ENVIRONMENT AND HERITAGE SERVICE

Managing the

WATER ENVIRONMENT

in Northern Ireland

2000

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FOREWORD

Water is essential for all of us. In Northern Ireland, it is vital to our health and well-being; it also contributes significantly to the natural environment. Local people have always known this; and more and more visitors are now discovering it.

The Department of the Environment (DOE) has a duty to promote the conservation of our water resources and the cleanliness of water in waterways and underground strata. The Environment and Heritage Service (EHS) (an Agency within DOE), through its Water Management Unit (WMU), plays a key role in this.

This is the latest in a series of five-yearly reports on our water environment. Previous reports have focused mainly on river water quality. This report, however, provides information on the quality of all waters during 2000, including rivers, lakes, groundwaters and marine waters. It also summarises all of the key activities of the WMU during 2000, including monitoring of water quality, preparing action plans to improve water quality, controlling effluent discharges and combating, or minimising the effects of pollution. The report describes the status of our waters and highlights the main challenges that lie ahead of us all in managing this invaluable resource.

In future, we will produce updated reports to cover the year 2001, and onwards. In addition, we will produce more detailed reports on particular aspects of the aquatic environment, such as marine waters, or individual sectors, such as waste water treatment and disposal.

The year 2000 marked a milestone in water policy, with the adoption of the EC Water Framework Directive. This is the result of a major review of European water-related legislation, and more than five years of discussions between experts, stakeholders and policy makers. The Directive establishes a new system for the protection and improvement of all aspects of the water environment including rivers, lakes, estuaries, coastal waters and groundwaters. In particular, it requires us to manage river basins in relation to ecological quality, rather than (as previously) just chemical quality. We will also have to be more explicit in understanding how actions in one part of a river basin have an impact on other parts of the basin, and how the quality and quantity of water are related. EHS is fully committed to the aims of the Directive. We believe that it provides an ideal opportunity for us all to take stock of our aspirations for our water environment, and how we can contribute to its future management. Throughout the report we have tried to indicate how the requirements of the Directive may impact upon our water resources.

We hope that the report will help to promote the message that this vital resource must be properly looked after by the whole community.

RICHARD ROGERS
Chief Executive

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ABBREVIATIONS

AESD	Agricultural and Environmental Science Division (of DARD)
ASPT	average score per taxon
BATNEEC	Best Available Technology Not Entailing Excessive Cost
BMWP	Biological Monitoring Working Party
BOD	biochemical oxygen demand
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CMD	Countryside Management Division (of DARD)
COD	chemical oxygen demand
CSO	combined sewer overflow
DAP	Drainage Area Plan
DARD	Department of Agriculture and Rural Development
DES	descriptive standard (for a waste water treatment works)
DETI	Department of Enterprise, Trade and Investment
DO	dissolved oxygen
DOE	Department of the Environment
DRD	Department for Regional Development
EA	Environment Agency (of England and Wales)
EC	European Commission
ECN	Environmental Change Network
EH(R)O	Environmental Health (Rivers) Officer
EHS	Environment and Heritage Service
EPA	Environmental Protection Agency (Republic of Ireland)
EPD	Environmental Policy Division (of DOE)
EQI	ecological quality index
EQO	environmental quality objective
EQS	environmental quality standard
EU	European Union
FCB	Fisheries Conservancy Board
FEPA	Food and Environment Protection Act 1985
FFD	Freshwater Fish Directive
FSSC	Freshwater Sciences Sub-committee
GIS	geographical information system
GQA	General Quality Assessment
GSNI	Geological Survey of Northern Ireland
ha	hectare(s)

INI	Invest Northern Ireland (of DETI)
IRTU	Industrial Research and Technology Unit (now part of INI)
kg	kilogram(s)
km	kilometre(s)
km^2	square kilometre(s)
LA	Loughs Agency (formerly Foyle Fisheries Commission)
m^3	cubic metre(s)
mg/l	milligrams per litre
MPMMG	Marine Pollution Monitoring Management Group
NH_4-N	ammoniacal nitrogen as N
NMMP	National Marine Monitoring Programme
NVZ	nitrate vulnerable zone
NWC	National Water Council
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic (signed at the Ministerial Meeting of the Oslo and Paris Commission on 22 September 1992)
PE	population equivalent
PILOTS	Pollution Incident Logging and Tracking System
RIVPACS	River Invertebrate Prediction and Classification System
RoI	Republic of Ireland
SEPA	Scottish Environment Protection Agency
SNIFFER	Scotland and Northern Ireland Forum for Environmental Research
SS	suspended solids
SWQI	Senior Water Quality Inspector
ug	microgram(s)
UKAWMN	United Kingdom Acid Waters Monitoring Network
UPM	urban pollution management
UWWT	Urban Waste Water Treatment (Directive)
WFD	Water Framework Directive
WHO	World Health Organisation
WMU	Water Management Unit
WQI	Water Quality Inspector
WQMC	Water Quality Management Committee
WS	Water Service
WTW	water treatment works
WWTW	waste water treatment works

I SUMMARY

This report describes the findings of the work undertaken by the Water Management Unit (WMU) of Environment and Heritage Service (EHS) during the year 2000. It is the fourth in a series of five-yearly reports, but, unlike the previous reports, which dealt mainly with the chemical and biological quality of rivers, it covers all of the activities of the WMU and provides a picture of the quality of all aquatic media in Northern Ireland.

It is EHS policy to maintain or improve the quality of surface waters and waters in underground strata as required by national policy, EC Directives and international agreements, and to generally manage river, estuarine and coastal waters to be at least 'Good' under the adopted classification schemes with no downward movement between classes.

Monitoring undertaken throughout 2000 has shown that:

- Chemical quality of rivers has improved since 1995 with an increase from 45% to 59% in the length of monitored rivers classified as of Very Good or Good quality under the General Quality Assessment scheme. Compliance with the requirements of the EC Freshwater Fish Directive has also improved from 61% of designated rivers to 91% over the same period.

- The biologically monitored river network was doubled in 2000 and some 62% of monitored rivers were found to be of Very Good or Good biological quality in 2000. There was, however, a deterioration of the biological quality of those rivers that were monitored in both 1995 and 2000, with a 9% drop over the period in the length classified as Very Good or Good and a corresponding increase in the length classified as Fairly Good.

- A range of dangerous substances were measured at the tidal limits of Northern Ireland's major rivers under international and domestic requirements. No result exceeded set environmental quality standards. Most samples were, in fact, below the level of detection, and only a few positive results were recorded, in particular for some pesticides.

- Acid waters monitoring at four sites in NI has revealed little change in the status of the monitored waters over the last decade.

- No classification system currently exists for lakes in Northern Ireland, but of the three lakes designated under the EC Freshwater Fish Directive, two (Upper and Lower Lough Erne) complied with the Directive. Lough Neagh failed to comply with the pH standard of the Directive.

- Groundwater is generally of a potable quality. However, elevated concentrations of iron and manganese occur at some sources. Some contamination by nitrates, pesticides and solvents has been detected at a small number of sources, and further investigation will be undertaken. Microbiologically, a significant number of sites are showing elevated concentrations of coliform bacteria, which probably originate close to the affected boreholes.

- Quality classification of estuarine and coastal waters is ongoing. A report will be produced in 2003.

- There has been an improvement in the quality of bathing waters since 1995, with all 16 identified waters complying with the Mandatory and Guideline coliform standards of the EC Bathing Water Directive in 2000.

- Except for a small number of exceedances of the zinc standard, designated shellfish waters complied with the Mandatory standards of the EC Shellfish Waters Directive in 2000.

- Some 52% of the trade effluent discharges sampled in 2000 met their consent conditions, continuing a gradual upward trend in compliance. However, the improvement in compliance over the period 1997-2000 has been small. A number of initiatives aimed at promoting awareness, including seminars targeted at particular sectors of industry, education campaigns and stricter regulatory controls, have been implemented in this period as part of a strategy to improve compliance.

- Of the Water Service waste water treatment works (WWTW) that were listed in the public register in 2000, more than 80% complied with their discharge standards. Some 46% of Water Service water treatment works (WTW) complied with their effluent discharge standards in 2000.

- There has been an increase in the number of licences applied for under the Food and Environment Protection Act 1985, especially for marine construction projects. The licensing system has developed to meet the requirements of EC Directives and European and international conventions for the protection of the marine environment. To assess the effective management of sea deposition of materials, a programme of disposal site monitoring is undertaken.

- Following a steady decline in the number of pollution incidents over the last few years, the number of incidents reported to EHS in 2000 rose to almost 2,600. Of these, 1,700 (66%) were substantiated. Agriculture and industry accounted for almost 60% of substantiated incidents.

2 INTRODUCTION

Water is one of our most vital natural resources. Not only is it essential to sustain life itself, but it also plays a crucial role in our economic development and social well-being. For centuries, rivers, lakes, estuaries, seas and groundwater have played a vital role in everyday life. Today in Northern Ireland (NI) these water bodies are important natural resources for agriculture, industry and fisheries, for amenity and recreational use, for their value to tourism and as sources of drinking water. Many waters also support ecological habitats and species of national and international importance. However, some of the activities for which we use water can threaten the very water quality on which they depend. Pollution of our waterbodies often originates in the surrounding catchment and can come from point sources such as industrial or sewage effluent discharges, or can be diffuse such as road or agricultural run-off. It is important that our water bodies are protected from pollution and managed as a sustainable resource for all of the activities that depend on them.

Under the Water (Northern Ireland) Order 1999, the Department of the Environment (DOE) has a duty to promote the conservation of the water resources of Northern Ireland and the cleanliness of water in waterways and underground strata. In performing this duty, it is required to have regard to:

(a) the needs of industry and agriculture;
(b) the protection of fisheries;
(c) the protection of public health;
(d) the preservation of amenity and the conservation of flora and fauna; and
(e) the conservation of geological or physiographical features of special interest and any feature of archaeological, historical, architectural or traditional interest.

The Water Order repealed, and re-enacted with amendments, the Water Act (NI) 1972. The water quality provisions of the Order came into effect on 24 August 2001.

Most of the action taken to conserve our water resources and to protect the quality of our surface water and groundwater is carried out by the Water Management Unit (WMU) of the Enviroment and Heritage Service (EHS). The WMU consists of scientific and administrative staff located in Belfast and Lisburn, and field staff based at a number of locations across Northern Ireland. The WMU protects the aquatic environment through a variety of activities including:

- monitoring water quality;
- preparing water quality management plans;
- controlling effluent discharges;
- taking action to combat or minimise the effects of pollution; and
- supporting environmental research.

Appendix 1 lists the current key primary legislation and Regulations enforced by EHS to protect the quality of the water environment in Northern Ireland.

NI is divided into nine areas of water pollution management (Map 1, overleaf) controlled by an Incident Response Headquarters in Belfast. Each of the nine areas has an Environmental Health (Rivers) Officer (EH(R)O) or Senior Water Quality Inspector (SWQI) and a number of Water Quality Inspectors (WQI). These staff act as field agents on behalf of EHS. They investigate reports of pollution, collate evidence of pollution offences, make advisory visits to industry, take effluent samples from consented discharge points and make recommendations on applications for discharge consents in respect of domestic and trade premises. They also initiate and supervise clean-up work following certain pollution incidents.

MAP 1

Chemical analysis of river waters

The Fisheries Conservancy Board (FCB) and the Loughs Agency (LA) also undertake pollution control on behalf of EHS. Staff from each of these bodies undertake river sampling and investigate reports of water pollution (mainly from agricultural sources). FCB and LA staff also collect evidence on behalf of EHS for use in Water Order prosecution cases.

Routine laboratory services and specialist field sampling are provided by the staff at WMU, Lisburn (formerly part of the Industrial Research and Technology Unit). In addition, hydrogeological, hydrometric and meteorological support are provided by the Geological Survey of Northern Ireland (GSNI), Rivers Agency (DARD) and the Meteorological Office respectively. Other non-routine laboratory services are carried out on behalf of WMU by DARD's Agricultural and Environmental Science Division (AESD) and a range of private consultants and universities. WMU also funds short, medium and long-term research directly by contract or through SNIFFER (Scotland and Northern Ireland Forum For Environmental Research) and QUESTOR (Queen's University Environmental Science and Technology Research Centre).

This report describes the findings of the work undertaken by the WMU during the year 2000. It is the fourth in a series of five-yearly reports, but, unlike the previous reports, which dealt mainly with the chemical and biological quality of rivers, it covers all of the activities of the Unit and provides a picture of the quality of all aquatic media in Northern Ireland.

The year 2000 also saw a landmark for water management within the European Union (EU) with the adoption of Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the 'Water Framework Directive'). This Directive is the product of an extensive review of EU water-related legislation and will determine how we manage our water resources for many years to come. Throughout this report reference is made to some of the key elements of the Directive and how its implementation may be approached. The implementation of the Directive is already the subject of ongoing consultations in NI.

3 WATER QUALITY POLICY

3.1 EHS Water Quality Policy Statement

Previous EHS water quality policy statements[1] were in effect a 'blanket' target for all waters. Under the EC Water Framework Directive (WFD), surface waters and groundwaters must achieve 'Good' status by 2015. In addition, the Directive requires Member States to produce a register of Protected Areas and to comply with any objectives that have been set for those areas. Such Protected Areas will include areas designated under the EC Habitats and Birds Directives, and areas designated to protect drinking water abstraction points, as well as areas in relation to nutrient management and recreation. Specific areas may therefore be designated where particular requirements and stricter quality objectives are needed for uses such as drinking water or bathing water, or for conservation purposes. EHS has reflected the aim of the WFD to achieve 'Good' status and targets for individual water bodies in the following policy statement:

> **'To maintain or improve water quality in surface waters and waters in underground strata as required by national policy, EC Directives and international agreements, and to generally manage river, estuarine and coastal waters to be at least "Good" under the adopted classification schemes with no downward movement between classes'.**

In time, as the implementation of the Water Framework Directive proceeds and, for example, classification systems for lakes and groundwaters are developed, this statement will be reviewed and updated. Later sections of this report explain how the application of these targets has been used in the first instance to prioritise river sub-catchments for action.

3.2 Approach to Catchment Management and Target Setting

Catchment management planning is the process by which the problems and opportunities resulting from catchment uses are assessed and action is proposed to maintain and improve the quality and sustainability of the water environment. The catchment is seen as the natural management unit for the integration of the work programmes of all relevant agencies relating to water quality, water resources and ecosystem management. The catchment planning process provides a medium for promoting discussion, resolving conflict, assigning priorities and setting targets against which progress on key issues can be monitored. This is the underlying approach of the EC Water Framework Directive.

In 1997 and 1998, EHS published proposals for water quality management strategies for the Foyle, Erne and Lagan catchments. These strategies were funded through initiatives under the European Regional Development Fund and, in the cases of the Erne and Foyle projects, were overseen by cross-border steering committees. From its experience in these processes, EHS has established a NI Water Quality Management Committee (WQMC) comprising representatives from divisions and agencies of the Department of Agriculture and Rural Development (DARD), Water Service (Department for Regional Development), Invest Northern Ireland (INI, formerly IRTU), the Fisheries Conservancy Board (FCB) and the Loughs Agency (LA). The purpose of the WQMC is to share information and to co-ordinate management activities aimed at minimising the risks of water pollution.

As stated above, EHS has adopted an approach to setting quality targets for water based on the requirements of national policy, EC Directives and international agreements. The development of this target setting approach is fully detailed in the document *EHS Policy for Setting and Delivering Targets, 2001*. The most up-to-date water quality monitoring information is used to assess compliance with the targets, and, using this assessment, the WQMC helps to prioritise catchments for investigation and management action. By this co-ordinated effort it is hoped to focus the activity of several agencies and optimise the use of limited resources.

Working in parallel with WQMC are the Freshwater and Marine Sciences Sub-Committees of the DOE/DARD inter-Departmental Scientific Liaison Committee. The Sub-Committees have a remit to 'co-ordinate and review the Departments' science programmes and requirements in relation to local, national and international commitments in the (aquatic) environment', and are using the catchment management approach as a framework for carrying out their business.

1 River Quality in Northern Ireland 1995

3.3 EC Water Framework Directive (WFD)

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for community action in the field of water policy (the 'Water Framework Directive') came into force on 22 December 2000. It establishes a new system for the protection and improvement of all of the EU's water environment including rivers, lakes, estuaries, coastal waters, groundwaters, heavily modified and artificial waters. It is a complex document, comprising 26 Articles and 11 supporting annexes, but its central aim is clear: to ensure that the water environment across the EU is managed in a sensible and consistent manner. The word 'Framework' means that the Directive sets out common principles and provides an overall structure for the protection of the water environment and action to be undertaken by each Member State.

