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<th><strong>Title</strong></th>
<th>Progress in Implementation of the Water Framework Directive in Ireland</th>
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</thead>
<tbody>
<tr>
<td><strong>Authors(s)</strong></td>
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<td><strong>Item record/more information</strong></td>
<td><a href="http://hdl.handle.net/10197/7910">http://hdl.handle.net/10197/7910</a></td>
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</tbody>
</table>

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PROGRESS IN IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE IN IRELAND

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Abstract
Successful implementation of the Water Framework Directive is vital to water resources management in Ireland. Based on lessons learned from the 1st cycle of implementation, more effective governance arrangements have been put in place, the EPA has been given additional responsibilities and community engagement has been given a high priority. Integrated catchment management (ICM) has become the accepted philosophy and approach. ICM requires catchments to be the appropriate organising landscape unit for water management, which is undertaken at five scales: site/field; water body (almost 5,000 groundwater, river, lake, transitional and coastal); subcatchment (583); catchment (46) and river basin (one national and two international). A comprehensive characterisation process is being undertaken which allocates all WBs into At Risk, Not at Risk and Review categories, whereby At Risk WBs require actions and resources to improve the situation. Geoscientific information and understanding are critical to the characterisation process. Initial subcatchment and catchment characterisation is due for completion in early 2017. Consideration of environmental objectives and mitigation measures has commenced, and will be finalised for the River Basin Management Plan due for publication in December 2017. A new tool, the WFD Application, has been developed to enable ready access to water quality data and the outcomes of the characterisation work. The Application is being made available through the development of a new ‘water hub’ website called catchments.ie.

THE CRITICAL ROLE OF THE WFD IN WATER RESOURCES MANAGEMENT
The Water Framework Directive (WFD) (Directive 2000/60/EC, European Parliament and Council) is the main driver for effective water resources management in Ireland for the following reasons:
♦ It establishes a legal framework to protect, preserve and improve the aquatic environment whilst encouraging the sustainable use of water.
♦ It encourages integration of all water types – groundwater, rivers, lakes, transitional and coastal waters – and considers both water quantity and quality as the basis for water management, and requires river basins or catchments as the means of connecting all waters with human activities.
♦ It requires the preparation of river basin management plans by Member States across three river basin planning cycles viz 2009-2015, 2016-2021 and 2022-2027 during which management measures must be implemented so as to achieve good ecological status in all waters.
♦ It requires engagement with and participation of catchment communities.
♦ Sanctions via European Court Judgements act as incentive for improved environmental management.
NEW GOVERNANCE ARRANGEMENTS

The OECD (2010) concluded that “The institutional arrangements for river basin districts may not prove sufficiently robust” and this conclusion was generally accepted. As a consequence, the European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014) brought a new three tier governance arrangement:

1. National Management & Oversight: led by the Department of Environment, Community and Local Government and dealing with policy, regulation and resources.
2. National Technical Implementation & Reporting: led by EPA and responsible for water monitoring, assessment, characterisation, identification of measures and reporting to the Commission, as well as licensing of discharges and monitoring of enforcement tasks and environmental outcomes. Significant new responsibilities have been assigned to the EPA, together with additional resources, which led to the setting up of the Catchment Science & Management Unit. EPA now has a leadership role in technical implementation and reporting. The EPA is i) undertaking catchment characterisation, ii) reviewing the impact of human activities, iii) preparing template river basin management plan(s), iv) drafting environmental objectives and v) compiling common programmes of measures for further development and input by local authorities at Tier 3, and finalisation and approval by the Minister for Environment, Community and Local Government.
3. Regional Implementation via Water Networks: led by the Local Authority Water and Community Office (LAWCO) in co-operation with local authorities and responsible for local authority monitoring, licensing and enforcement actions, implementation of the programme of measures by relevant public bodies, and public awareness and engagement.

As part of the new arrangements, the existing seven River Basin Districts (RBDs) have been merged into one national RBD, together with two international cross-border RBDs.

