role in supporting aquatic ecosystems, excessive levels above that expected for certain physical settings, can be detrimental to freshwater and marine life, particularly if it is associated with other pressures such as nutrients. Hydromorphological pressures include physical alterations to channels and banks, alterations to the flow or water level regime, and the loss of connectivity within the adjoining floodplains. These pressures can include straightening, widening, deepening and dredging channels, removal of riparian vegetation, land drainage, abstraction, traditional flood protection structures and development adjacent to surface waters. In addition, structures such as culverts, locks, weirs and dams, act as barriers to the longitudinal continuity which can impact the migration of fish and eel and impede the natural siltation process i.e. downstream movement of riverine material from coarse gravels to fine silt. In accordance with the WFD, the Hydromorphology of river water bodies comprises of the elements as in Table 1.

Table 1: *Hydromorphological Quality Elements for Rivers*

River	**Hydromorphological Quality Elements**	
	Hydrological regime	quantity and dynamics of water flow
		connection to groundwater bodies
	River continuity	longitudinal and lateral connectivity
	Morphological conditions	river depth and width variation
		structure and substrate of the river bed
		structure of the riparian zone

For activities such as arterial drainage schemes, the physical effects of the schemes impact channel hydromorphology through altering the hydrology and channel form, the instream and riparian condition, as well as river continuity, particularly lateral connectivity. The physical impacts, in turn, impact the biological quality elements and potentially the ecological status of the river.

In terms of assessing hydromorphology, there are two methodologies used in Ireland for hydromorphjologcial assessment of rivers i.e. Morphological Quality Index (MQI) and River Hydromorphological Assessment Technique (RHAT). The RHAT score provides a quality rating for a suite of hydromorphology elements and gives insight to the physical habitat quality at site specific scale. RHAT surveys have been ongoing as part of the joint OPW and IFI scientific monitoring within a specific catchments under the Environknetal River Enhancement Programme (ERREP). Figure 4 shows the results of over two hundered RHAT assessment completed on arterially drained channels.

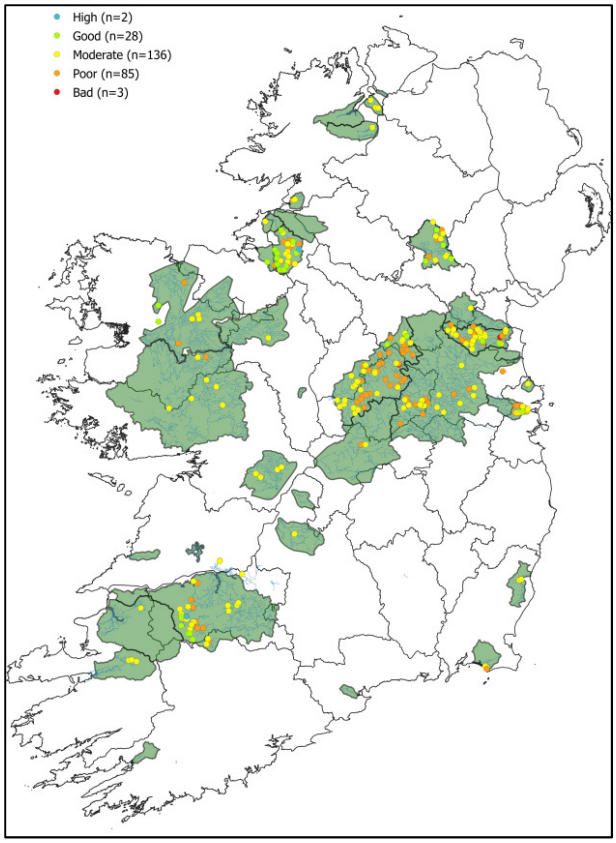

Figure 4: *RHAT scores on arterially drained channels*

From a total of 254 RHAT assessments on arterial drained channels, 12% are Good or higher with 88% below Good, predominatently in the Moderate (54%) and Poor (33%) categories. This reflects the fact that arterial drainage works result in a number of hydromorphological changes reduced flood plain connectivity and un-natural channel form.