More specifically, the Directive sets out how water quality objectives should be set. For surface waters these must include a chemical quality objective and, for the first time, an ecological quality objective. Quantitative and chemical quality objectives must also be set for groundwaters.

At the heart of the WFD is the requirement to produce strategic management plans for each river basin, with specific objectives for the waterbodies within the river basin. The plans must be based on a detailed analysis of the pressures on the water bodies within the river basin and an assessment of their impact. This allows a comprehensive 'programme of measures' to be drawn up, tailored to the specific circumstances in the river basin and targeting improvements and monitoring effort on those water bodies which are most at risk of failing to meet their objectives.

The Directive requires individual river basins (including estuaries, coastal waters and groundwaters) to be identified and assigned to river basin districts (RBDs). Small river basins may be combined with larger river basins to form individual RBDs. These RBDs are then used as the main administrative unit for managing the water environment under a comprehensive River Basin Management Plan (RBMP). The Directive also provides that, where a river basin covers the territory of more than one Member State, the river basin must be assigned to an international river basin district (IRBD).

A recent consultation document by the Environmental Policy Division of DOE proposed that EHS should be designated as the sole competent authority responsible for implementation of the Directive in NI. EHS will not however be able to deliver all of the Directive's requirements without the support of other government departments and agencies, non-governmental organisations and the public. As NI shares many of its river basins with the Republic of Ireland (RoI), it has also been proposed that EHS will be the body to liaise with competent authorities in RoI.

The WFD sets a very challenging implementation timetable for Member States to achieve, as briefly described in Appendix 2. EHS is already heavily involved in technical developments within NI, on an all-island basis and at UK and European level. Through these developments, monitoring programmes, river basin planning and programmes of measures will continue to evolve over the coming years. EHS will also promote the understanding of these developments, ensuring that information is available to enable all members of society in NI to become involved in the decisions made to manage our water resources in a sustainable manner for the future.

3.4 Eutrophication

Eutrophication is now considered to be the most widespread threat to water quality in NI. It has been defined in the EC Urban Waste Water Treatment Directive (91/271/EEC) as:

> **'the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.'**

Throughout Europe, a large proportion of surface waters, both freshwater and saline, are now eutrophic and there is a trend towards deteriorating trophic status in many others. Current knowledge of nutrient enrichment in NI indicates that this is true of both Lough Neagh and Lough Erne and that many other lakes, rivers, estuaries and coastal waters are affected by eutrophication. To ensure the sustainable use of water resources in NI, this trend must be brought under control. Experience to date, both in NI and elsewhere, strongly suggests that this can best be achieved by adopting a co-ordinated river basin approach to water quality management.

Eutrophication can affect both rivers and lakes

Eutrophication is associated with algal blooms, excessive weed growth, shifts in fishery status, deoxygenation, loss of biodiversity, loss of amenity and a range of problems associated with water treatment. In freshwaters, the plant community, including algae, will in most instances take up phosphorus from the water in preference to nitrogen, making phosphorus the growth-limiting nutrient, though nitrogen does play a role in the process. Nitrogen is generally the growth-limiting nutrient in coastal waters. However, taking the river basin approach, excess nitrogen entering freshwaters may eventually contribute further downstream to problems in the estuarine and marine environment. The results of a number of lake surveys carried out between 1988 and 1994 indicated that some 63% of NI lakes were either eutrophic or hypertrophic. While point discharges from industry and waste water treatment works (WWTWs) are major contributors of nutrients, it has been identified that diffuse contributions from agriculture are the primary cause of the current levels of eutrophication in NI. Where in the past it was considered that only lakes were affected, it has now been demonstrated that rivers and estuaries are also showing signs of impact.

In 1999, EHS published for consultation a document entitled *Eutrophication in Northern Ireland's Waters - Proposals for a Strategy to Control Nutrient Enrichment*. Three general approaches emerged: voluntary nutrient management, education, and legislative measures. The legislative approach has been adopted by RoI and other EU countries. The Department is committed to publishing its Eutrophication Control Strategy and is currently in consultation with other government departments to establish a wider understanding of how best to incorporate the implications of recent developments at an EU level.

4 RIVER MONITORING

4.1 River Water Quality Monitoring Network Review

River water quality monitoring in NI is carried out by EHS in order to manage the aquatic environment in a sustainable manner. A major review of the long-standing river water quality monitoring network was undertaken in 1999.

The review defined the objectives of the *routine* river monitoring programme to be:

- to classify general river water quality using the appropriate national chemical and biological schemes;
- to assess compliance with specific EU Directives and international agreements; and
- to provide the river quality information required for the setting of discharge consent standards.

Other *operational* or *investigative* monitoring programmes are required to determine the causes of pollution where it occurs or to monitor the effects of management activities.

The review led to the cessation of sampling at a number of routine monitoring stations because (a) they were affected by known effluent discharges and, therefore, not representative of general river water quality, or (b) statistical analysis of results showed that they were surplus to requirements as the information they were providing could be obtained from neighbouring stations.

Forkill River near Forkill, Co. Armagh

Following assessment of the rationale underlying other river monitoring networks in the UK and the Republic of Ireland (RoI), it was decided that rivers with a mean daily flow of at least 5,000 m^3 per day should be considered for inclusion in the NI network. Some of these rivers were excluded from the network, however, because they were unsuitable for effective sampling or for Health and Safety reasons related to access.

The review more than doubled the number of sampling stations and increased the length of rivers monitored from around 2350 km to more than 5000 km. Each sampling station is used to provide information about the quality of a particular length (or 'reach') of river. The larger rivers that were being monitored prior to the review were categorised as 'primary'. Those added to the network were categorised as either 'secondary' (smaller rivers at least 3 m wide) or 'minor' (smaller rivers from 1.5 to 3 m wide). Primary and secondary rivers (approximately 4100 km) are monitored chemically and biologically, while minor rivers (approximately 1000 km) are monitored biologically.

A description of the network review and a list of the river quality monitoring stations are included in the EHS document *A River Water Quality Monitoring Strategy for Northern Ireland* which may be viewed on the EHS website (www.ehsni.gov.uk) or obtained on request from WMU.

4.2 Year 2000 Classifications

4.2.1 General Quality Assessment

Following the 1999 review, rivers were monitored biologically once, twice or three times in 2000 (depending on the size of the river) and chemically on a monthly basis. The data derived from this monitoring are used to categorise river quality into a number of discrete bands or classes using the General Quality Assessment (GQA) scheme. Since the 1980s, the Department has published river classifications in five-yearly reports, most recently for 1995. This report includes the river classifications for 2000 and compares these with the 1995 classifications.

The GQA scheme examines a range of chemical and biological determinands which, taken together, describe the overall quality of the river environment. The values of these determinands at the various sampling points reflect the quality of NI rivers by detecting the general impact of diffuse and point source pollution from agricultural, industrial and sewage sources.

In 1995, Northern Ireland rivers were surveyed for the first time to determine the distribution of water plants (macrophytes) and larger benthic algal species. This survey, and additional recording in subsequent years, has produced information which can be useful in interpreting anomalies in chemical data.

Chemical GQA Monitoring 2000

The Chemical GQA scheme is described in detail in Appendix 3. Under it, chemical river quality is separated into six discrete bands, from Very Good, through Fair, to Bad Quality, using nationally accepted criteria. GQA uses three determinands to classify river reaches. These are ammonia, biochemical oxygen demand (BOD) and dissolved oxygen (DO).

Ammonia and BOD are indicators of organic pollution and, if present in excess, will result in a decline in DO concentrations in river waters. In contrast, where low DO concentrations occur in the absence of high BOD or ammonia concentrations, these can be the result of plant and algal growth processes. Swings in DO concentrations from extremely high to low levels can also be indicative of excessive plant and algal growth, often due to excessive concentrations of nutrients such as phosphorus and nitrogen.

A summary of the class limiting criteria for each determinand is given in Appendix 3. The worst of the three classes for the individual determinands becomes the overall Chemical GQA class for the river reach. The Chemical GQA classification system reduces the risk of mis-classifying by using the data set from the previous three years of chemical monitoring. For this reason, chemical GQA classifications for secondary rivers in the extended network will not be available until 2003 when data will be available for the period 2000 to 2002 inclusive.

As well as the three chemical determinands used for GQA classification, a range of other tests are carried out on river waters. The suite of tests varies depending on, among other things, the size of river (whether primary, secondary or minor) and whether the river is designated under the EC Freshwater Fish Directive. The suites of tests currently carried out are set out in Appendix 4.

Biological GQA Monitoring 2000

Taken in isolation, chemical monitoring can result in a river being classified as of good quality when pollutants not specifically tested for, such as herbicides and insecticides, are present, or where periodic and intermittent pollution events are not detected by the chemical sampling programme. Biological monitoring can reveal the effects of pollution not detected by chemical monitoring.

Unlike chemical monitoring which examines the water itself, biological monitoring looks at the abundance and diversity of the tiny creatures (macroinvertebrates) that live in the river. The Biological GQA classification scheme is based on an assessment of the representativeness of the benthic macroinvertebrate community of river reaches. Within each natural

macroinvertebrate community there are organisms which cover a range of sensitivities to pollution. In addition, specific types of organisms are particularly sensitive to specific types of pollution. For example, mayfly nymphs are sensitive to acidification, while snails and other molluscs are sensitive to metal contamination, which interferes with their shell forming processes.

Sampling river macroinvertebrates

These macroinvertebrate communities act as 'in-line' monitors because they are relatively static and cannot escape the effects of any pollution that may occur. In addition, their relatively slow recolonisation rates allow damage to be detected several months after an actual pollution incident.

The Biological GQA classification scheme relies on a computer program called RIVPACS (River Invertebrate Prediction and Classification System). Using the physical, geographical and chemical characteristics of a monitoring site, RIVPACS can predict what the natural macroinvertebrate fauna of that site would be in the absence of environmental stress, of which pollution is an important form. RIVPACS is used throughout the UK, and a specific program based on the species diversity of rivers in NI has been developed.

The current RIVPACS programme for NI (RIVPACS III+, Version 1.3) is based on data collected at 70 of the least-impacted sites in the primary network representing the full geographical range and types of larger rivers in NI. The programme may not therefore accurately predict the macroinvertebrate communities in the smaller secondary and minor waterways monitored in 2000, many of which are in more upland locations. For this reason, data from a further 40 least-impacted sites in the secondary and minor networks are currently being added to the RIVPACS programme for NI. When this development is complete, the Year 2000 results will be recalculated.

Like the Chemical GQA, the Biological GQA separates water quality into six bands which have been defined in accordance with standard national procedures (Appendix 5). These bandings also range from Very Good, through Fair, to Bad Quality, but it should be stressed that the chemical and biological bandings are not directly comparable. Chemical river quality is assessed by analysis of the water itself while biological quality is defined by the fauna found in the river.

In 2000, biological GQA monitoring was carried out on primary, secondary and minor rivers on a three-season (spring, summer and autumn), two-season and one-season basis respectively.

Excessive amounts of larger aquatic plants and 'blankets' of algae can significantly affect the chemical, and, to a lesser extent, the biological (in terms of invertebrates) quality of a river. Corroborating evidence in support of the 1995 and 2000 classifications has been derived from a plant and algal survey undertaken during these years as an aid to the interpretation of any anomalies detected in the classifications.

GQA Chemical and Biological Classifications 2000

Table 1 sets out the Primary river lengths in the various chemical classes in 1995 and 2000. There has been a considerable improvement in chemical quality over the five year period, with an approximate 10% drop in the length of rivers in the worst three quality classes (Fair to Bad) and a 14% increase in the length classified as Very Good to Good. Improvements have in most cases been due to improved DO concentrations in the rivers. The most notable improvements have occurred in the Ballinamallard and Colebrooke catchments where water quality has improved by up to two classes, and in one reach by three classes. The lower reach of the River Lagan and its major tributary, the Ravernet, have also improved significantly over the period. Other areas where improvement is evident are the River Roe catchment and parts of the River Foyle catchment, such as the Mourne, Derg and upper reaches of the Drumragh system.

Table 1 GQA Chemical Classifications of Primary Rivers 1995 and 2000

Class	1995		2000	
	Length (km)	Length (%)	Length (km)	Length (%)
A (Very Good)	141	6.0	167	6.9
B (Good)	911	38.7	1246	51.9
C (Fairly Good)	688	29.3	634	26.4
D (Fair)	329	14.0	252	10.5
E (Poor)	284	12.1	103	4.3
F (Bad)	0	0	0	0
TOTAL	2353	100	2403	100

Maps 2A and 2B show the chemical river classifications for 1995 and 2000 respectively.

Table 2 sets out, for all of the rivers monitored, the lengths in the various biological classes in 1995 and 2000. The two years are not directly comparable as the monitored network more than doubled over the five-year period. To allow comparison between the two years, Table 3 sets out the classified lengths for those rivers (the 'primary network') that were monitored in both years. There has been little change over the period in the length of rivers classified as Fair to Bad, but there has been an approximate 15% decrease in the length classified as Very Good and a corresponding increase in the length classified as Good or Fairly Good. The deteriorations (in most cases by a single class but occasionally by two classes) are most noticeable in the Burn Dennet, Faughan and Roe systems, parts of the Owenkillew and Drumragh systems, and in some of the coastal catchments of Antrim and South Down. There are also isolated instances of slight deterioration elsewhere. This trend mirrors what has been reported recently about river quality in RoI, where there has also been little change in the condition of poorer quality rivers but some deterioration in those rivers previously reported as being of better quality.

MAP 2A


CHEMICAL QUALITY 1995
GQA Class
Class A
Class B
Class C
Class D
Class E
Class F
Coleraine
Londonderry
Ballymena
Antrim
Bangor
BELFAST
Omagh
Lough Neagh
Lough Derg
Lower Lough Erne
Upper Lough Erne
200000
300000
400000
350000
Kms
Miles

MAP 2B

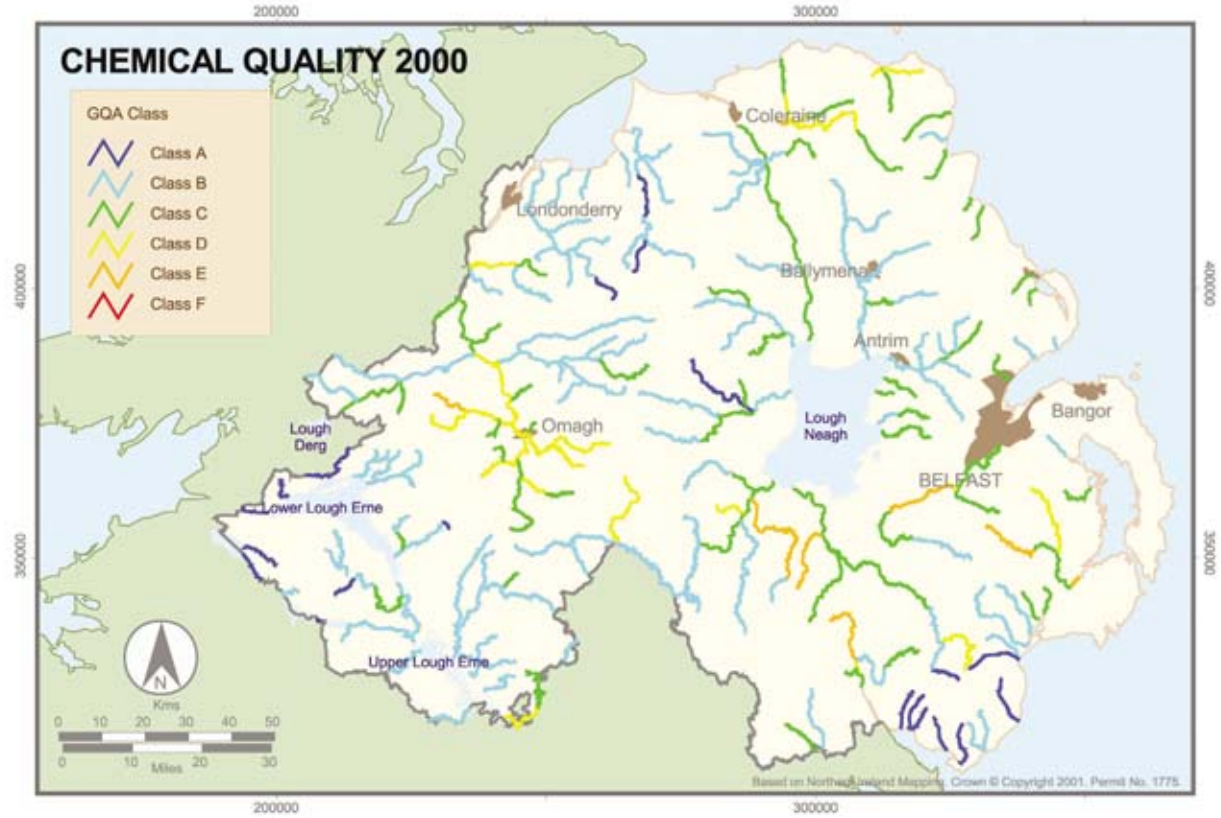

CHEMICAL QUALITY 2000
GQA Class
Class A
Class B
Class C
Class D
Class E
Class F
Coleraine
Londonderry
Ballymena
Antrim
Bangor
BELFAST
Omagh
Lough Neagh
Lough Derg
Lower Lough Erne
Upper Lough Erne
200000
300000
400000
350000
Kms
Miles

Table 2 GQA Biological Classifications of Rivers 1995 and 2000 - All Monitored Rivers

Class	1995		2000	
	Length (km)	Length (%)	Length (km)	Length (%)
A (Very Good)	847	36.4	1231	24.0
B (Good)	911	39.1	1928	37.5
C (Fairly Good)	439	18.8	1296	25.2
D (Fair)	123	5.3	547	10.7
E (Poor)	11	0.5	117	2.3
F (Bad)	0	0	19	0.4
TOTAL	2331	100	5137	100

Table 3 GQA Biological Classifications of Rivers 1995 and 2000 - Primary River Network

Class	1995		2000 (Primary Network)	
	Length (km)	Length (%)	Length (km)	Length (%)
A (Very Good)	847	36.4	512	21.6
B (Good)	911	39.1	1059	44.6
C (Fairly Good)	439	18.8	643	27.1
D (Fair)	123	5.3	150	6.3
E (Poor)	11	0.5	13	0.5
F (Bad)	0	0	0	0
TOTAL	2331	100	2377	100

Table 4 sets out the classified lengths for those rivers ('secondary' and 'minor') that were added to the monitoring network following the 1999 review described earlier. The most notable feature of this table is the length of minor rivers classified as Fair to Bad. Some 35% of the length of minor rivers classified fell into the worst three quality classes in 2000, compared with just 7% of primary rivers and 9% of secondary rivers. Most of the problems found in the minor rivers were due to biodegradable organic pollution. Minor rivers, because of their size, afford less dilution and are therefore more vulnerable to such pollution. Similar findings have been reported in Great Britain following the monitoring of smaller waterways there.