CHANGES IN WATER QUALITY

There has been a gradual net improvement in water quality since WFD implementation commenced. For instance in the period 2010, there was an improvement of 4% in the length of unpolluted monitored river channel – from 69% to 73% (Bradley, et al., 2015). In 2009 the EPA reported that 116 of 757 groundwater bodies (GWBs) were at poor status, equating to about 14% of the land area. The majority of these poor status GWBs were a result of the estimated phosphate load from groundwater contributing to less than good status rivers. However there were also a small number of GWBs at poor status due to over abstraction, contamination from industrial, waste & historic mining activities and upward trends in nitrate concentrations at drinking water abstraction points. Significant knowledge shortcomings were also identified in relation to groundwater dependent terrestrial ecosystems (GWDTE) and the level of pollution from some industrial and waste facilities.

Further work by the EPA in the interim has included site specific data gathering in relation to GWDTE, an improved process for assessing pollution from industrial and waste facilities (in the context of WFD classification) and greater integration in relation to assessing the contribution from groundwater to surface water. Subsequently a new GWB layer, with 513 GWBs, has been developed. In the 2010-12 Water Quality in Ireland Report the EPA reported that only 13 of the original 757 GWBs were at poor status; however a caveat was added that the status update did not include the updated assessment for GWDTE and

1 With contributions from the GSI, Donal Crean (at the time with OCM), CDM Smith, Geosyntec, RPS, Sarah Kimberley, Shane Regan, Owen Naughton, Melinda Lyons, Pól O’Seasnain, Regina Campbell, Matthew Craig, Anthony Mannix & the EPA Informatics team.
industrial and waste facilities. In essence the “improvement” was attributed to a slight reduction in groundwater phosphate concentrations, and a related improvement in some of the receiving rivers. Initial characterisation of the 513 GWBs indicates that 61 GWBs (approximately 7% of the land area) are At Risk of failing WFD objectives (mainly due to contamination from industrial & waste facilities), with 280 GWBs still under review (mainly due to diffuse pressures and GWDTE) and the remainder characterised as being Not at Risk of failing WFD objectives. Many of the under review GWBs are a reflection that whilst there has been some improvement in recent years (e.g. slight reductions in groundwater phosphate concentrations), ultimately these GWBs remain close to the tipping point. However, along with the Not at Risk GWBs, it’s likely that the majority of the under Review GWBs will also be classified as being at good status in 2017; indeed a small number of the GWBs that are currently At Risk may also revert from poor to good status due to measures recently taken by licensees to satisfy requirements of the 2010 Groundwater Regulations.

INTEGRATED CATCHMENT MANAGEMENT

Although first proposed for use in Ireland only three years ago (Daly, 2013; Harris, 2013), ICM has become the accepted philosophy and approach for achieving successful management of water resources and implementation of the WFD (DECLG, 2015). This strategic new direction represents a shift away from traditional top-down and one size fits all approaches to a requirement to build partnerships; engage with and involve local communities; take a catchment-based approach; undertake catchment characterisation to a level that enables critical source areas to be delineated and pathways for water and pollutants to be understood; and select both country-wide and targeted measures to achieve objectives.

CATCHMENTS

A CATCHMENT-BASED APPROACH

The catchment (or river basin) is the appropriate organising unit for water resources as it is defined by natural hydrology and hydrogeology, ‘connects’ all relevant elements, including pressures, receptors (including all water types and ecosystems) and the people living there. While this has been accepted in principle for decades, the reality is that water management tends to be localised, dealing with specific issues, often discipline-bound and seldom connecting groundwater with surface water. Therefore, it is proposed here that there needs to be a development of the paradigm for water management that requires a clear mental image, converted to a working reality, of catchments as 3-D landscape-based units on which water management decisions should be based. This, to some degree at least, is a challenge to the more traditional discipline-based approaches, including those with an interest and expertise primarily in the underground component of the hydrological cycle. Perhaps now is the time to think a bit more of “looking up from the borehole” while still maintaining, developing and promoting hydrogeological expertise and input!