5. ARTERIAL DRAINAGE AND FLOOD RELIEF

Ireland by its nature is liable to flooding and drainage problems principally due to the fact that the country has a relatively low-lying interior surrounded by coastal highlands. Many major rivers are sluggish in character and this coupled with relatively high rainfall, inevitably leads to chronic drainage problems. The OPW is the body through which Central Government exercises its statutory responsibilities in respect of river drainage and flood relief. Between 1945 and 1995, the OPW completed 34 Arterial Drainage Schemes on river catchments together with 5 Estuarine Embankment Schemes, benefiting 263,000Ha of lands. The OPW has a statutory responsibility for the maintenance of these schemes consisting of over 11,500km of channel and 730km of embankments, some 18,500 bridges and 750 ancillary structures such as sluice gates and pumping stations. Approximately 2,000km of channels are maintained annually.

Construction of the original Arterial Drainage Schemes required major hard engineering, widening and deepening the existing channel with some localised straightening and, in a few cases,the opening of a new channel reach. Works entailed excavation of all soil types such as peat, clays and gravel while rock was normally blasted. The channel cross section was excavated to a trapezoidal form, channel width was standardised, longitudinal gradients were made more uniform and cross sectional bed levels were made even. All instream and riparian vegetation and soils were removed and access for construction plant was made along the channel banks. In schemes prior to circa 1973, excavated

material was stockpiled in spoil heaps setback parallel to the channel and post 1973, the spoil was levelled out on riparian lands. Typically the riparian water table would have been dropped by circa one metre although this value would vary widely depending on a number of characteristics such as soils, geology, topography, catchment hydrology and design factors. Arterial drained channels differ from more natural channels in that the waterway has significantly more uniform flow velocities,more constant depth/width ratios, a reduction in connectivity to floodplains but with more instream storage.

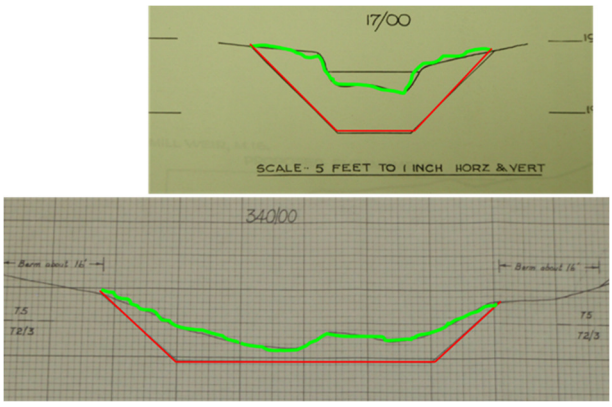

Figure 5: *Typical cross sections of historic Arterial Drainage Scheme design (Green – original ground, Red – design level)*

Maintenance works entail a much more moderate approach in construction activities and are executed within a framework of environmental work practices. The purpose of arterial drainage maintenance is to retain the scheme channel's design and outfall for drainage for the riparian lands as set by the original scheme. Following the initial scheme works, channel capacity will gradually reduce as both silt and vegetation levels increase and other obstructions develop, necessitating maintenance to return the channel capacity to it's design condition. This is achieved by removal of the silt and vegetation, repairing bank damage or slippage and removal of obstructions such as trees encroaching at low levels on the banks. The material removed is normally spread along the bank or on top of existing spoil heaps where present. In most cases, no alterations to the bank are required and channel segments are left un-disturbed if no build up of material is present.

Figure 6: *Typical medium size arterial drainage channel being maintained*

Figure 7: *Typical estuarine embankment strengthening works*

In terms of flood relief schemes, since the Arterial Drainage (Amendment) Act, 1995, the OPW has commenced a programme of flood relief schemes. Typically these schemes address urban flooding but also address some localised rural areas where dwellings or infrastructure is subjected to flood damage. The schemes are carried out in collaboration between the OPW and the relevant Local Authority. Schemes are generally designed for flood protection up to the 100year flood eveny in fluvial scenrois and involve major infrastructural works in urban zones incorporating a range of flodd reief mechanism such as improved defence (walls, embankmets), improved conveyance (widening, deepending), upstream storage (upstearm reservoir) and by-pass (new channel), demountable defences (barriers, gates), flood forecasting an warning system.