It should be borne in mind when comparing the quality of primary, secondary and minor rivers, that results derived from single-season sampling of minor rivers are less statistically robust than those from two-season sampling of secondary rivers and three-season sampling of primary rivers. Also, as previously mentioned, the RIVPACS computer model used to classify the minor rivers in 2000 is not currently designed to cater for smaller waterways. Further research is under way to produce a version of the model better suited to smaller, more upland waterways. The year 2000 results will be re-assessed when this model becomes available.

Table 4 GQA Biological Classifications of Rivers 2000 - Secondary and Minor Rivers

Class	Secondary Rivers		Minor Rivers	
	Length (km)	Length (%)	Length (km)	Length (%)
A (Very Good)	550	31.8	168	16.3
B (Good)	625	36.1	244	23.7
C (Fairly Good)	398	23.0	255	24.7
D (Fair)	131	7.6	266	25.8
E (Poor)	25	1.4	79	7.7
F (Bad)	0	0	19	1.8
TOTAL	1729	100	1031	100

Maps 3A and 3B (overleaf) show the biological river classifications for 1995 and 2000 respectively.

Under the WFD it will be necessary to develop new river quality classification methodologies for other biological elements, such as macrophytes and fish. In 1999, EHS awarded a studentship to the University of Ulster at Coleraine to develop an objective classification methodology based on the macrophyte data currently available. We will also support similar research into techniques for fish assessment. Once developed, these new monitoring methodologies will have to become part of the routine monitoring programme.

4.2.2 EC Freshwater Fish Directive (FFD)

The EC Directive (78/659/EEC) on fresh waters needing protection or improvement in order to support fish life (the 'Freshwater Fish Directive') sets standards of water quality for the protection of coarse and game fisheries, together with monitoring requirements. Member States are to designate freshwaters needing protection or improvement in order to support fish life, and have a duty to produce action plans to ensure compliance with the standards. Two categories of water are to be designated: suitable for salmonids (salmon, trout) and suitable for cyprinids (coarse fish). An Annex to the Directive sets out 14 physical and chemical parameters against which are listed Mandatory (or 'Imperative') and Guideline standards for salmonid and cyprinid waters. Member States must set standards no less stringent than the Mandatory standards and must 'endeavour to respect' the Guideline standards.

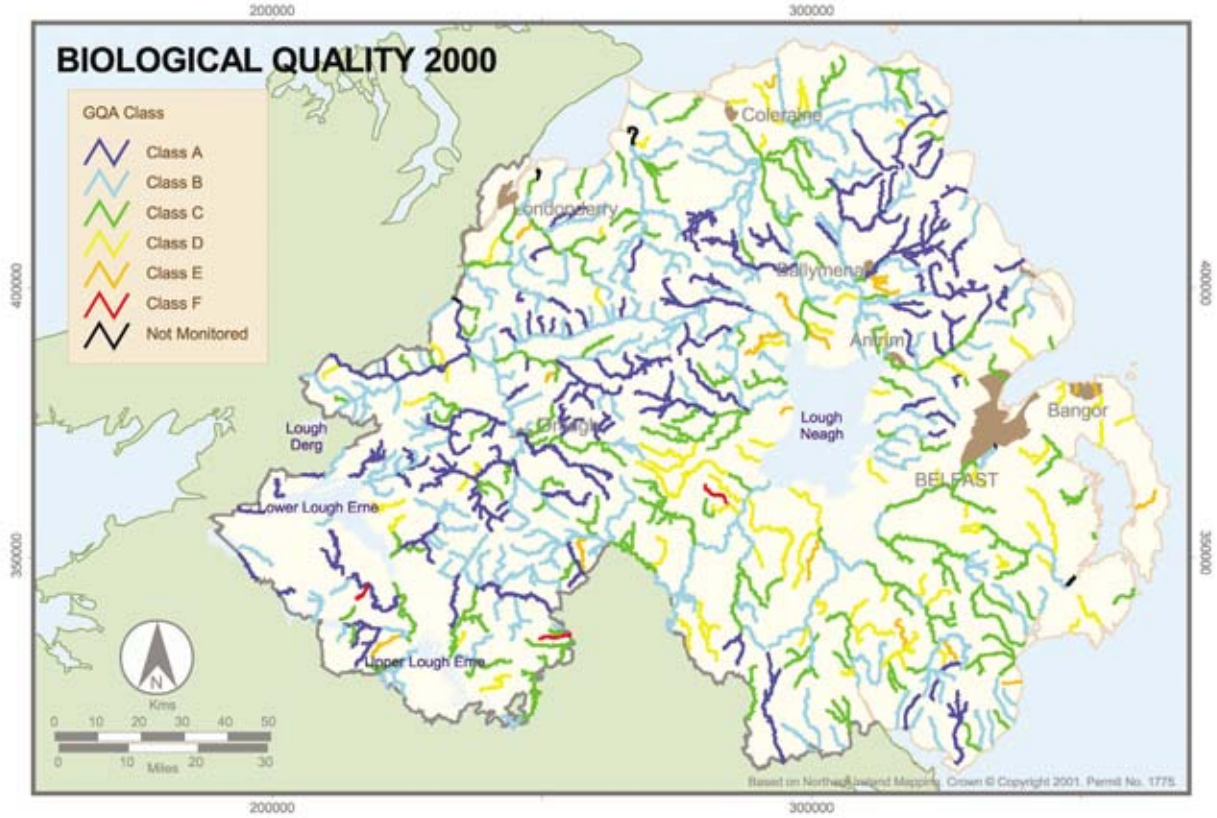
Member States are to establish action plans, and to ensure that within five years of designation the waters conform to the standards set. Minimum sampling frequencies are given, but where the water quality is high, sampling frequency may be reduced. If sampling shows that a standard is not being met, appropriate remedial action is to be taken.

The DOE has designated 1062 km of rivers as salmonid and 129 km as cyprinid under this Directive. The three largest loughs, Lower Lough Erne, Upper Lough Erne and Lough Neagh with Lough Beg (totalling some 55,000 hectares) have also been designated as cyprinid. The designated waters are shown in Map 4A (overleaf). Further designations are planned which will double the length of designated rivers and upgrade the designation of Lower Lough Erne from cyprinid to salmonid. WMU has analysed all of the monitoring sites on both the designated, and proposed designated, river reaches and lakes on a monthly basis for the parameters required under this Directive (see Appendix 4) for a number of years. This monitoring allows EHS both to assess compliance with the standards for the designated reaches and to predict compliance for those reaches proposed for designation.

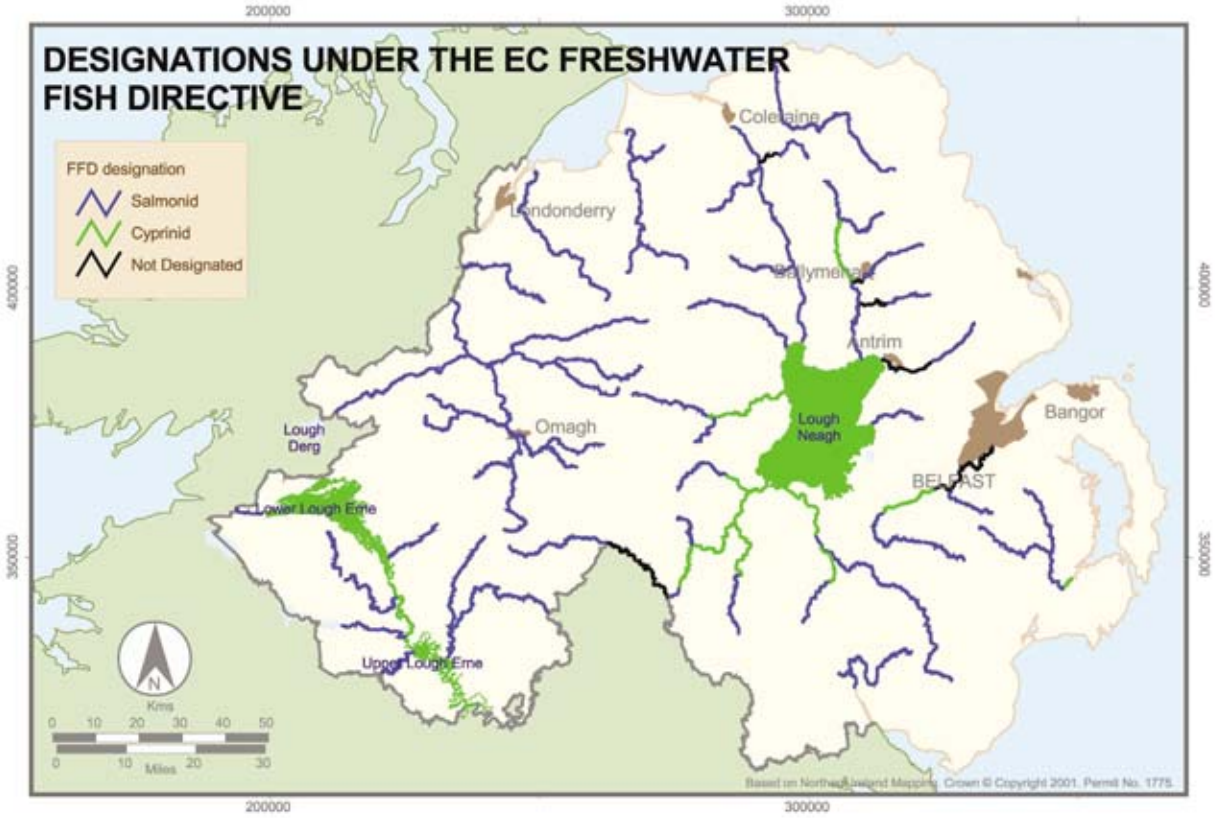
MAP 3A


BIOLOGICAL QUALITY 1995
GQA Class
Class A
Class B
Class C
Class D
Class E
Class F
Not Monitored
Coleraine
Londonderry
Ballymena
Antrim
Bangor
BELFAST
Omagh
Lough Derg
Lough Neagh
Lower Lough Erne
Upper Lough Erne
200000
300000
400000
350000
Kms
Miles

MAP 3B


BIOLOGICAL QUALITY 2000
GQA Class
Class A
Class B
Class C
Class D
Class E
Class F
Not Monitored
Coleraine
Londonderry
Ballymena
Antrim
Bangor
BELFAST
Omagh
Lough Derg
Lough Neagh
Lower Lough Erne
Upper Lough Erne
200000
300000
400000
350000
Kms
Miles

MAP 4A



Compliance with the EC Freshwater Fish Directive

Table 5 (overleaf) sets out compliance with the FFD in 1995 and 2000.

The compliance rate for designated waters, both rivers and lakes, in 1995 was the lowest recorded since compliance monitoring began in 1984. The main reason for the poor river compliance in 1995 was low DO concentrations in a number of catchments, although there were also isolated instances of failures due to high ammonia concentrations and high pH values.

Overall, compliance has improved markedly since 1995, with more than 90% of designated rivers complying with the requirements of the Directive in 2000. Many rivers and reaches that failed to comply in 1995 were compliant in 2000, most notably in the Erne and Foyle catchments. In only one case did a river which complied in 1995 fail to comply in 2000. As in 1995, the main reason for failures to comply with the Directive in 2000 was low DO concentrations in a small number of catchments, though again there were also isolated instances of failures due to high ammonia concentrations and high pH values. The DO problems have been attributed in most cases to the respiratory processes of extensive plant growth in rivers, which is caused by over-enrichment of the rivers with plant nutrients. The high pH values have been attributed to the same cause. Ammonia problems, where they occur, are the result of biodegradable inputs to the rivers.

Failures in designated lakes were due mainly to the effects of excessive algal growth.

The larger designated lakes are monitored at several points. If the water at any of these points fails to comply with the Directive, the whole lake is deemed to have failed. In 2000, Lough Neagh failed because the water at one of its five monitoring points had a pH value outside the Directive limits. The other four points complied with the Directive standards.