CATCHMENT SCALES

Catchments exist at multiple scales. In principle, the activities needed to achieve the various water/catchment objectives must be at a scale that is appropriate to achieving these objectives, and, in particular, to enable the problems, solutions and consultations to be targeted effectively. Depending on the scale, different parties may take different roles. For example, for a River Basin District, national state agencies will lead catchment management efforts, while at the local, detailed scale, local authorities and local community groups/stakeholders, will take the lead in developing and implementing solutions. In following the principle outlined above, five scales are used. While these are defined here, linkages across the scales are essential to successful water/catchment management. It is not possible to manage and understand our water resources by focusing on one scale. We cannot “fix” at the national and RBD scale without paying attention to necessary issues and
changes at the scales below, and we cannot ensure the future well-being of the water resources we all care about without paying attention to changes and developments at the national scale. Therefore, we need to think 'multiple scales' (Daly, et al., 2014).

The scales being used in WFD implementation are outlined in Figure 1 and are as follows:

- **Site/Field scale**: Many water supplies and potential point pollution sources are investigated and dealt with at this detailed scale (e.g., septic tank systems, farmyards, landfills, wells, nutrient and sediment runoff from fields.)

- **Water body (WB) scale**: WBs are the ‘units’ for monitoring and reporting status and risk characterisation results. Although the WFD probably intends that the WBs are the WFD water management units, in practice they will not fulfil this function as they are bodies of separate water types that are not linked (e.g., groundwater with surface water) or are poorly linked (e.g., rivers with estuaries, coastal waters and lakes). In addition, the sizes vary enormously (e.g., rivers a few kilometres long with small (<10 km²) catchment areas and groundwater bodies several hundred km² in size). Integration of WBs, or their water management issues, is not readily feasible at this scale.

- **Sub-catchment scale**: Waterbodies have been aggregated into subcatchments, varying in area from approximately 70-200 km². This is the scale at which the science of characterisation is undertaken. Compliance checking and community engagement are also carried out primarily at this scale.

- **Catchment Scale**: These are the catchments as defined, with some additions in the Shannon catchments, by the nationally-defined hydrometric units, giving 46 catchments in the Republic of Ireland. They are coherent landscape units encompassing and connecting i) water flowing from upland areas to the coast or, in the case of the Shannon catchment, the Shannon itself and ii) all pressures with the potential to impact on all the water types in the catchment. They are at a practical scale for deciding on, planning and coordinating activities; in effect, this is a practical management and ‘governance’ scale for water.

- **River Basin District (RBD) scale**: The seven RBDs used for the 1st cycle of the WFD have been merged to form one national RBD and two cross-border RBDs. The outputs at this scale are the River Basin Management Plans.

### Figure 1: Scales used in catchment management and WFD implementation
CATCHMENT CHARACTERISATION

CHARACTERISATION, ENVIRONMENTAL OBJECTIVES AND RISK

Catchment characterisation is the foundation of integrated catchment management as it provides an understanding of how catchments work. This includes the physical, hydrochemical, and ecological characteristics, impacts, pressures and quantification of pollutant loads and abstraction pressures in the catchment. The aim is to use characterisation to identify the significant pressures so that strategies, measures and resources can be prioritised and targeted to enable effective protection or restoration, as required, of our water resources.

A key component of characterisation is the determination of the ‘risk’ of not meeting WFD objectives. The environmental objectives are set out in Article 4 of the WFD and are summarised as follows:

- Prevent deterioration in status of all bodies.
- Aim to restore to good status by 2015.
- Aim to reduce pollution to surface water bodies from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances.
- For groundwater bodies, reverse any significant and sustained upward trends and prevent or limit the input of pollutants.
- For protected areas, such as drinking water protected areas and Natura 2000 sites, achieve compliance with the required standards and objectives.

Alternative objectives may be set, such as:

- Achieving Good status by 2021.
- Achieving High status by 2021 for surface water bodies whose status declined from High to Good.
- Achieving Good status by 2027.
- Recovering to Good after 2027 (lower stringent objective).
- Improving trends in the elements influencing status. (This is not a stated requirement of the WFD.)

