

IMPLEMENTING THE WATER FRAMEWORK DIRECTIVE IN IRELAND, THE ROLE OF THE ENVIRONMENTAL PROTECTION AGENCY.

Larry Stapleton & Paul Toner, Environmental Protection Agency

INTRODUCTION

The Water Framework Directive (WFD) is probably the most significant piece of water related legislation produced by the EU and is certainly the most comprehensive and complex. It provides a common legislative framework for the protection and improvement of the quality of water resources and for their sustainable use and integrated management. The Directive entered into force on 22 December 2000 and applies to inland surface waters; transitional (i.e., estuarine) waters; coastal waters (out to a distance of one nautical mile beyond the baseline from which territorial waters are measured), and groundwater. 'Artificial' and 'heavily modified' water bodies also come within the ambit of the Directive.

The main unit for management is to be the *River Basin District* (RBD), which may consist of one or several contiguous river basins and their associated groundwaters and coastal waters. Ireland has designated four RBDs wholly within the State while three (of which the Shannon is one) are shared with Northern Ireland.

In contrast to previous directives in the water area, which were concerned with specific uses of waters, the WFD is aimed at the restoration and preservation of the aquatic ecosystem. Thus, the assessment of the status of waters is to be based on a range of quality elements as follows:

- for rivers, lakes and transitional waters: flora (phytoplankton, macrophytes and phytobenthos) and fauna (invertebrates and fish) as well as the 'supporting' elements, viz. hydrological, morphological and physico-chemical features;
- coastal waters: as above but excluding fish.

The directive requires all waters to achieve good quality by 2015; while this time frame may appear to be long, a much tighter implementation timetable is specified for many of the intermediate steps, as summarised later.

The implementation of the WFD raises many scientific and technical challenges. At EU level these are being addressed through the Common Implementation Strategy (CIS), which aims at providing support through the development of a common understanding and guidance in relation to key elements of the Directive. At the level of the Member State, more specific scientific and technical challenges must be addressed. Finally, at the level of the RBD, there are many further challenges, particularly in relation to information dissemination, co-ordination and the identification of measures to address the target of good quality.

Over the past several years the Environmental Protection Agency (EPA) has been involved in work, at the various levels outlined above, for the implementation of the WFD. In December 2003 the European Communities (Water Policy) Regulations (referred to herein as the 'WFD Regulations') assigned a wide range of functions to the Agency. The present paper reviews the work of the Agency, initially for the period up to the end of 2003 and then in the context of the WFD Regulations.

EPA INVOLVEMENT PRE 2004

EPA involvement pre-2004 included advisory input during the period of consideration of the proposal for this Directive and a variety of preparatory tasks undertaken to support its implementation. These have included the following:

- organising and attending committees and expert groups on a wide variety of WFD aspects at various levels (EU, Ireland-UK, North-South, National, RBD);

- input to the development of the CIS guidance documents;
- the commissioning and supervision of research projects directed at meeting specific needs of the Directive (a total of over €6.7 million is being spent on research related to water under the EPA's Environmental Research Technological Development and Innovation (ERTDI) programme including €1.5 million on a special call for proposals in support of WFD implementation);
- work on the specification of *typology* and *reference conditions*;
- preliminary aspects of monitoring programmes;
- development of the Register of Protected areas;
- support to the early-established River Basin Management (RBM) projects;
- further development of a soils and sub-soils project (implemented by Teagasc);
- fellowship on the testing of guidance documents (funded under ERTDI);
- support to a project on typology of tidal waters undertaken by the Scotland and Northern Ireland Forum for Environmental Research.

While it is not possible to detail all of these activities, it is worthwhile to give a brief summary of some that are particularly relevant in the present context.

WFD GROUP ON HYDROLOGICAL ASPECTS

One of the working groups set up by the EPA is the WFD Group on Hydrological Aspects. The aims of the Group are to co-ordinate hydrological activities in relation to the WFD, including the development of the National Hydrometric Programme to meet the requirements of the Directive and to liaise with the RBM projects on the hydrological aspects of their work. The Group comprises representatives from the main organisations involved in implementing hydrometric work and related activity as well as users of this data, including the RBM project leaders and the Northern Ireland Rivers Agency and the Environment and Heritage Service.

The Group has reviewed the relevant function of the individual bodies and the aspects of the WFD that relate either directly or particularly closely to hydrological and hydrometric work, including:

- the identification and characterisation of river basins;
- the identification of the boundaries of surface waters;
- the hydromorphological elements of ecological status (i.e., hydrological and morphological elements);
- the groundwater quantitative aspects;
- hydrometric data to allow for analyses of pressures and impacts;
- hydrometric data necessary for many other aspects of the Directive.