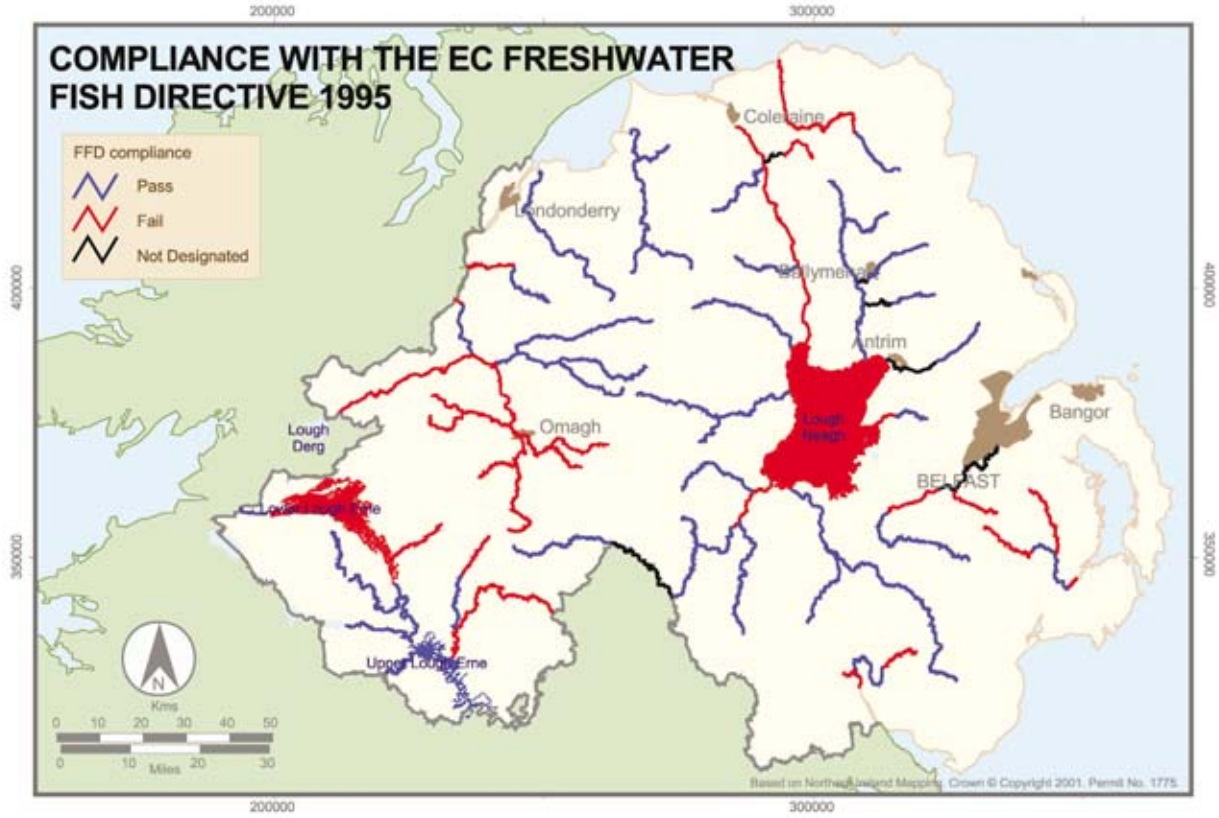
Table 5 Compliance with the EC Freshwater Fish Directive - 1995 and 2000

Year	Rivers			Lakes*		
	Designated (km)	Complying (km)	Complying %	Designated (ha)	Complying (ha)	Complying %
1995	1191	730	61	55000	4300	8
2000	1191	1079	91	55000	15300	28

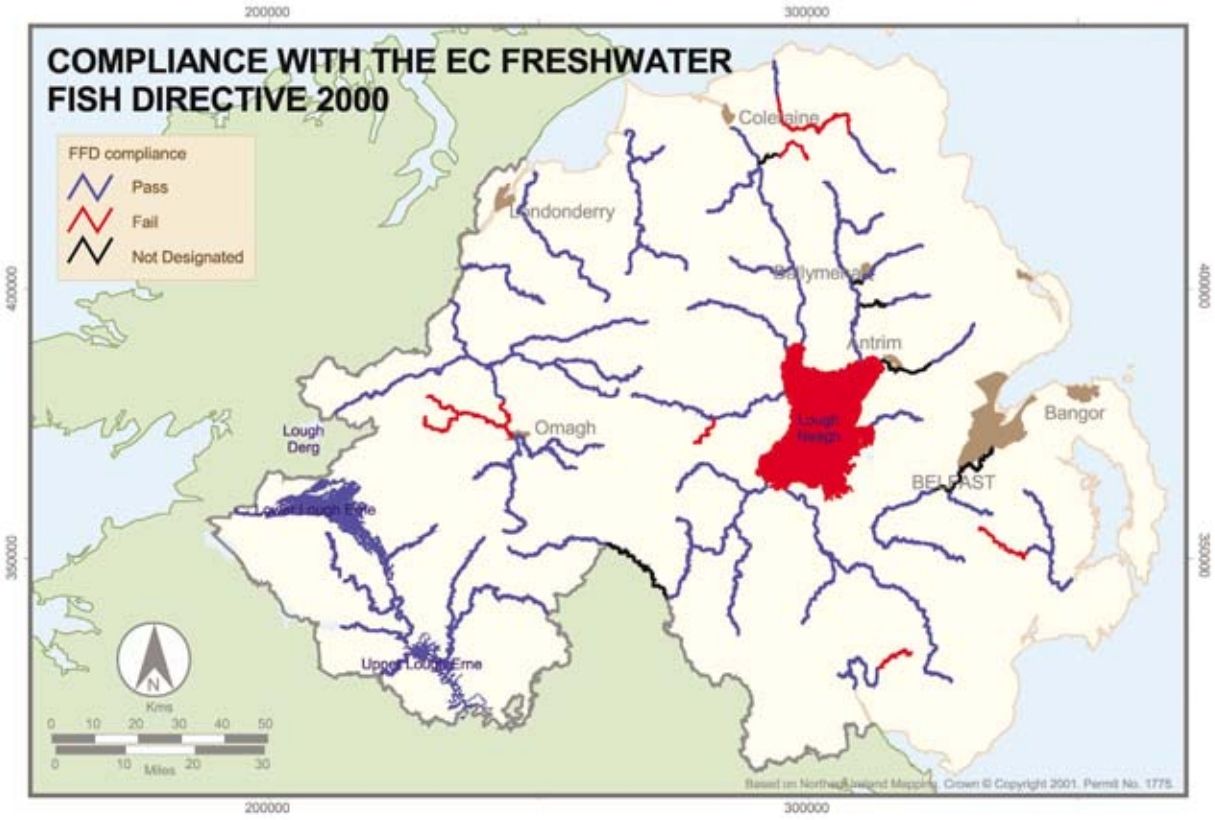
*Only three large lakes are designated, so a single failure has a large effect on compliance rate.

Maps 4B and 4C illustrate compliance with the current designations under the FFD in 1995 and 2000 respectively. In these maps, compliance for both years has been assessed using the 2000 network of monitoring stations.

MAP 4B



MAP 4C



Other River Monitoring

In 2000, EHS also monitored rivers under the EC Dangerous Substances Directive, the EC Nitrates Directive, the UK Environmental Change Network Monitoring Programme and the UK Acid Waters Monitoring Programme. The findings of these monitoring programmes are discussed in Sections 8.1, 8.2 and 8.3 of this report.

4.3 Targets for Rivers

WMU's approach to setting water quality targets and the role of the WQMC in this process have been described previously in the water quality policy section of this report (Section 3.2). As stated earlier, the most up-to-date water quality monitoring information is used to assess compliance with targets, and from this catchments are prioritised for investigation and management action.

The target-setting process is based on the EHS water quality policy statement, in particular the intention that waters should be 'at least "Good" under the adopted classification schemes'. 'Good' status can be attributed to rivers that achieve certain standards under various water quality classification schemes and meet certain legal quality requirements as follows:

- rivers should be GQA Biological Class B (Good), or better, based on the modal annual 'three-season' classifications for 1995-2000 with no downward movement between classes;
- rivers should be GQA Chemical Class B (Good), or better, based on the modal annual classifications for 1995-2000 with no downward movement between classes; and
- monitored rivers should comply with the FFD, where designated, and with other relevant EC Directives.

These targets use currently available classification schemes to approximate to the requirements of the WFD, which, by default, will require all waterbodies to be of 'Good' status.

Targets apply to all waterways, but compliance can be reported only for monitored waters. These river water quality targets will remain in place until 2005 when they will be reviewed to reflect more specifically the requirements of the WFD. In the interim period, EHS will continue to review annual compliance with these targets in order to prioritise programmes for pollution control and prevention.

Biological and chemical quality targets for NI rivers are shown in Maps 5A and 5B respectively.

MAP 5A

MAP 5B

4.3.1 Year 2000 Compliance with Targets

Summaries of the Biological GQA and Chemical GQA river classifications for the years 1995 and 2000 are shown in Figures 1 and 2 respectively, together with water quality class targets for the year 2000 and compliance with these targets. Comparison of the percentage river lengths in the various quality classes in 1995 and 2000 provides an overview of the overall change between the two years.

Figure 1: GQA Biological Classifications of Primary Rivers 1995 & 2000 and Compliance with Year 2000 Targets

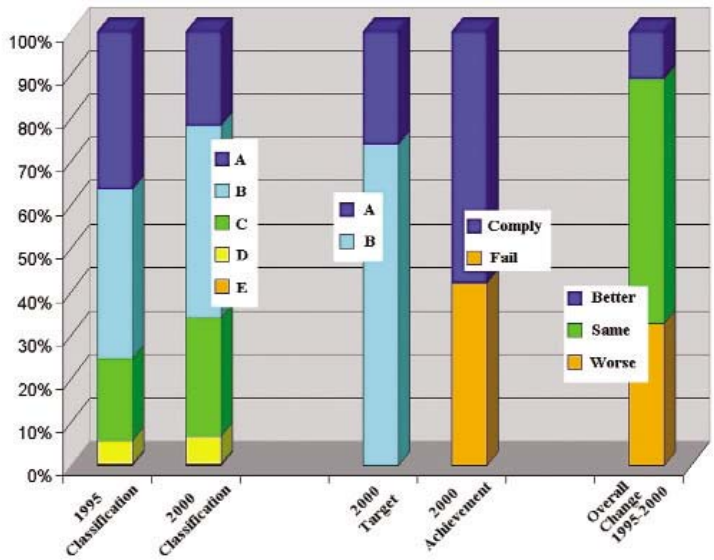
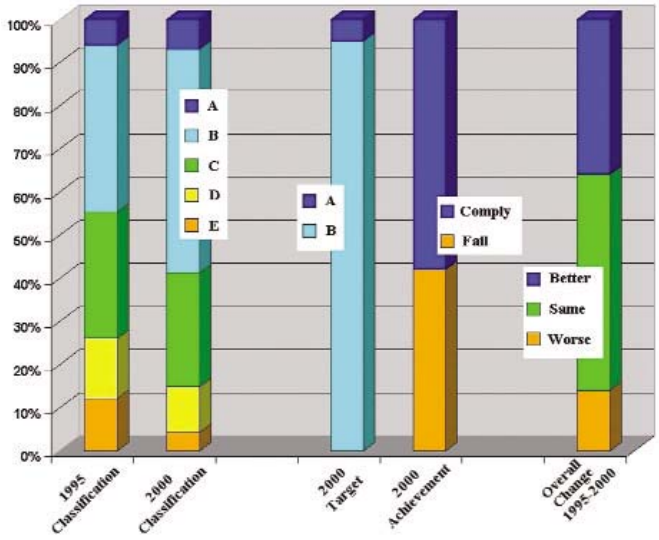


Figure 2: GQA Chemical Classifications 1995 & 2000 and Compliance with Year 2000 Targets



In summary, for the year 2000, 42% of monitored rivers failed to meet the required GQA Biological target. Coincidentally, 42% of monitored rivers also failed to comply with their respective GQA Chemical targets.

Compliance with FFD designations in 1995 and 2000 has been described earlier (Section 4.2.2) and is outlined in Table 5, and Maps 4B and 4C.

4.3.2 Prioritised Catchments

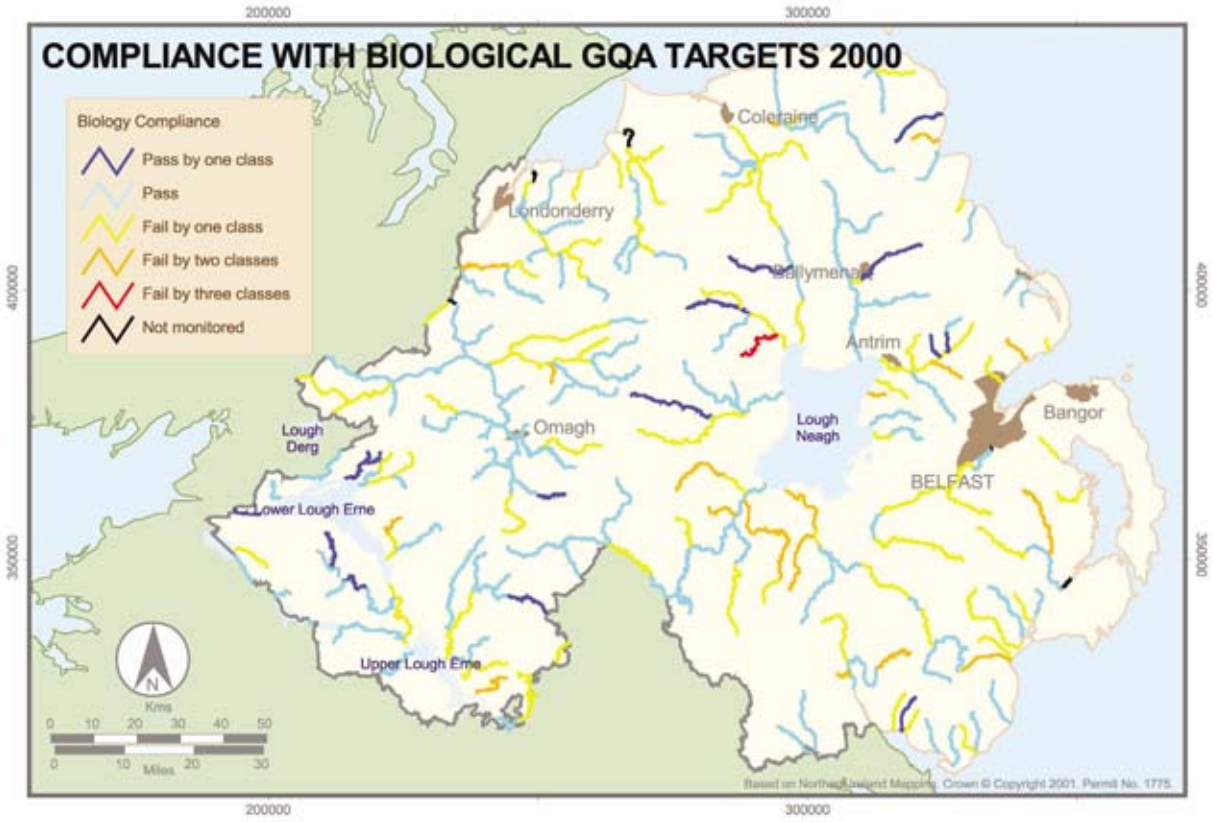
Information on the level of compliance with targets enables EHS to prioritise and target appropriate management action. Based on recent performance, and year 2000 compliance with Biological GQA targets (Map 6A), Chemical GQA targets (Map 6B) and FFD designations (Map 4C), waters in the following catchments or sub-catchments have been prioritised for action (Map 7A):

- Upper Bann;
- River Bush;
- River Lagan;
- Newry River;
- Strule River System;
- Tall River.

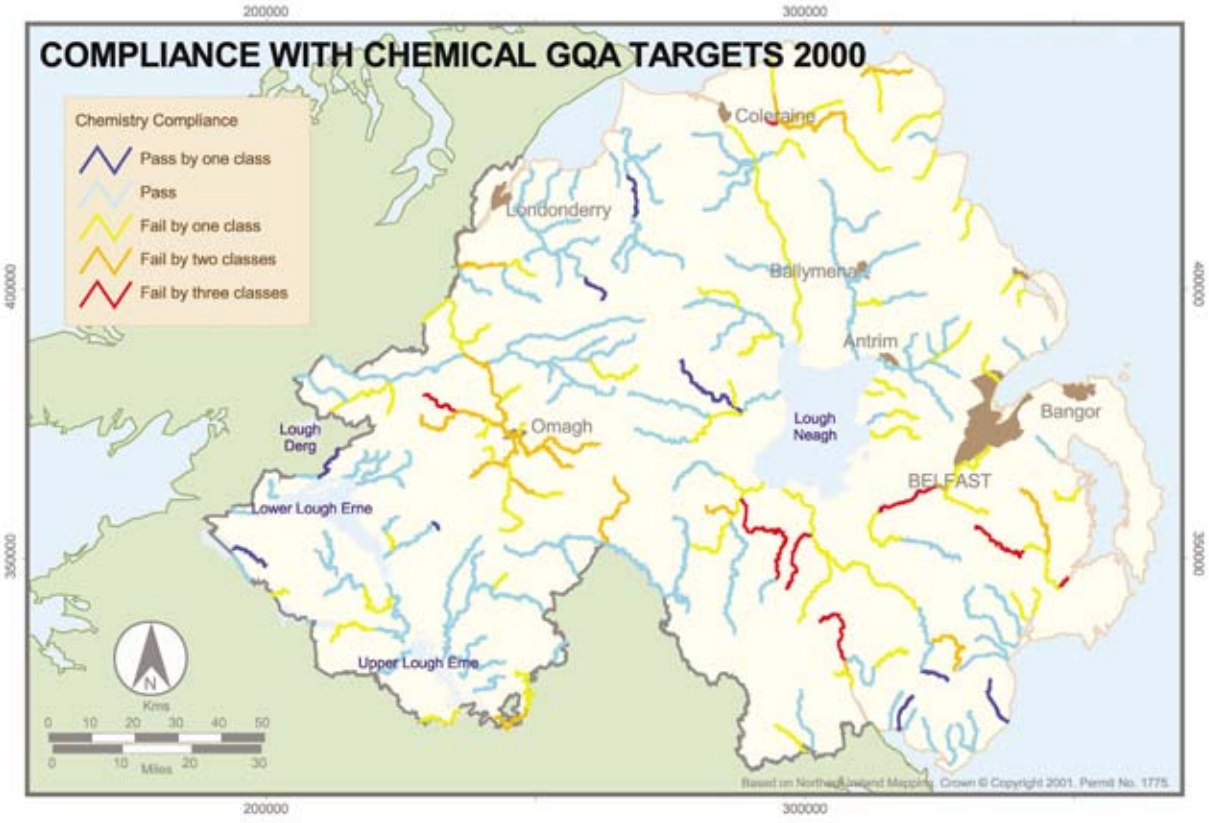
Water quality and aquatic habitat quality can be monitored and reported in many ways. EHS is supporting research and development of additional water quality monitoring and reporting techniques. As more monitoring programmes become established on a national basis, the information generated by them will be used in conjunction with that derived from existing programmes for future prioritisation exercises, which will also be extended to cover lakes, marine waters and groundwater.