Risk characterisation looks forward towards the targeted environmental objectives for water bodies, and it highlights the areas where monitoring and measures need to be implemented and/or adjusted so that the objectives can be met on time. Three risk categories are used: Not At Risk, At Risk and Review; where Not At Risk water bodies require maintenance of existing measures; At Risk water bodies require new, often more targeted, mitigation measures requiring resources in terms of both finances and staff; and Review water bodies requiring, perhaps, additional monitoring and assessment. The Risk designation is based on: i) consideration of the status of the water bodies (good and poor for groundwater bodies, and high, good, moderate, poor and bad for surface water bodies); ii) the trends in hydrochemistry, particularly of phosphate, nitrate and ammonium; and iii) the distance to thresholds, such as environmental quality standards, as a means of determining whether there is a likelihood of deterioration to a lower water quality status or that a small improvement might ensure a return to a better status.

Three tiers of characterisation are being undertaken so that the level of assessment is commensurate with the level of risk posed:

1. Preliminary Waterbody Risk Screening (Tier 1): An automated screening process to identify waterbodies ‘At Risk’ based on the national water quality monitoring dataset.
2. **Initial characterisation of subcatchments and catchments (Tier 2):** Waterbodies are grouped into catchments and subcatchments and prioritised so that integrated catchment science assessments can be carried out where necessary. Where waterbodies are ‘At Risk’, potential significant pressures causing the impacts are identified. This is a desk-based stage.

3. **Further characterisation (Tier 3):** Potential significant pressures will need to be further investigated in many circumstances, such as in rural areas where there are diverse concerns, to confirm that they are significant pressures, i.e. those actually causing the issues. This tier will frequently require fieldwork/investigative assessments and will be undertaken primarily by local authority staff, but in some circumstances will be assisted by specialists such as hydrogeologists and biologists.

**THE CRITICAL ROLE OF GEOSCIENTIFIC INFORMATION AND UNDERSTANDING**

For significant pressures that are either diffuse (pasture and arable crops, forestry or urban areas) or small point sources (septic tanks systems or farmyards), geoscientific information provided by the Geological Survey of Ireland (bedrock, aquifer, vulnerability, subsoil permeability, karst features) and Teagasc (soils, subsoils) are essential in providing a basis for understanding and modelling the movement of water and pollutants through the landscape, thereby enabling prediction of pollutant attenuation and pollutant loading to water. The EPA-funded Pathways Research Project (Archbold, et al., 2015) and subsequent EPA *Catchments Tools* Project has used the pathway susceptibility concept (Daly, 2004) and produced national (1:25,000 scale) pathway susceptibility maps for both nitrate and phosphate as a means of evaluating the likelihood of these pollutants reaching water. For instance, Archbold, et al., (2015) concluded “Therefore, for mitigation measures and management strategies to be successful, it is essential that these transport pathways are identified and understood at subcatchment scale and that mitigation measures and management strategies are pathway specific”. In addition, by overlaying the loading of phosphate and nitrate from agriculture and forestry on the susceptibility maps, three national pollution impact potential maps for phosphate to surface water, nitrate to groundwater and nitrate to surface water have been created, thereby enabling critical source areas to be determined, and investigative assessments and measures to be targeted to areas where the greatest environmental benefits can be derived.

**SOURCE LOAD APPORTIONMENT**

A data-driven Source Loading Apportionment Model has been developed by the EPA *CatchmentTools* Project for Irish conditions as a means of predicting the sources of nutrient loads (phosphorus and nitrogen) to surface water from urban wastewater treatment plants, industrial discharges, agriculture, septic tank systems, forestry and urban areas. This enables the identification of the main sources and therefore facilitates the evaluation of the required load reduction and the targeting of mitigation measures.

**CHARACTERISATION RESULTS**

To-date, the preliminary risk screening is completed. Initial characterisation is being undertaken by the EPA, with the assistance of RPS consultants, and will be completed by December 2016. The approach is being piloted in the Suir catchment and some of the initial results are illustrated by means of the following maps in Figures 2 - 8: water body risk (of not meeting WFD objectives); pathway susceptibility based on geological/hydrogeological information and understanding water and pollutant movement in the landscape (a map indicating the susceptibility of groundwater to impact by nitrate is also available); pollution impact potential, based on overlaying estimated diffuse nutrient loads on the susceptibility maps and modelling impacts on water; significant pressures on surface waters; and estimated load reductions required to reduce nutrient concentrations.
Figure 4: Map indicating the susceptibility of surface water to impact by phosphate