As part of the rolling progarmme of flood rleief schemes, to date 44 schemes have been completed, 12 are at construction, a further 80 are in various planning and design phases with an addditional 60 to be commenced as part of the curent Natinal Devekopment Plan 2018-2027.

Figure 8: *Typical urban flood relief scheme with floods walls and flood gates*

6. DRAINAGE DISTRICTS

There is a long history of drainage works in Ireland stretching back to the mid 19th century with historical river drainage works been carried out under legislation such as the 1842 Arterial Drainage Act and Arterial Drainage (Minor Schemes) Act, 1928. Several hundred of these more minor schemes were carried out on localised areas of river catchments, with Local Authorities having statutory maintenance responsibility for them. Some of these schemes have since been subsumed into Arterial Drainage Schemes carried out under the 1945 Arterial Drainage Act but circa 170 of these schemes remain standalone and are known as Drainage Districts (DDs), comprising a further 4,600 km of river channel. Maintenance responsibility for DDs resides with the Local Authorities with the OPW having

a policing role with duties to inspect the condition of the Drainage Districts and obligations for Local Authorities to return annual reports on them. The level of maintenance works varies widely across the DDs, in some cases the channel has not been maintained for many decades hence the river has likely largely renatualised and in other cases, the DDs are activley maintained similar to the arterial drainage network.

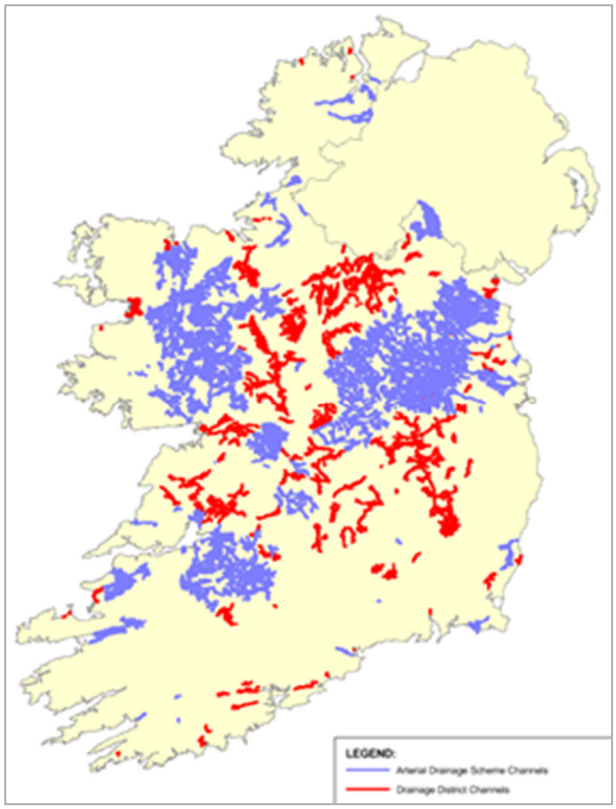

Figure 9: *National network of Arterial Drainage and Drainage Districts channels*

7. HEAVILY MODIFIED WATER BODIES

The concept of HMWB was introduced into the WFD in recognition that many water bodies in Europe have been subject to major physical alterations so as to allow for a range of specified water uses. The list of the specified uses is limited to water storage for drinking supply and/or hydroelectric power, navigation, drainage for agricultural production, flood protection and urbanisation. The specified use may mean that it is not possible to achieve Good Ecological Status (GES), due to the modified hydromorphological conditions. Furthermore, measures to restore the water body to good ecological status may have a negative impact on the specified use or the wider environment, with no other alternative options available.