The following sections provide an overview of the issues in the six priority catchments.

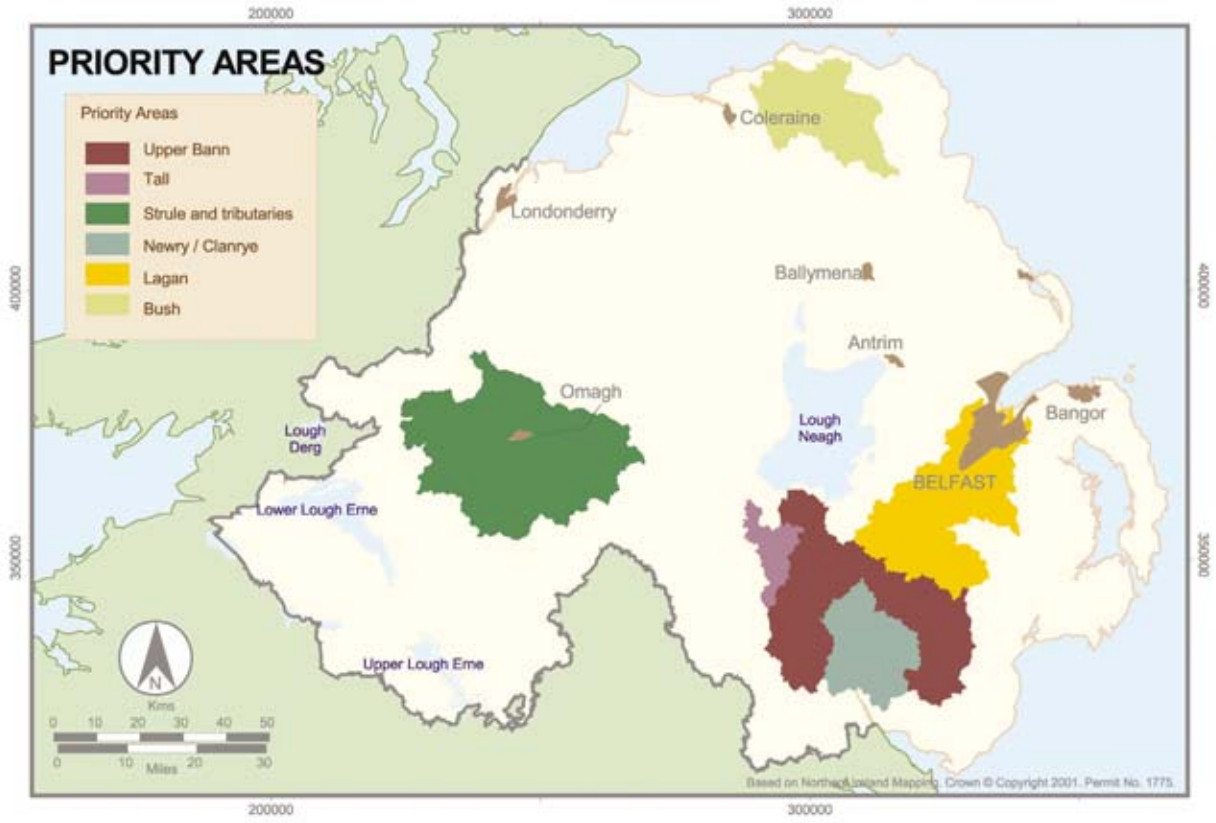
MAP 6A


COMPLIANCE WITH BIOLOGICAL GQA TARGETS 2000
Biology Compliance
Pass by one class
Pass
Fail by one class
Fail by two classes
Fail by three classes
Not monitored
Coleraine
Londonderry
Ballymena
Antrim
Bangor
BELFAST
Omagh
Lough Derg
Lough Neagh
Lower Lough Erne
Upper Lough Erne
200000
300000
400000
350000
Kms
Miles

MAP 6B


COMPLIANCE WITH CHEMICAL GQA TARGETS 2000
Chemistry Compliance
Pass by one class
Pass
Fail by one class
Fail by two classes
Fail by three classes
Coleraine
Londonderry
Ballymena
Antrim
Bangor
BELFAST
Omagh
Lough Derg
Lough Neagh
Lower Lough Erne
Upper Lough Erne
200000
300000
400000
350000
Kms
Miles

MAP 7A



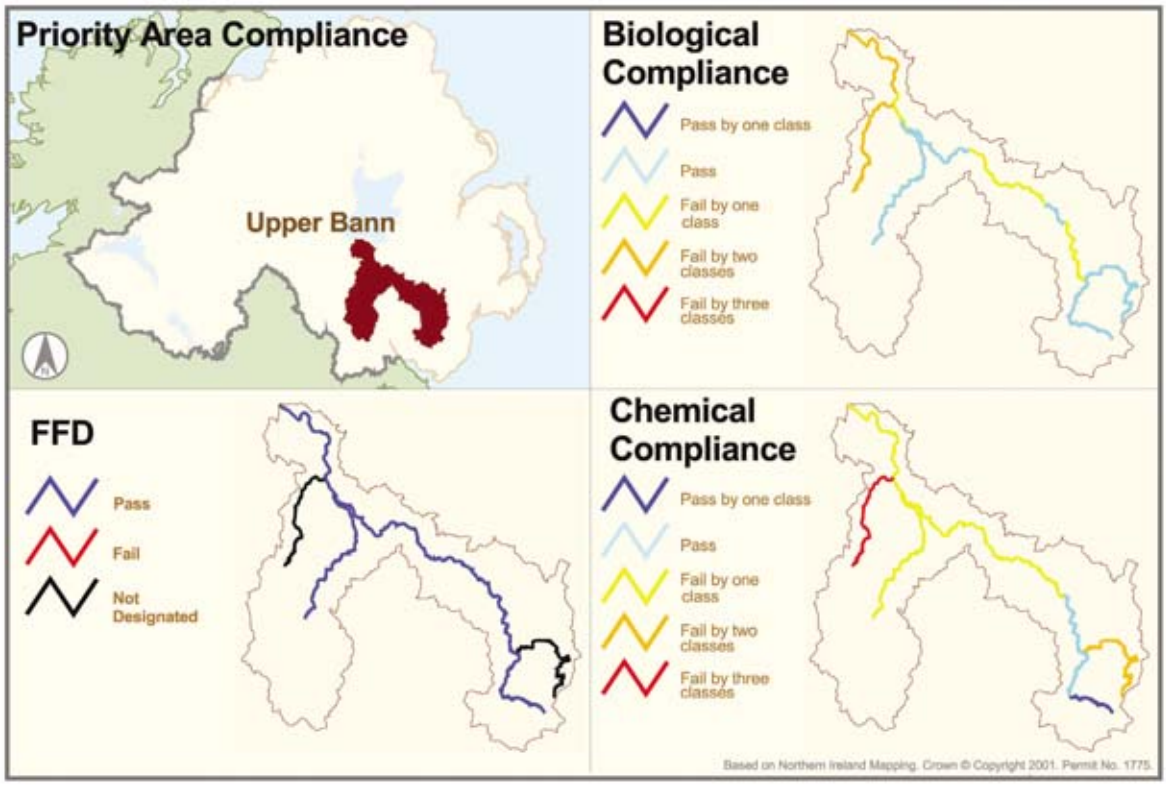
Upper Bann

The Upper River Bann (catchment area 656 km^2) rises on the western slopes of the Mourne Mountains and discharges to Lough Neagh at Bannfoot about 15 km north west of Portadown. The river has considerable game fishery potential in its middle and upper reaches, and is a highly valued coarse fishery from upstream of Portadown through to Lough Neagh. It has two major tributaries, the Cusher and Ballybay Rivers.

The Upper Bann is a complex catchment with a wide range of land uses, including fruit growing, livestock farming, arable farming and urbanisation. Historically, the designated reaches have demonstrated intermittent non-compliance with the FFD. However, in the year 2000, the FFD results were compliant. (Map 7B). There is, nevertheless, widespread non-compliance with Chemical GQA targets (Map 7B). The Muddock River, which flows into the Upper Bann near Rathfriland, and the Ballybay River, failed by two and three classes respectively. The headwaters of the Upper Bann itself, including the Muddock, for the most part were represented by good or very good biological quality. However, there are tributaries throughout the catchment which demonstrate poorer biological quality (Map 7B). These are typical of many other smaller watercourses throughout the catchment which are of poorer quality than the larger river into which they flow.

The perceived pressures on water quality include nutrient enrichment and siltation associated with diffuse pollution from agricultural activities. There are occasional short-term, but high-impact, point-source pollution incidents including oil, slurry, silage effluent and sewage spills. Waste water treatment works (WWTWs), storm sewers and water treatment works provide sources of high biochemical oxygen demand (BOD) and ammoniacal nitrogen. Surface drainage, together with household waste-water, not including raw sewage, has a significant impact in urbanised areas.

MAP 7B



Chemically, there can be dramatic DO fluctuations due to varying BOD, and because of aquatic plant and algal growth within watercourses. There are also pollution risks from pesticides associated with soft fruit growing activities. Biodegradable organic wastes from soft fruit processing industries have also been a problem. Poor sheep-dip disposal practices are also thought to be the cause of biological stress within various stretches of river.

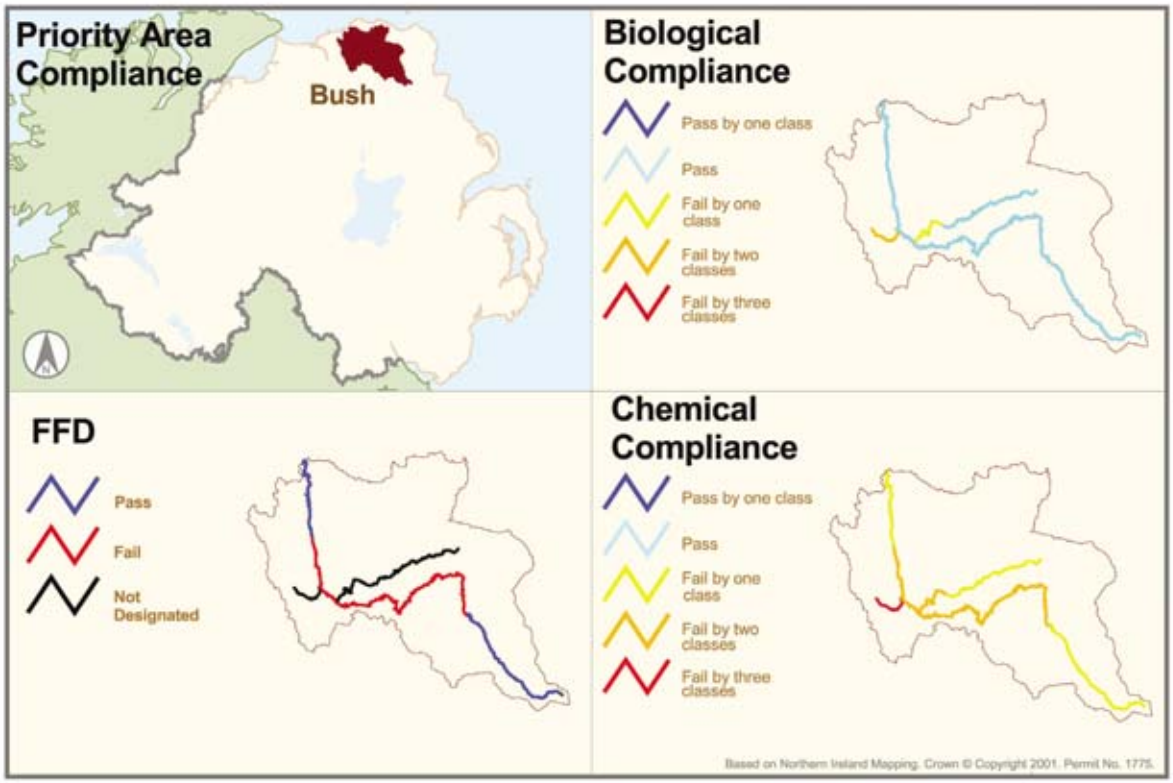
Against a background of sporadic pollution problems, EHS commissioned a detailed biological study of the Upper Bann in Autumn 1999 to provide a baseline for future management initiatives in the river system. This investigation showed that by far the most widespread problem affecting the system was biodegradable organic pollution and that this could not be attributed to known point sources such as the major WWTWs. More likely causes of biodegradable organic pollution are agricultural activities, urban run-off and septic tanks, or a combination of these. Sections of the main river between McCombs Bridge and Gilford were found to be particularly susceptible. More recent work has identified similar problems in the Ballybay sub-catchment, and archived data also indicate that the upper part of the River Cusher sub-catchment is similarly affected.

River Bush Catchment

The River Bush (catchment area 329 km^2) rises on the Antrim plateau before flowing northward to reach the sea close to Portballintrae. Its main tributaries are the Dervock and Burn Gushet Rivers. The River Bush is widely recognised as one of Europe's premier salmon fisheries. However, it is generally accepted that it has suffered a serious decline in the quality of its fishery habitat in recent years. In-river engineering, canalisation and erosion may be to blame for the sedimentation of salmonid spawning gravels.

In 2000, none of the monitored rivers in the catchment complied with their Chemical GQA targets (Map 7C). The Lower Dervock and Burn Gushet Rivers are falling short of their Biological GQA target, and the River Bush itself has a poor record of compliance with the FFD (Map 7C). Chemically, the main reason for these failures is low DO concentrations. In more general terms, intermittent pollution stress and nutrient enrichment, principally from agriculture, are the primary problems. The latter encourages the seasonal growth of macrophytes, which can cause dramatic DO variations in a short space of time. It is also likely that the WWTW at Dervock is adding to the problem.

MAP 7C



In May 2000, WMU hosted a River Bush Catchment Information Exchange Workshop. The aim was to bring together all identifiable researchers and management agencies, to clarify the diversity of interests and to discuss and exchange information available on the catchment. The main objectives of the Workshop were to:

- collate a register of known information;
- identify actual changes within the system and their possible causes;
- identify information gaps;
- advise managers and prioritise management options to improve water quality;
- identify issues, pressures and impacts to be addressed in a River Basin Management Plan; and
- identify the new expectations and targets created by the WFD and outline options for delivering the objectives of the Directive.

Under the auspices of the Freshwater Sciences Sub-Committee, the River Bush is the subject of a catchment study, due for completion by early 2004, designed to derive a better understanding of the complex interactions between water quality and land use. The first phase of this work is under way involving the collation of a wide variety of scientific

research and monitoring data into a single database linked to a computerised mapping system known as a Geographical Information System (GIS). An interagency project team will direct the second phase of the work. The eutrophication of the main river has been identified as a key issue and will be specifically addressed as part of a broader EHS eutrophication strategy.