The individual Articles of the WFD were also reviewed, and it is clear that many specific aspects of the directive require the availability of good quality hydrological data. Such data is the foundation on which all else depends, in addition to being a key component of many of the specific requirements. Experience from previous work, including the Three Rivers Project, was also reviewed and consideration has been given to the main factors to be taken into account in upgrading the hydrometric network, which are considered to include the following:

- to determine freshwater input to transitional waters;
- to monitor abstractions $> 100 \text{ m}^3/\text{day}$;
- to determine pollution loads from significant tributaries;
- to quantify groundwater contribution to surface water from springs;
- to provide data for management of lakes, including inflow, outflows and water levels;
- to support work of dealing with accidental pollution discharges to waters;
- to quantify transfer of water across state boundaries.

A critical requirement is for data on low flows and their durations. An issue to be addressed is when it is appropriate to model or estimate flows and when it is necessary to have a new hydrometric station installed. The particular need for reliance on models in the case of tidal waters was noted. Other issues include the best approach to monitoring the outflows from springs (as any structures required interfere with a spring's output) and the need to upgrade the quality of many existing hydrometric gauging stations.

ASPECTS OF RESEARCH

The EPA's ERTDI Programme is funding a wide range of research in respect of the aquatic environment, and support to the implementation of the WFD is the driver for much of this research, including the following projects:

- Characterisation of unpolluted groundwater;
- Characterisation of a karstic groundwater body, including linkage with associated ecosystems (e.g., turloughs);
- Recharge and groundwater vulnerability;
- Hydromorphology of rivers;
- Nature conservation designated areas where the status of water is an important factor;
- The role of mathematical modelling in the implementation of the WFD in Ireland;
- Reference conditions and testing of typology of rivers;
- Palaeolimnological investigation – reference status of Irish lakes;
- Archive of historical information on high quality river sites;
- Monitoring methodologies for the ecological assessment of lakes;
- Pilot river basin project (Shannon);
- Relationship between the biological quality index and fish stocks in rivers;
- Environmental Research Centre of Excellence projects including WFD GIS development.

Some aspects of the foregoing particularly relevant in the present context are briefly discussed.

The project on the hydromorphology of rivers was a desk study to determine a monitoring methodology for this aspect of the WFD. The draft report (McGinnity *et al.*, 2004) proposes a methodology that is based on a tiered hierarchical structure with control variables, operating at a catchment level, which in turn influence response variables, operating at a reach/segment level. It is proposed that control variables would be generated through GIS and utilising a customised hydromorphology toolbox, with remote sensing and high resolution digital photography used to deliver many of the response variable data. The response variables also require measurement in the field to ground truth the aerial imagery, to provide quantitative data and to and populate the data models.

Environmental assessment and reporting at the international level is increasingly based on the DPSIR framework of driving forces, pressures, state, impact and response, and the ERTDI project on the role of mathematical modelling in the implementation of the WFD in Ireland (see also separate paper on this topic) categorises models under the broad headings of this framework. The essential role of mathematical models in providing the links between 'pressure' and 'state' and also between 'state' and 'impact' has been noted. The draft report (Irvine *et al.*, 2004) notes that implementation of the WFD requires an understanding of the entire hydrological cycle, and notes that low flow models should be further investigated for applicability for the estimation of impact on ecological indicators and reference conditions and to develop flow duration curves for ungauged sites. It notes also that artificial intelligence has high potential for the interpretation of biological and environmental data. It concludes that modelling techniques are likely to be of particular importance for the implementation of the WFD in respect of the following:

- Identification of the risk to ecological quality from catchment pressures;
- Hydrological regimes and estimation of annual nutrient loads;

- Assistance with elucidation, assessment and choices of programmes of measures; and
- Definition of spatial and temporal resolution of monitoring systems for the identification of hydromorphological, chemical and ecological status.

The ERTDI programme has supported, through the funding of a fellowship project, Ireland's participation in the European-wide Pilot River Basins (PRB) project which has the objective of testing the guidance documents produced under the CIS. The Irish river basin chosen for this purpose is the Shannon and the work of the fellowship is integrated closely with that of the Shannon RBM Project. The work has included a focus on risk assessment methodology for diffuse groundwater pollution in the Shannon River Basin District in the context of the good quality target (Kilroy *et al.*, 2004.) A screening exercise was undertaken using available GIS layers and following a 'source-pathway-receptor' model. The steps are as follows:

- develop a good conceptual understanding of each groundwater body;
- combine information on groundwater vulnerability with aquifer flow regime characteristics to identify the degree of pathway susceptibility to diffuse pollution;
- set pressure magnitude thresholds;
- combine pathway susceptibility and pressure magnitude to produce an impact potential map;
- final risk designation.