It is important to note that if a waterbody is designated as a HMWB, it will still have an environmental objective (i.e. Good Ecological Potential) and the physical modification caused by the use will need to be mitigated against as much as possible. Any other physical alterations, not associated with the particular specified use, will have to be rectified. Furthermore, biological and physico-chemical quality elements will still need to be improved while retaining the use of the waterbody. Therefore, a HMWB designation does not diminish the worth of a water body or mean that an impacted waterbody will not get additional measures; its designation simply means that a realistic objective will be set that acknowledges that the water body has been physically altered to facilitate the specified purpose. This allows the highest possible environmental objectives for that waterbody to be determined within those constraints, so that it can be managed appropriately.

There is also a further category of water body that recognises physical alteration i.e. Artificial Water Body (AWB). An artificial water body is a surface water body which has been created in a location where no water body existed before and which has not been created by the direct physical alteration, movement or realignment of an existing water body. This encompasses man made waterways such as canals and headraces but is generally not applicable to arterial drainage or flood relief.

In accordance with European Commission guidance, there is a prescrbed step by step process for the identification, designation and classification of HMWBs. Up to the 2nd WFD cycle, as per Figure 10, Ireland had the lowest percentage of waters designated as heavily modified in the EU with 0.5% HMWB, UK having 22% and the average Member State designating circa 15% HMWB.

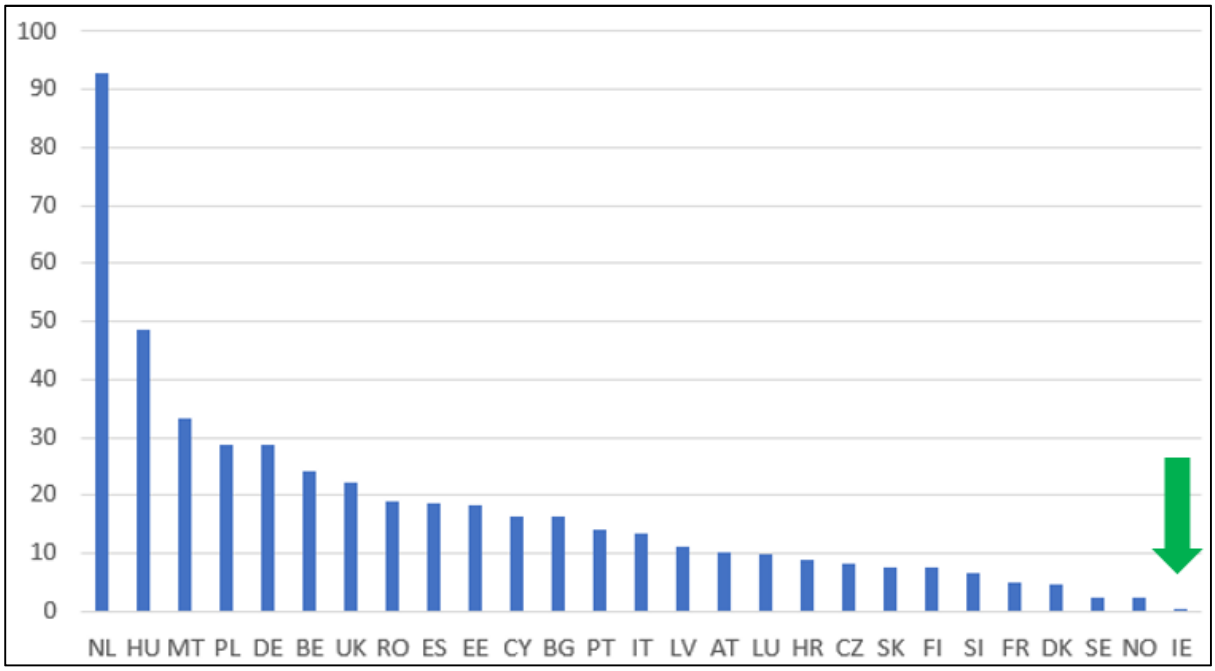

Figure 10: *EU HMWB Designation to date – % HMWB for Rivers*

There were a total of 31 water bodies designated as HMWB in the 2nd cycle 2015-2021, which included a number of surface waterbody types i.e. rivers, lakes and transitional. A small number of water bodies were designated for flood protection use such as the River Fergus due to a tidal barrage, a number of water bodies were designated for water storage use such as the Vartry reservoir and other waterbodies were designated for port development such as Cork harbour.