River Lagan

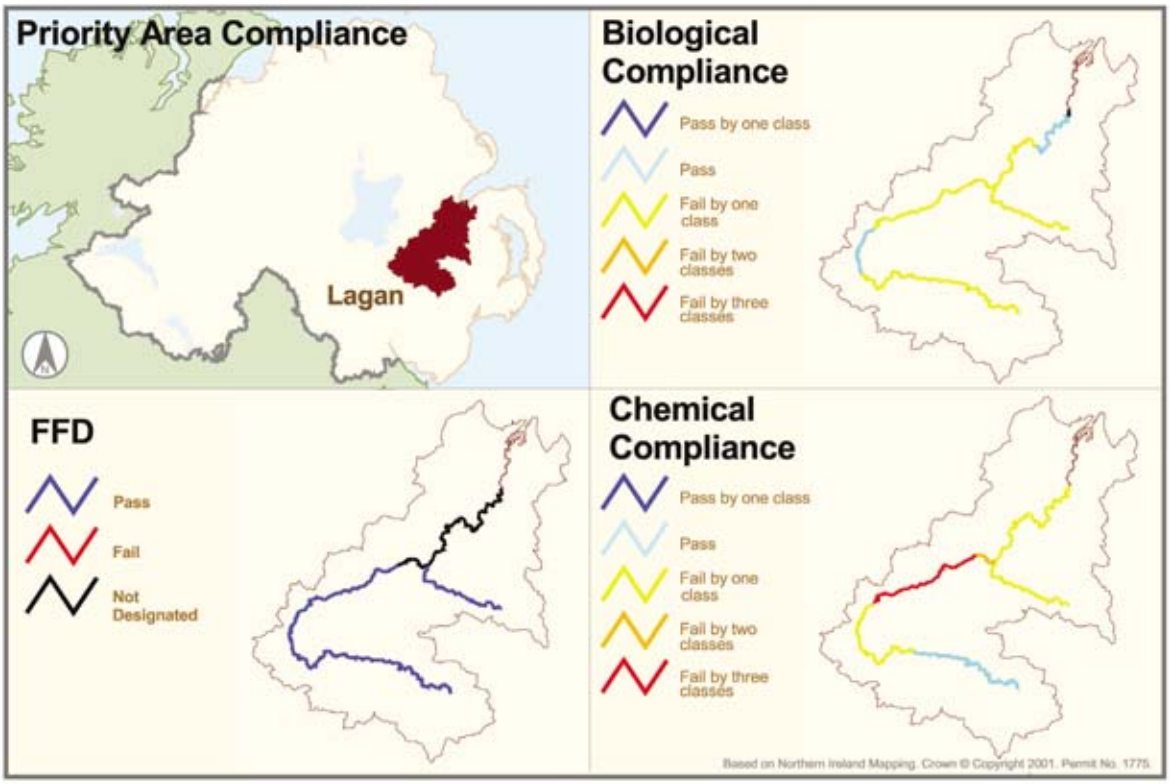
The River Lagan catchment (area 592 km^2) is the most densely populated in Northern Ireland. The river is inevitably under pressure, especially in its lower reaches, from point source inputs such as consented industrial discharges and WWTWs. Moreover, agricultural activity within the catchment is relatively intense and contributes to the high degree of nutrient enrichment evidenced by extensive submerged plant growth particularly in the middle reaches of the river between Moira and Lisburn.

Salmon have been reintroduced to the river and have sucessfully spawned at a number of sites, most notably in the Ravernet tributary. This increases the need to target water quality problems which might compromise survival rates of juvenile fish.

The lower reaches of the River Lagan displayed non-compliance with the FFD during the 1980s and early 1990s due to both ammoniacal nitrogen and un-ionised ammonia concentrations. This problem was specifically related to the under-performance of WWTWs. Subsequent capital investment in several WWTWs has delivered a dramatic improvement in water quality. Ongoing investment is also addressing sewerage infrastructure.

In the year 2000, many stretches of the river were non-compliant with Chemical and Biological GQA targets (Map 7D). Chemical failures are almost wholly related to low DO concentrations. This suggests that the main pressures within the catchment have changed from point-source pollution (WWTW and industrial discharges) to more widespread, or diffuse, pollution.

MAP 7D



As mentioned earlier (Section 3.2), in 1998 EHS published a consultation document outlining proposals for a water quality management strategy for the River Lagan catchment. The document proposed a series of management options to address the key issues arising from an assessment of the catchment. The management options did not represent government policy but were a list of ideas put forward to stimulate discussion. The proposed strategy received widespread support and has acted as a guide to water quality management, as well as supporting significant advances towards integrated catchment management. The document highlighted long-term strategic issues, identified catchment problems, and specifically stressed the need to set targets for individual stretches of rivers.

A review of this document is currently being undertaken by EHS, and initial findings would suggest that a number of initiatives have been established and progressed to address the concerns raised regarding the decline in water quality in the River Lagan catchment. In particular, WMU hosted a River Lagan Catchment Information Exchange Workshop in February 2001 (initially focusing on inland surface waters and groundwater). Like the River Bush Workshop, the aim was to bring together all identifiable researchers and management agencies, to clarify the diversity of interests and to discuss and exchange information available on the catchment. Consideration is now being given to updating the existing catchment management plan for the River Lagan.

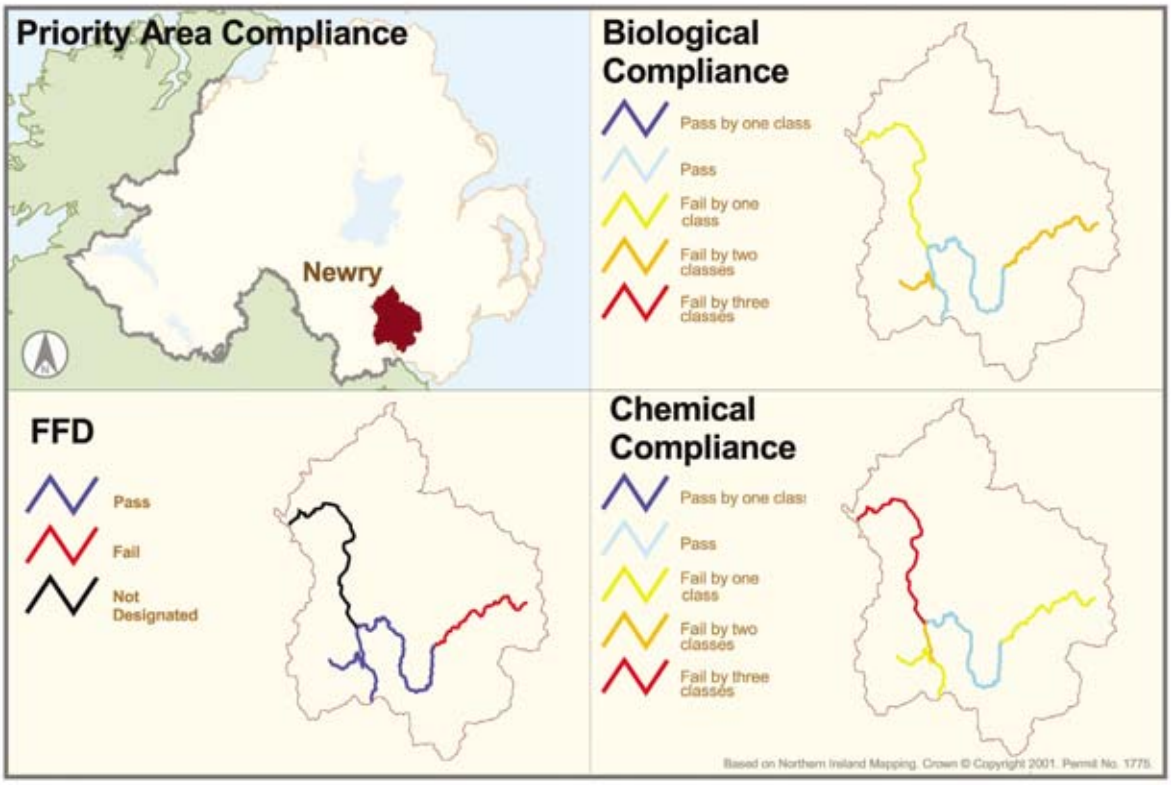
The River Lagan has been included, along with about 30 other waterbodies across the EU, in a study designed to draw up guidance on the identification and designation of artificial and heavily modified water bodies under the WFD. The Directive defines an artificial water body as 'a body of surface water created by human activity', and a heavily modified water body as 'a body of surface water which as a result of physical alterations by human activity is substantially changed in character'.

Newry River

The Newry River system (catchment area 275 km^2) has three main tributaries, the Clanrye River, which rises close to Rathfriland, the Jerretspass River and the Bessbrook River. While only the Clanrye River currently supports significant fish populations, all three tributaries have the potential to sustain salmonid species but are subject at present to significant pollution pressure.

The three main tributaries of the Newry River are non-compliant with a number of their targets (Map 7E). The Bessbrook River fails its GQA Chemical target due to BOD, and also falls short of its GQA Biological target. The Clanrye fails to meet its GQA Chemical target and to comply with the FFD because of BOD and ammonia. It has also failed its GQA Biological target. The Clanrye has, however, shown improvement in recent years. The Jerretspass River is non-compliant with its GQA Chemical target because of low DO concentrations and also fails to meet its GQA Biological target. These symptoms may indicate WWTW under-performance. Rathfriland WWTW shows poor compliance with its discharge standards. However, local studies also indicate poor quality in the waterways upstream of the WWTW. Apart from the obvious point sources at Rathfriland and Bessbrook, the main pollution pressure is consistent with diffuse pollution from agricultural activities.

MAP 7E



Strule River and Tributaries

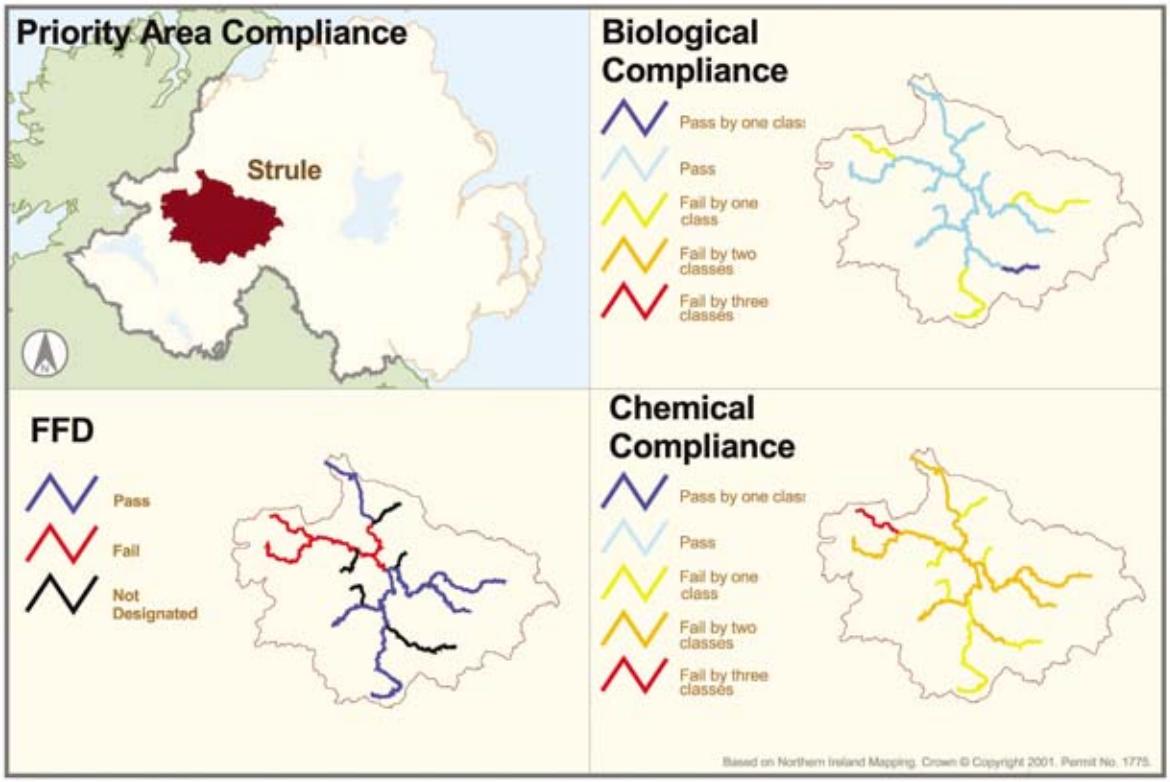
The Foyle catchment, of which the Strule River and its tributaries form a major part, is of primary economic importance because of its productivity as a salmon and trout fishery. The Strule sub-catchment (882 km^2 including the Fairy Water, Camowen and Drumragh) is relatively intensively farmed, and there is an associated risk of nutrient enrichment of its rivers.

The Strule River and its tributaries show widespread non-compliance with Chemical GQA targets due almost entirely to low DO concentrations (Map 7F, overleaf). This problem is also reflected by FFD failures in the Fairywater sub-catchment and in the upper reaches of the Strule River, along with other localised non-compliance (Map 7F).

The expansion of the biological river monitoring network in 2000 revealed pollution pressures on a number of minor tributaries apparently caused mainly by biodegradable inputs, the sources of which remain to be identified. However, in several instances, particularly in the upper Derg and upper Fairy Water catchments, there is evidence of toxic effects possibly arising from pesticide use.

Biological monitoring demonstrates that the catchment would be capable of achieving, at least, a 'Good Ecological Status' as defined in the WFD. However, there are certain river reaches that have not achieved their biological targets. The Fairy Water has mostly been Class C (Fairly Good) over the last number of years and the biological quality of the upstream section of the Quiggery Burn has declined. The Camowen River has deteriorated by two classes since 1995. Historically, this river has been shown to be a suitable habitat for invertebrate species, but its decline may be associated with sedimentation, among other factors. Frequent pollution incidents have been confirmed involving sand-washing discharges into rivers in the catchment. While there are significant problems from Omagh WWTW and combined sewer overflows in the Omagh area, there is also evidence of widespread nutrient enrichment from agriculture throughout the catchment.

MAP 7F



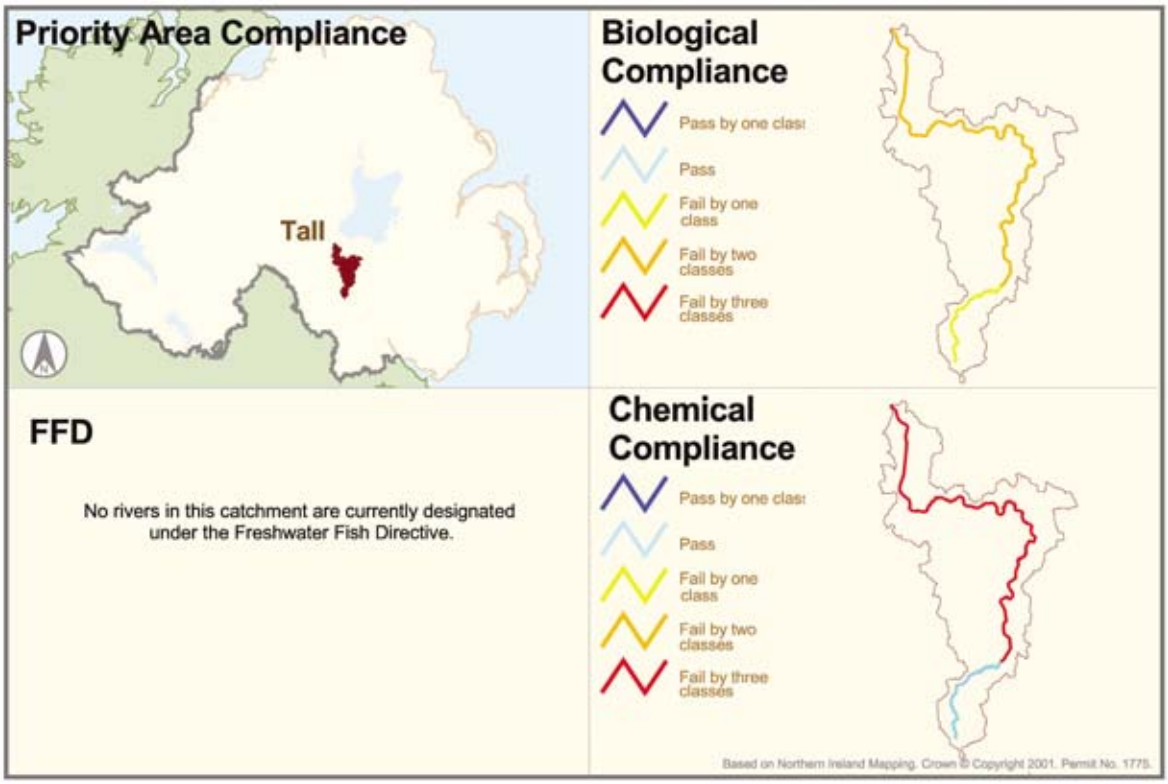
Tall River

The Tall River (catchment area 93 km^2) rises close to Richill in Co Armagh before flowing in a northerly direction to join the River Blackwater at Verners Bridge. It is a relatively small river by NI standards, but nonetheless sustains good coarse fisheries.

All sections of the river, with the exception of the most upstream reach, fail to meet their Chemical GQA targets (Map 7G). This is mainly because of varying DO concentrations, a problem exacerbated by nutrient enrichment and high levels of organic loading, almost certainly due to agricultural activities.

None of the river complies with its Biological GQA target, and the failures are more significant in the downstream reaches (Map 7G). An investigative biological survey was commissioned as a result of the inclusion of the River Tall in the list of prioritised catchments. The survey revealed significant pollution problems affecting considerable sections of the river and many of its tributaries. Most of the problems were associated with biodegradable organic pollution, but one instance of oil contamination was also detected. There was no evidence to suggest that this organic pollution is from WWTWs, and the most likely source is agricultural activity in the catchment. The biological data also suggested toxicity in some sections of the river that could be related to biocide (herbicides and pesticides) use associated with horticultural activity in the area. EHS has, in this context, initiated a research project to investigate the extent of the presence of a number of horticultural biocide residues within both the water column and the sediments of the catchment.