It was concluded that different aquifer types will require different management responses appropriate to their spatial extent, flow regime, degree of groundwater-surface water interaction, and connectivity with groundwater-dependent terrestrial ecosystems

THE WFD REGULATIONS AND THE EPA

In December 2003 the WFD Regulations assigned a wide range of tasks to the EPA. These may be grouped under a number of headings as set out in the table.

Table: Tasks Assigned to the EPA in the WFD Regulations

River Basin Districts and Competent Authorities:

EPA to deliver, not later than 22 June 2004, in relation to each river basin district:

- precise description of the boundaries of the district;
- a list of the main rivers in the district;
- identification of the individual river basins in the district;
- the information required by Article 3(8) of the Directive in relation to competent authorities.

This task was completed by the EPA and the report submitted by the due date. The precise description of the boundaries entailed significant fieldwork by the EPA's hydrometric teams and GIS work by EPA Centre of Excellence fellows.

Water bodies, typology and reference conditions:

EPA to complete, not later than 22 December 2004:

- map the location and boundaries of groundwater bodies and surface water bodies;
- identify each surface water body as either: river, lake, transitional water, coastal water, artificial water body or heavily modified water body;
- provide the typology for all surface waters;
- establish type-specific reference conditions;
- prepare these in GIS form.

Characterisation, risk analysis & economic analysis

The relevant local authorities shall, not later than 22 December 2004, carry out in relation to each river basin district:

- an analysis of its characteristics;
- a review of the impact of human activity on the status of surface waters and of groundwater;
- an economic analysis of water use.

The EPA shall not later than 22 March 2005 publish and send to the Minister and EC a summary report on the above.

Register of Protected Areas

The EPA shall establish, not later than 22 December 2004, a register of protected areas in accordance with Article 6 of the Directive and subsequently keep the register under review and up to date.

Classification Systems

EPA to establish, not later than 22 June 2006, systems for:

- estimating the values of the biological quality elements specified for each surface water category, heavily modified water body and artificial water body;
- the classification and presentation of the ecological status and chemical status of surface waters; and
- the classification and presentation of the chemical status and quantitative status groundwater.

Monitoring programme

EPA to prepare, not later than 22 June 2006, a programme of monitoring of water status; the programme shall:

- specify the nature, frequency and extent of monitoring to be carried out by public authorities;
- specify the public authorities by whom the monitoring is to be carried out;
- provide that monitoring programmes are in established and operational by 22 December 2006.

Further EPA functions

Further functions assigned to the EPA include the following:

- report to minister on programmes of measures, indicating amendments (if any) to the published programme;
- make recommendations (in absence of EC agreement) on environmental quality standards for priority substances;
- make recommendations (in absence of EC adoption) on criteria for the assessment of groundwater.

IMPLEMENTATION TASKS IN 2004

The first deliverable required of the Agency was to provide the following in respect of each river basin district: precise descriptions of the boundaries of the district; a list of the main rivers in the district; identification of the main river basins in the district; and the required information on the competent authorities. Considerable effort had been devoted to the determination of the boundaries of the river basin districts. Boundaries produced by two separate approaches, by hand from the contour maps and electronically using a digital terrain model (DTM), were first compared and all significant anomalies between the two outputs were identified. These were then investigated in the field by the EPA hydrometric teams, with additional spot checks, in order to produce a validated boundary set. The required information was supplied to the European Commission by the due date in June 2004.

In addition to meeting the June 2004 delivery deadline, the EPA has continued the scientific work on developing typologies and related aspects and has undertaken key co-ordination tasks. The Agency has established and chairs a National Technical Co-ordination Group (TCG). It also chairs a Working

Group on Risk Assessment and has set up a Working Group on Monitoring. Previously established working groups, which had reported to the National Co-ordination Group chaired by DEHLG, are now operating under the aegis of the TCG. These include groups dealing with groundwater, priority substances and reporting.

Further significant deliverables are required over the coming months. The Agency is required to map water bodies, categorise them (including whether or not they are heavily modified water bodies), prepare typologies and establish type-specific reference conditions.

While it is for the relevant local authorities to produce the 'characterisation report', with a review of the impacts of human activity on the status of waters, the Agency must publish a summary of this and sent it to the Minister for the Environment, Heritage and Local Government by 22 March 2005. In reality all of this constitutes a major collaborative effort between the Agency, the Department, the Local Authorities and their consultants, GSI, Marine Institute, CFB and others including, in particular, the relevant bodies in Northern Ireland.

Some specific aspects of the work undertaken to date are briefly summarised below.