8. HEAVILY MODIFIED WATER BODY DESIGNATION REVIEW

A review of HMWB designations for Ireland is being carried out under the umbrella of the National Hydromorphology Working Group, led by the EPA in collaboration with the relevant sectoral authorities. This is in accordance with the step by step process prescribed by the Commission combined with both increased hydromorphological assessment results i.e. MQI and RHAT and increased understanding of hydromorphologial impacts stemming from the EPA and LAWPRO on site catchment assessment work.

The main change to the scale of HMWB designation declared by Ireland will be in connection with the arterial drainage channels. Current understanding is that these channels have been substantially

changed in character, the original drainage scheme work is extensive, widespread and profound. There are no key restoration measures (i.e. to restore bed level) that can be implemented without impacting the specified use i.e. the drainage outfall and there are no alternative options whilst maintaining the specified use, land drainage. There are feasible mitigation and enhancement measures to assist achieve good ecological potential where designated. Note that Drainage District channels were not deemed to be potential heavily modified as in some cases the original channels have likely re-naturalised and there is no readily available national dataset to identify channels where significant physical alterations still exist.

Including Arterial Drainage, Flood Relief and other specified uses such as Urbanisation, Water storage, and Navigation, there are a just over 750 river water bodies that are potential HMWB designation based on pre-ecological status considerations i.e circa 22% of river water bodies with major physical alteration and no feasible alternatives.

However, an important principle is that where water bodies could still achieve GES, despite physical modification caused by specified uses, then they should not be considered for a heavily modified designation. Accordingly, waterbodies were screened out of HMWB designation where;

- GES was achieved in the last three EPA monitoring cycles (2013-2018, 2010-2015, 2007-2009)
- A water body is unassigned in status
- A waterbody has a nutrient issue (to allow time to address the nutrient issues first, so that a more true assessment of the physical modifications impacts can be made).

Stemming from this ecological status screening stage, there are 135 river water bodies to be designated as HMWB in the third River Basin Management Plan 2022-2027 which represents circa 4% of rivers, predominantly due Arterial Drainage and Flood Relief. It was concluded that more evidence is required to understand the ecological and hydromorphological impacts of impounding structures related to water storage and regulation (i.e. dams and reservoirs) and navigation (i.e. weirs). A further 55 river water bodies from these specified uses are not to be designated as HMWB but are denoted as a separate 'HMWB Review' category, reflecting the fact that they will be reviewed in the 3rd cycle as they require further understanding.

Notwithstanding the findings to date, similar to all Member States, the monitoring of current biological indicators are often driven by nutrient and organic pollution issues, and may not reflect the true impacts of physical modification pressures. Hydromorphological modification and nutrient issues are difficult to disentangle in these settings but as knowledge and understanding continues to build, the scale of water bodies designated as HMWB will be reviewed as part of an ongoing process.

9. MEASURES TO IMPROVE ECOLOGICAL QUALITY

A suite of environmental mitigation measures has been developed which captures a comprehensive list of mitigation measures that are feasible but do not have a significant effect on the specified use. Implementing a range of these measures will improve the hydromorphological condition and accordingly, assist water bodies achieve Good Ecological Potential which is the objective for heavily modified waters.

For arterial drainage channels, some channels will have an objective of Good Ecological Potential and others will have the objective of Good Ecological Status. Current practice is that feasible mitigation measures are applied in any suitable scenario, hence in reality there will be no difference in the

environmental management standards for HMWB or non HMWB channels on the arterial drainage network.

Types of improvement measures that are currently engaged and will continue to expand include practices such as:

- Drainage maintenance is carried out in accordance with a best practise guide '*Environmental Guidance: Drainage Maintenance and Construction'* which includes techniques such as how to minimise vegetation removal.
- River enhancement works on suitable channels in collaboration with IFI to increase in-channel morphological diversity e.g. instream features such as spawning gravels, deflectors)
- Improvements to longitudinal connectivity in collaboration with IFI by barrier identification and easement works on drained channels.