MAP 7G



4.3.3 Catchment Management Activities

Members of the Water Quality Management Committee (WQMC) and other agencies have responsibility for delivering a range of management activities or information functions that can protect or improve both water quality and aquatic ecosystems. The agencies involved include the Water Service (WS) of DRD, the Countryside Management Division (CMD) and Agricultural and Environmental Science Division (AESD) of DARD, the Rivers Agency (RA) and Fisheries Division of DCAL, the Roads Service of DRD, Invest Northern Ireland (INI) of DETI and the Fisheries Conservancy Board and Loughs Agency. EHS aims to co-ordinate the activities of these agencies in the identified Priority Areas through the WQMC. The ongoing activities in the six Priority Areas are summarised in Figure 3 (overleaf).

Figure 3: Summary of Management Activities and Potential Effects in the Six Priority Catchments

Ongoing Action/Activity	Agency / Body	Lagan	Upper Bann	Newry	Strule	Bush	Tall
Review industrial consents	EHS	●	●				●
Review WWTW discharges	EHS	●	●	●		●	●
WWTW improvements & reduction of N & P discharges	Water Service (DRD)	●	●	●	●	●	●
Sewerage systems improvement	Water Service (DRD)	●	●	●			
Urban pollution management schemes in major towns	WS / EHS	●	●	●	●		
Asset management prioritisation in Priority Areas	WS / EHS	●	●			●	
Pollution prevention visits (urban / industrial)	EHS / Field Agents	●	●	●	●		●
Farm pollution risk assessments	CMD (DARD)	●	●	●	●	●	●
Pollution prevention visits (rural)	Fisheries Division	●	●	●	●	●	●
Scientific research commissioned to understand problems	EHS / DARD / Universities	●	●		●	●	●
Specific investigation following non-achievement of water quality target	EHS	●	●			●	●
Field staff investigations of rivers and streams, sourcing polluting impacts	EHS / Field Agents	●	●	●	●	●	●
In-river engineering work	RA (DCAL)	●	●	●	●	●	●
Macrophyte removal from selected streams	RA / Fisheries Div. (DCAL)	●	●	●	●	●	●
Use of Codes of Good Agricultural Practice	CMD / Farmers	●	●	●	●	●	●
Development of Eutrophication Control Strategy	EHS / DARD	●	●	●	●	●	●
Farm Nutrient Management Planning	CMD / EHS	●	●	●	●	●	●
Implement SUDS (Sustainable Urban Drainage Systems)	EHS / Roads Service (DRD)		●		●		
Prosecute polluters	EHS / Fisheries Agencies	●	●	●	●	●	●
Industrial Waste Management/Exchange	INI (DETI)	●	●				●
Environmental Audit Schemes / Environmental Management Systems	INI (DETI) / EHS	●	●				●
Fish restocking	DARD (AESD)	●	●			●	
Target setting and co-ordination of information and action	EHS	●	●	●	●	●	●
Information exchange workshops	EHS, All relevant agencies	●	●		●	●	

Ongoing Action in Catchment	
Immediate Impact on Water Quality (WQ)	●
Longer Term Process & Positive Impact on WQ	●
General Management Activity	●
Potentially Beneficial	●

5 LAKE MONITORING

5.1 Quality Assessment

Northern Ireland has many lakes and is notable for having some of the largest lakes in the British Isles, including Lough Neagh, Lower Lough Erne and Upper Lough Erne. Lakes are important natural resources particularly for fisheries, recreational use, amenity value and as sources of drinking water. Approximately 40% of drinking water in NI is abstracted from natural lakes[2]. Many lakes also support ecological habitats and species of national and international importance.

Drumlin hollow lake near Shrigley, Co. Down

However, some of the uses listed above can threaten the water quality of the lakes on which they depend. As with rivers, pollution in the surrounding catchment can come from point sources such as industrial discharges or WWTWs, or from diffuse sources such as road or agricultural run-off. The retention of pollutants in lakes, in contrast to rivers where flows remove pollutants over shorter time periods, increases the likelihood of adverse ecological effects. Lakes can also vary spatially due to their complex hydrology, and they cannot necessarily be treated as uniform bodies of water. It is important that lakes are protected from pollution and managed as a sustainable resource for all of the activities that depend on their water and consequent ecological quality.

Most national and international studies on lakes have focused on specific problems such as eutrophication and acidification. Other studies have been targeted at ecological components for conservation purposes. Locally, studies such as the Northern Ireland Lakes Survey and monitoring of the eutrophication status of the larger lakes by the Agricultural and Environmental Science Division (AESD) of the Department of Agriculture and Rural Development (DARD) have greatly advanced our understanding of the pollution impacts on these water bodies and their associated ecology. The future focus for lake monitoring in NI will, however, be the requirement to comply with the WFD, which will require an assessment of the impact of all pollution pressures.

Under the Directive, surface water bodies including lakes must be divided into types and classified according to their biological, hydromorphological and chemical status. The biological status of lakes will be defined as a measure of their invertebrate, plant, phytoplankton and fish communities.

2 Water Service (2002) Northern Ireland Water Resource Strategy 2002-2030

No classification system currently exists for lakes that would meet the needs of the WFD. In 1998, EHS, in collaboration with the then Industrial Research and Technology Unit (IRTU), of the Department of Enterprise Trade and Investment (DETI), supported macroinvertebrate, macrophyte and chemical monitoring at a limited number of key sites on the major loughs (Neagh, Erne, Melvin and Macnean). The chemical parameters monitored are set out in Appendix 4. This work was undertaken as a preliminary step towards producing a classification system and as a means of assessing temporal trends. More recently, EHS has commissioned, in partnership with local universities, a number of projects aimed at developing a lake classification system to meet the needs of the Directive. Three PhD studentships were awarded in 1999 through the University of Ulster at Coleraine to investigate classification using macroinvertebrates, macrophytes and phytoplankton. A fourth one-year project, funded by EHS through the EU INTERREG II initiative, has been completed by the Queen's University of Belfast studying lake classification based on fish populations. In the longer term, EHS will introduce a phased lake ecological assessment programme in response to the needs of the WFD based on the output of the research programmes currently under way.

In 2000, EHS also monitored lakes under the EC Freshwater Fish, Dangerous Substances and Nitrates Directives, and the UK Acid Waters Monitoring Programme which are discussed elsewhere in this report.

5.2 Targets for Lakes

As mentioned above, there are currently no classification schemes for lakes in use in NI. However, in keeping with EHS's general water quality policy, monitored lakes should comply with all appropriate EC Directives including the Nitrates (91/676/EEC), Freshwater Fish (78/659/EEC) and Dangerous Substances (76/464/EEC) Directives. Action plans have been or will be put in place for all lakes failing to meet their water quality objectives. A large number of lakes are subject to eutrophication. Much of the action required to improve lake water quality will be carried out through the EHS strategy to control nutrient enrichment in NI waters.

6 GROUNDWATER MONITORING

Groundwater is the water stored within the rocks beneath our feet and represents an important freshwater resource that is vulnerable to pollution and depletion. Rocks which store and transmit significant quantities of groundwater are known as aquifers. Groundwater in NI forms an important component of water supply and contributes to flow in rivers and wetlands.

Groundwater issuing from the rocks in Co Fermanagh *(picture courtesy of GSNI)*

Due to geological and climatic conditions in NI, surface water is the dominant source of public water supply. However, groundwater still provides a significant proportion, estimated at approximately 8%, of total public water supply. In addition, it is widely used as a local supply for agricultural, industrial and domestic purposes with thousands of wells and boreholes in use. Geological factors generally determine where the best yielding groundwater supplies can be obtained. In NI, the most productive aquifers are within the Lagan and Enler valleys and in sand/gravel deposits within river valleys such as the Main and the Braid. However, most areas of NI can supply small to moderate quantities of groundwater where local hydrogeological conditions are favourable.

Significantly, groundwater also provides a contribution of flow ('baseflow') to rivers and wetlands which helps sustain their flow and water levels in low rainfall periods. As such it plays an important role in supporting biodiversity and the ecological quality of surface water systems.

Groundwater quality tends to be more consistent than surface water quality and less susceptible to pollution due to the attenuation and retarding properties of the overlying soil and subsoil. However, where pollution occurs, it can be persistent and difficult to remedy. The potential of groundwater to transfer contaminants to surface water bodies must also be borne in mind when considering surface water quality.

EHS has a duty to protect the quality of, and manage the use of, the groundwater resources of NI. Groundwater quality has to be monitored under the EC Nitrates (91/676/EEC) and Groundwater (80/68/EEC) Directives. (The requirements of these Directives are discussed elsewhere in this report.) In the future, the EC Groundwater Directive will be repealed

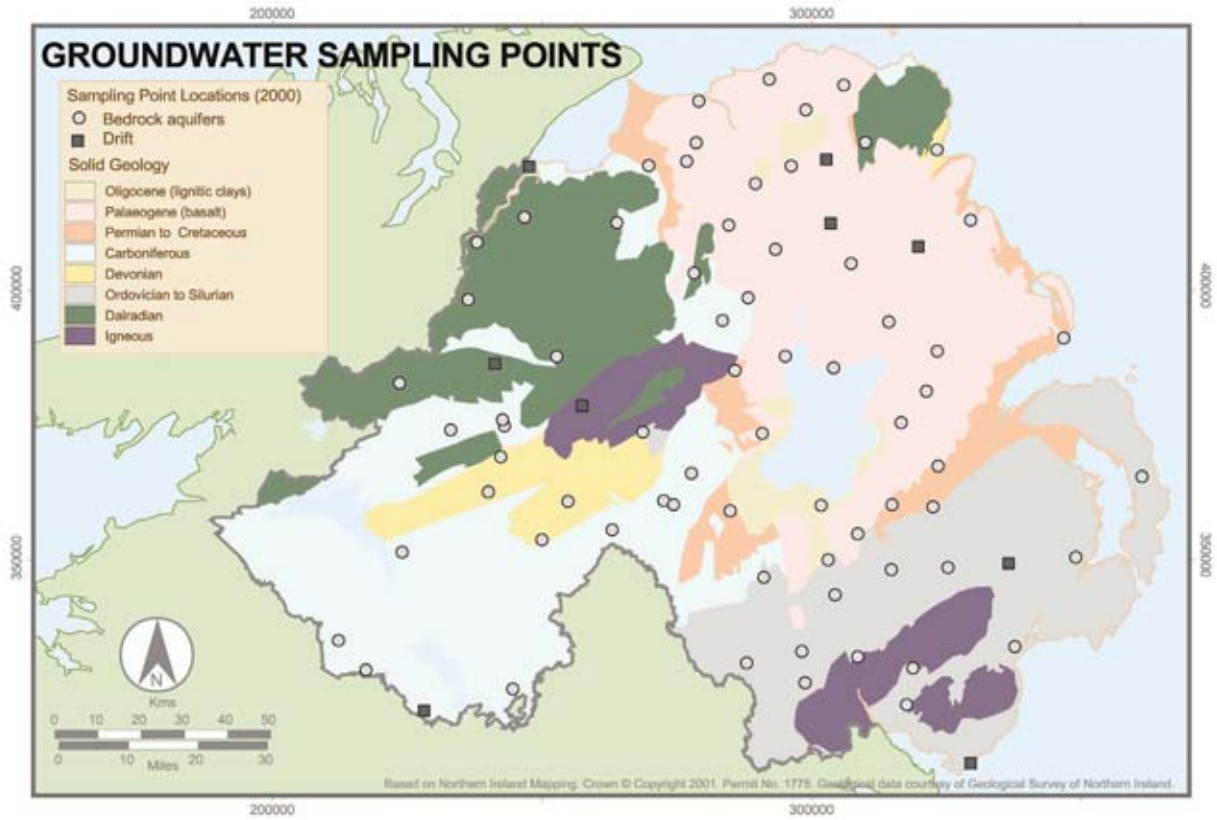
and groundwater quality monitoring will be co-ordinated through the EC Water Framework Directive (2000/60/EC). Through this Directive, future legislation relating to permitted concentrations of various substances in groundwater is expected. The general aim of the WFD in relation to groundwater is to reduce the input of contaminants into water bodies and to reverse rising trends in contaminants where identified. The current monitoring being carried out by EHS will help identify the presence and trends of such contaminants in groundwater. Further background on groundwater management issues can be found in the EHS document *Policy and Practice for the Protection of Groundwater in Northern Ireland* which can be downloaded from the EHS website (www.ehsni.gov.uk) or obtained on request from the WMU.

6.1 Groundwater Quality Monitoring Programme 2000

Between 1992 and 1994, a baseline study of groundwater quality was carried out by the British Geological Survey (BGS) on behalf of EHS. The findings of this are incorporated in the publication *Hydrogeology of Northern Ireland* - Robins (1996) obtainable from the Geological Survey of Northern Ireland (GSNI).

In 2000, EHS initiated regular monitoring of 78 sites (Map 8A) representing a subset of sites sampled in the original baseline survey and comprising mainly private agricultural boreholes along with some industrial and public water supply sources.

MAP 8A



The natural chemistry of groundwater varies depending on a number of factors including the chemistry of the rainwater from which it originates, and the types of soil, subsoil and rock it subsequently passes through. In particular, the time water spends in contact with the surrounding media affects its chemistry. At specific sampling points, the chemistry of the groundwater can be affected by local point source and diffuse pollutants within the catchment, or by pollutants entering the borehole directly around the well-head.

Representative groundwater sampling is complex and costly. In some instances, dedicated observation boreholes located away from obvious sources of contamination are appropriate to establish the general quality of a groundwater body. In other instances, representative samples can best be obtained from continuous yielding sources such as public water supplies.

Sampling for basic chemistry was carried out four times during 2000. This included well-head measurements of dissolved oxygen (DO), pH and redox potential, along with standard major ion analysis and nitrates. In addition, on one occasion in the year, samples from each source were analysed for a much wider range of parameters including pesticides, hydrocarbons and metals. Microbiological sampling was also carried out on two occasions. The parameters monitored are set out in Appendix 6.

The monitoring strategy and further details of the parameters measured can be found in the EHS document, *A Groundwater Monitoring Strategy for Northern Ireland*, which can be downloaded from the EHS website (www.ehsni.gov.uk) or obtained on request from the WMU.

The main aims of the monitoring programme in 2000 were to:

(i) establish the variation in the natural chemistry of the groundwater;
(ii) assess compliance with the EC Nitrates and Groundwater Directives;
(iii) determine whether groundwater is being impacted by pollution; and
(iv) provide information to support future management programmes.

It is recognised that some of the sources currently sampled are less than ideal for use in a regional quality monitoring network. This is reflected in some of the results found at the sources. It is intended that the network will be modified in future years to improve its overall integrity and to increase the reliability of the results being obtained from it. Nevertheless, the results obtained are a valuable dataset on which certain comments can be made.

In addition to the above monitoring, EHS, through initiatives under the European Regional Development Fund, has supported research by the Queen's University of Belfast into groundwater quality in the Sherwood Sandstone aquifers in the Lagan and Enler valleys.

6.2 Targets for Groundwaters

There are currently no classification schemes for groundwaters. However, in keeping with EHS's general water quality policy, monitored groundwaters should comply with the EC Groundwater (80/68/EEC) and Nitrates (91/676/EEC) Directives.

The results in 2000 were also compared with the prescribed concentrations listed in the Private Water Supplies Regulations (Northern Ireland) 1994. These Regulations apply to private supplies that serve more than one household for purely domestic purposes, or are used in commercial food production. Private water supplies in Northern Ireland are defined as any supplies of water provided otherwise than by the public provider (Water Service). The Regulations determine the wholesomeness of such water intended for drinking, washing, cooking or food production, and relate to the actual water used, possibly following treatment if required. The responsibility for monitoring and assessment of the private water supplies which fall under these Regulations rests with the Drinking Water Inspectorate of EHS who publish a separate *Northern Ireland Drinking Water Quality* report each year. It was considered appropriate to compare the results of the WMU Groundwater Monitoring Programme 2000 with these standards in the absence of environmental quality standards under any other current legislation. Parameters analysed for but not listed in the Private Water Supplies Regulations were compared against World Health Organisation (WHO) standards.

It should be borne in mind, however, that raw (untreated) groundwater is not required to comply with the Private Water Supplies Regulations and WHO standards as both of these apply to the actual water used by the consumer after treatment if necessary. Failure of the raw water to comply, therefore, does not necessarily mean that the water used by the consumer is unfit for consumption. Private water abstractors concerned about the chemical and/or biological quality of water from their source can contact the Environmental Health Department of their local District Council (for single household supplies) or the EHS Drinking Water Inspectorate for further advice.