Typology and Reference Conditions for Surface Waters

The assessment of surface waters in relation to the target of good quality is largely based on the status of the floral and faunal communities and the degree to which these show deviations from the natural state. Since these communities are largely determined by the natural physical and chemical features of the aquatic system, their composition will vary between different types of waters. In order, therefore, to make a proper assessment of a water body, it is necessary to know the appropriate reference state for the biological elements in that location. This requires the identification of the physical types of rivers, lakes and tidal waters that support distinctive communities of animals and plants - so that appropriate reference conditions are used when assessing the degree to which these communities diverge from the natural state in the particular water body being assessed. The physical features to be taken into account in carrying out this typology are set out in Annex V of the directive.

The EPA has now developed a typology for rivers and lakes based on information available from past survey work and taking into account the results of research projects supported by the ERTDI programme. In doing so, liaison has been maintained with the agencies in Northern Ireland and in the rest of the UK, in particular because of shared ecoregion considerations, resulting in the need for a consistency of approach in the two jurisdictions. Unfortunately, extant examples of reference condition sites do not exist for all of the types identified and there will be a need to resort to expert judgement or, possibly, the use of historical data in these cases.

In the case of tidal waters, the Agency has collaborated with the UK to develop a common typology and associated reference conditions for the tidal waters of the two islands. Further work will be commissioned, however, to provide local information on reference conditions for the types identified in the State.

Groundwater

The Groundwater Working Group is convened by the GSI. The fundamental unit of management for groundwater within the context of the WFD is the groundwater body, which is defined in the Directive as 'a distinct volume of groundwater within an aquifer or aquifers.' The groundwater characterisation process for each RBD involves two elements: physical characterization and risk characterisation. Physical characterisation provides relevant information on groundwater receptors and on the geological pathways that link pressures and receptors. For each groundwater body in the country, relevant layers of geological and hydrogeological information are being produced by the GSI. It is based on using subsoils (from Teagasc and GSI) and bedrock (from GSI) maps and information to

delineate aquifers. These in turn were used to delineate approximately 410 sand/gravel and bedrock groundwater bodies in the Republic of Ireland. Close co-operation in undertaking the work exists between the relevant public bodies, viz. GSI, GSNI, EPA and Environment and Heritage Service, NI. The RBM Project consultants are completing the physical characterisation process by undertaking mapping of extremely vulnerable areas in counties not mapped by GSI and by undertaking recharge assessments.

Risk Assessment

A key component of the WFD Characterisation Report is the identification of the water bodies at risk of not attaining good quality. Much of the work on this aspect is being carried out by the consultants appointed to undertake the RBM projects but co-ordination at national level is being facilitated by the EPA through its chairing the working group on this topic, referred to earlier. The work consists of deriving criteria and thresholds to identify situations where either pressures (e.g., waste discharges) or receptor condition (e.g., river water quality) constitute a risk of the target not being achieved. These criteria and thresholds are based on proposals from a UK working group and also take into account guidance from the EU advisory groups. A further step in the process is to gather the available data on pressures and receptor state to allow the assignment of risk to be made.

The procedure recognises four categories of risk as follows:

- 1a: At Risk
- 1b: Probably at Risk
- 2a: Probably not at Risk
- 2b: Not at Risk

In general, the overall risk level will be determined by the most pessimistic rating applied to individual pressures or to an aspect of receptor quality.

It is important to emphasise that the process is not one of classification but rather a flagging of situations where there is the likelihood that there will be problems in meeting the requirement for good quality. In many cases, the follow up investigations that will be necessary may show that this initial assessment has been unduly pessimistic. Clearly, the water bodies falling into the 1a and 1 b categories will be the priority for such follow-up studies. However, for many of the 1a water bodies, the case for moving immediately to identifying restorative or preventive measures may be strong.

IN CONCLUSION

While the foregoing may appear as a set of discrete tasks with a sequence of delivery dates, nevertheless there is considerable continuity and interdependence as the implementation of the Directive builds from one stage to the next. Similar specialist expertise in each of the ecological areas is needed as the work develops through typology and reference conditions to classification systems and monitoring programmes.

Apart from the development of classification systems and of monitoring programmes, there are further obligations on the Agency to fulfil over the coming few years, including reporting to the Minister on programmes of measures, making recommendations on quality standards for priority substances and criteria for the assessment of groundwater (in the absence of EC adoption).

It is clear that the WFD represents a major challenge for the EPA and for the other public authorities in Ireland involved, and its implementation will require better environmental performance from all sectors, public and private. The WFD, however, also provides an opportunity to ensure that trends of

declining water quality are not repeated and provides a systematic approach to the protection of a unique economic, ecological and recreational resource - the waters of Ireland.

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