Figure 5: Pollution impact potential (PIP) map for phosphate to surface water arising from diffuse agricultural sources
Figure 6: Pollution impact potential (PIP) map for nitrate to groundwater arising from diffuse agricultural sources

Figure 7: Map of significant pressures
PRIORITISING ENVIRONMENTAL OBJECTIVES

As resources are inevitably limited, knowledge of the causes of impact are not always clear-cut and environmental responses are variable even when measures are undertaken. It is necessary to prioritise the objectives for the 2nd cycle River Basin Management Plan and in the process the resulting mitigation measures. As a means of illustrating the process, some of the priorities are given below:

1st Priority: i) protect high status water bodies; ii) prevent deterioration of existing At Risk high and good status water bodies (WBs); iii) complete all Investigative Assessments.

2nd Priority: i) “easy wins” – moderate status WBs close to good status boundary, giving consideration to those with an already improving trend; ii) piloting work to improve the situation in a selection (perhaps 10% of the 583 subcatchments) of the At Risk WBs with interdisciplinary and multi-organisational involvement; iii) a research and investigation programme to define the environmental supporting conditions for Natura 2000 sites where they don’t currently exist; iv) developing a farm advisory service to aid communication of environmental issues with farmers and achieve behavioural change.

3rd Priority: i) improving trends in phosphate concentrations; ii) improving trends in nitrate concentrations in catchments/subcatchments with At Risk TraC WBs and At Risk groundwater bodies; iii) maintaining existing Not at Risk WBs.

4th Priority: i) achieving good status everywhere; ii) improving trends in nitrate concentrations everywhere.

CATCHMENT MANAGEMENT STRATEGIES

Following the analysis of catchment conditions, quantification of pollutant loads and abstraction pressures, determination of the loading targets or abstraction reductions needed to meet the catchments objectives, identification and evaluation of potential management measures and practices can be undertaken. There is a wide variety of possible management strategies. As a means of adopting a structured approach to their evaluation, they are subdivided into the following categories:

1. Local (site/field-scale) mitigation measures.
   - e.g., buffer zones, increasing the use of clover in grass swards.

2. Engagement & Partnership.
   - e.g., farm advisors, Rivers Trusts.
3. Incentives.
   • e.g., GLAS, funding for Rivers Trusts.
4. Innovation & new technology.
   • e.g., precision farming.
5. Integration of WFD objectives into the planning process.
6. Licensing of discharges to water.
7. Compliance checking & enforcement.

Evaluation of these strategies has commenced; for instance evaluation of local measures will include consideration of costs, effectiveness, potential for benefits for biodiversity, flood mitigation and reduction on greenhouse gas emissions and acceptability.

ENGAGEMENT AND COMMUNICATIONS

The characterisation approach, together with selection and successful implementation of measures and management strategies will involve integration of datasets and knowledge at a national scale. With this in mind, a Catchment Management Network has been established to provide a platform for the EPA, government departments and agencies, local authorities, other public bodies and environmental non-government organisations to work together to avoid duplication of effort while working towards RBMP delivery and achieving integrated catchment management. The Network will also provide a mechanism for knowledge exchange and initiating public participation as community involvement will be essential. Above all, it will enable catchment managers to come together to exchange ideas and assist one another in delivering the 2nd cycle RBMP and taking Ireland further along the path towards achieving integrated catchment management. In addition, the newly initiated Catchments Newsletter (www.catchments.ie ) is providing an informal means of facilitating communication and networking on catchment issues.

MAKING THE INFORMATION AVAILABLE

Characterisation is a multi-disciplinary task requiring a variety of datasets, many of which are not currently captured or accessible in a centralised system. The EPA have used IT automation systems to develop a WFD Application that provides a single point of access to catchment data, which will be useful for many catchment science and management purposes, not just those that are specific to the WFD. The Application is accessible currently through EDEN (https://wfd.edenireland.ie/) and is available to EPA staff as well as staff in other public agencies. The information will be made more widely available later in 2016 through a new public website which is in development and will be called www.catchments.ie.

REFERENCES