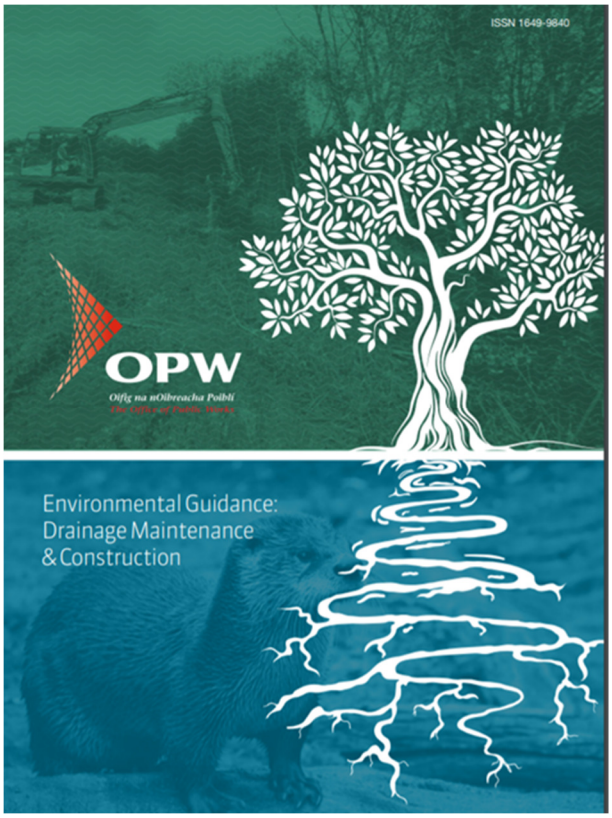

Figure 11: *Drainage maintenance best practice guide*

Figure 12: *River continuity improvements within Flood Relief works*

Figure 13: *River enhancement - spawning gravel addition to a drainage channel*

10. CONCLUSION

The WFD aims at protecting all waters and has introduced a more holistic way in which to measure water quality by considering the ecological condition of the river corridor and recognising that physical alteration impacts this ecology. With just over half of surface water bodies in Ireland in satisfactory ecological health, this is the lowest since the mid-1990s and quality is deteriorating in rivers. While excessive nutrients (nitrogen and phosphorus) is the most significant pressure on water quality in Ireland, hydromorphology is now ranked as the 2nd most significant pressure on river water bodies.

There are now greater number of people involved with on-site catchment assessments such as the ongoing EPA monitoring teams, now further supported by the new Local Authority Water Programme (LAWPRO) which brings 60 new staff to this sector. In addition, there are a further 30 personnel though the Agricultural Sustainability Support and Advisory Programme (ASSAP) programme whom bring on-site advice to farmers. Stemming from this increased site inspections and monitoring, the understanding of how hydromorphological pressures impact water quality has advanced in recent years and is becoming a greater focus of water quality impact assessments. LAWPRO has identified both physical alteration and excess silt as significant problems in many of our waterways. Sources of silt that may lead to issues include any activities that are poorly managed such as: maintenance dredging, land drainage works, river bank erosion, soil erosion from agricultural practices e.g. reseeding/lack of buffer strips/ livestock poaching, forestry operations, adjoining construction activities and peat extraction.

There are widespread physical alteration activities in Ireland with arterial drainage and flood relief works that impact channel hydromorphology to achieve a specified use such as drainage for agricultural production through to flood protection. While currently Ireland is the lowest rate of heavily modified designation in the EU at 0.5%, following a national HMWB review process, this will rise to 4% for the forthcoming River Basin Management Plan 2022-2027. A further batch of river water bodies primarily under the arterial drainage and flood relief use, while having a significant physical change, are not designated as heavily modified as they may have potential to achieve good ecological status when nutrient issues are resolved. At a later WFD cycle, if theses water bodies move to HMWB, this would bring Ireland to 22% of rivers as HMWB.

In recognition that as understanding increases around hydromorpholgy and that this is deemed to be a larger pressure than traditionally recognised, the increase from 0.5% to 4% for HMWB is a truer reflection that there are hydromorphological pressures on river water bodies.

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