6.3 Groundwater Monitoring Results 2000

General Chemistry
The baseline study of 1992-94, which involved sampling from 351 sources throughout Northern Ireland, found that most groundwaters were dominated by calcium and bicarbonate ions, with some tending towards sulphate domination. For the most part, groundwaters contained low to moderate concentrations of dissolved solids and were also generally oxygenated. This is thought to reflect water that has spent a relatively short time below ground. Waters with no, or only minimal, DO were also found in certain parts of the country. These waters are thought to have spent a longer time below ground.

Overall, during the 2000 monitoring period, seasonal variation for the majority of parameters was found to be slight. As might be expected, the basic chemistry of the waters was similar to that found in the baseline survey.

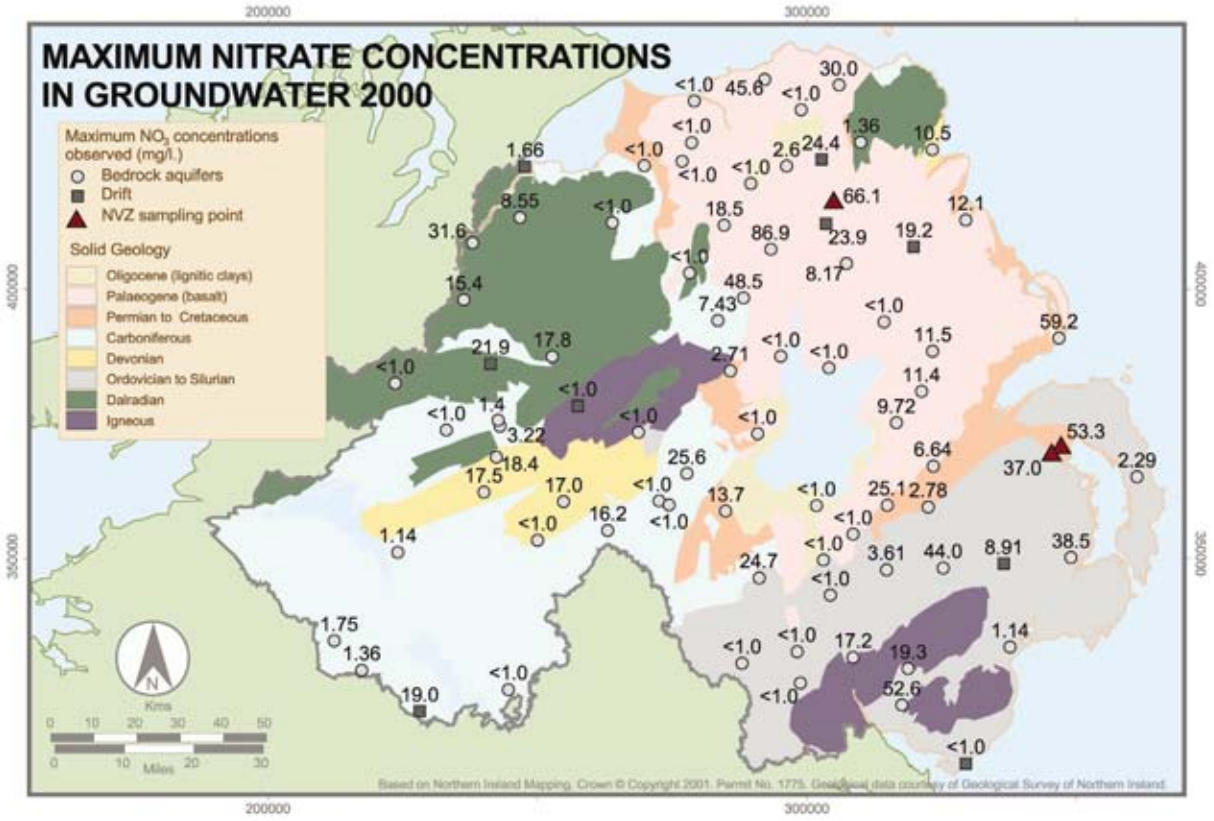
Nitrates
Nitrates are a common cause of groundwater contamination generally resulting from agricultural activities. Under the EC Nitrates Directive, waters with a nitrate concentration above 50 mg/l or trending towards 50 mg/l must be identified as vulnerable, and action programmes must be initiated to reduce nitrate concentrations. To date, three Nitrate Vulnerable Zones (NVZ) have been designated in Northern Ireland, two in the Comber area of Co Down and one near Clogh Mills, Co Antrim (Map 8B).

MAP 8B

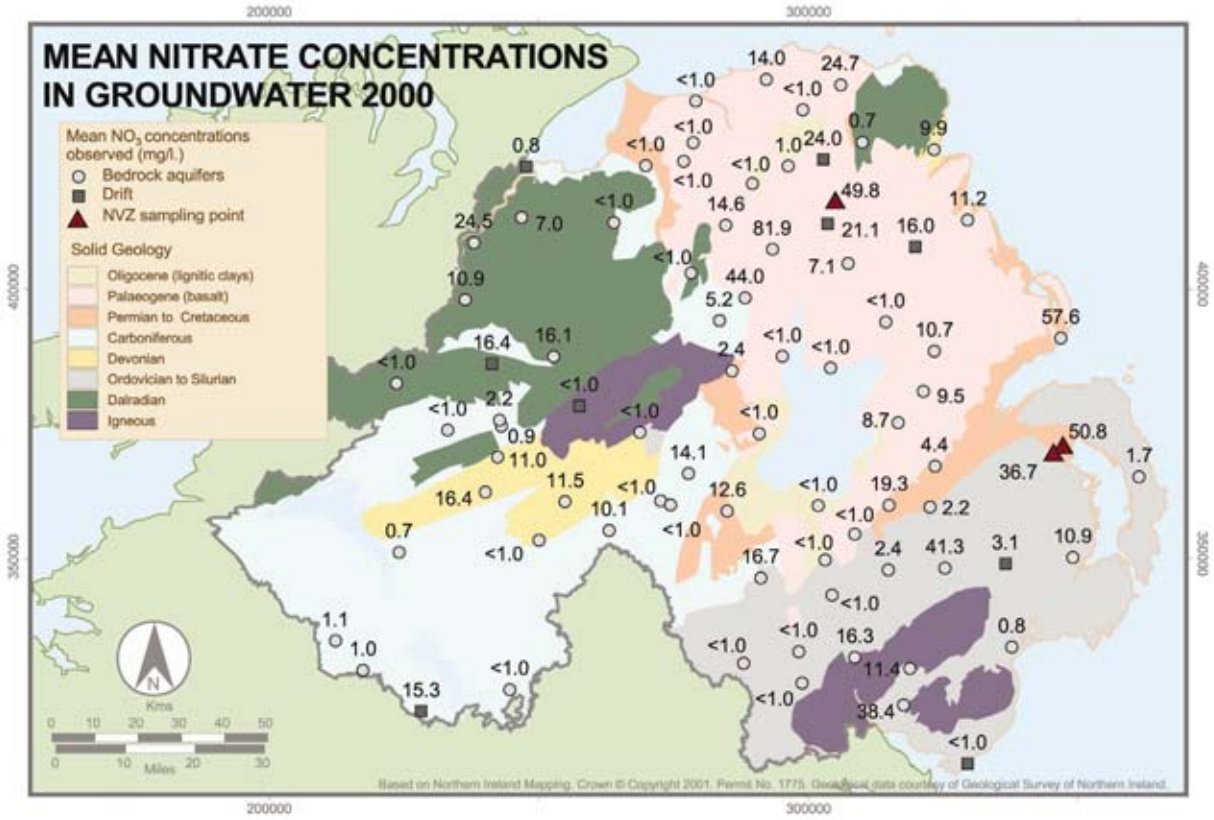
The maximum and mean nitrate concentrations found in 2000 are shown in Maps 8C and 8D respectively. Also shown are results from nitrate monitoring in the Comber and Clogh Mills NVZ areas. In these areas where high concentrations have been found previously, nitrate concentrations remain high. Elsewhere, some elevated nitrate concentrations were found in the Tertiary Basalts north of Lough Neagh with occasional, isolated, elevated concentrations at certain other sources.

Further investigation of the sites with elevated nitrate concentrations is required to determine whether the concentrations

MAP 8C


MAXIMUM NITRATE CONCENTRATIONS IN GROUNDWATER 2000
Maximum NO_3 concentrations observed (mg/l.)
Bedrock aquifers
Drift
NVZ sampling point
Solid Geology
Oligocene (lignitic clays)
Palaeogene (basalt)
Permian to Cretaceous
Carboniferous
Devonian
Ordovician to Silurian
Dalradian
Igneous
200000
300000
400000
350000
Kms
Miles
Based on Northern Ireland Mapping. Crown © Copyright 2001. Permit No. 1775. Geological data courtesy of Geological Survey of Northern Ireland.

MAP 8D


MEAN NITRATE CONCENTRATIONS IN GROUNDWATER 2000
Mean NO_3 concentrations observed (mg/l.)
Bedrock aquifers
Drift
NVZ sampling point
Solid Geology
Oligocene (lignitic clays)
Palaeogene (basalt)
Permian to Cretaceous
Carboniferous
Devonian
Ordovician to Silurian
Dalradian
Igneous
200000
300000
400000
350000
Kms
Miles
Based on Northern Ireland Mapping. Crown © Copyright 2001. Permit No. 1775. Geological data courtesy of Geological Survey of Northern Ireland.

are representative of groundwater generally in the area and therefore point to the need for remedial action, or whether they are just associated with local sources of contamination around the sampling point.

Ammonia
This compound is generally present in natural waters, usually at very low concentrations. Concentrations much above 0.1 mg/l as nitrogen (N) may indicate contamination by sewage or other sources. Ammonia as measured at the well-head using a field test kit, exceeded the Private Water Supplies Regulations standard of 0.5 mg/l at 22 of the 78 sites but was generally less than 1 mg/l. This may reflect poor construction and well-head protection of the borehole.

Iron and Manganese
Iron and manganese were detected above the standards set in the Private Water Supplies Regulations at a significant number of sites. At high concentrations this can cause aesthetic and taste problems but is not generally considered to be a health problem. On contact with air the iron or manganese or both can precipitate out causing discoloration.

Generally, when one element was elevated so was the other, with iron usually having a higher concentration than manganese. In some instances, however, only one of the elements was found at significant concentrations. Some of the highest concentrations found were at a site in Co Londonderry with iron 10.3 mg/l and manganese 1.2 mg/l. The Private Water Supplies Regulations standards for iron and manganese are 0.2 mg/l and 0.05 mg/l respectively. The source of these elements can be minerals found in rocks and soils, pollution by organic wastes, or occasionally, in relation to drinking water supplies, the corrosion of fittings in the supply system.

Phosphorus
Phosphorus occurs widely in nature in plants, micro-organisms and in animal wastes. It is also used extensively as a constituent in fertilisers and detergents. Its role in eutrophication problems in surface waters is widely recognised.

Phosphorus was measured in the annual suite and was found to be below detection limits (0.1 mg/l) in all but three of the sites. Of these three detections, the highest concentration (0.38 mg/l) was in a shallow sand/gravel aquifer and was well below the Private Water Supplies Regulations standard of 2.2 mg/l.

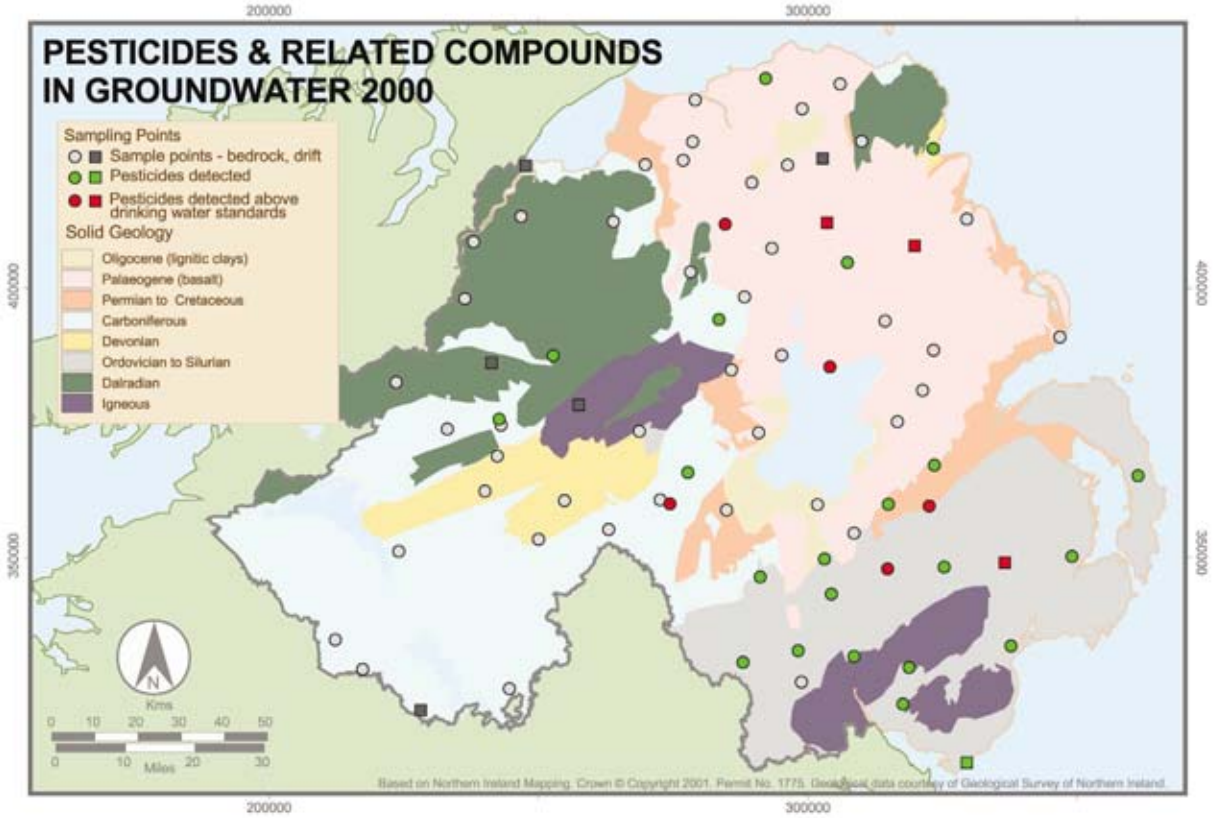
Fluoride
Fluoride is a naturally occurring element in groundwater. Concentrations were generally low (less than 0.2 mg/l) but with marginally increased concentrations to the south-west as would be expected based on geological considerations. One site in County Fermanagh slightly exceeded the Private Water Supplies Regulations standard of 1.5 mg/l, with a concentration of 1.7 mg/l.

Pesticides and Related Compounds
Map 8E shows sites where pesticides were detected and also where they exceeded the Private Water Supplies Regulations standard of 0.1 ug/l. The data would apparently indicate pesticides occurring particularly within the Ordovician/Silurian strata in Co Down and at some other sources mainly in the Tertiary Basalts. Although detected, pesticide concentrations are generally below the Private Water Supplies Regulations standard which is set at a very low concentration. Exceedances, where they occurred, were generally only just above the standard, although one site did show more significant concentrations.

The majority of detections within the area to the south of Lough Neagh relate to Propham (a herbicide compound) with concentrations mostly reported as just above detection limits. Further sampling is required to confirm or rule out the presence of this compound. Further investigation will also be required where other pesticides were identified.

Hydrocarbons
A range of hydrocarbon compounds were analysed in the annual suite. Hydrocarbons were detected at a small number of sites but are considered more likely to originate from well-head contamination at the monitoring site than to represent more general contamination of groundwater. MTBE, a fuel additive used in some unleaded fuel, and a highly soluble compound, was also analysed. It was not detected in any of the samples.

MAP 8E



In particular, toluene was found at 11 sites at concentrations generally just above the detection limit of 2 ug/l but significantly below the WHO guideline value of 70 ug/l. This substance can be found in a wide range of materials including petroleum products, paints and solvents. It was detected on only one sampling visit, and further investigation is required into the apparent presence of this particular substance. More recent samples (2001) have shown significantly fewer detections.

Microbiological Analysis

Overall, the microbiological quality was poor with 32 sites out of 78 showing the presence of coliforms on at least one occasion. This suggests that local sources of pollution are impacting groundwater quality at the sampling point. This is probably due to a combination of inadequate well design and poor well-head protection standards, together with the proximity of animal wastes and septic tanks at many of the sampling sites.

7 ESTUARINE/COASTAL WATER MONITORING

7.1 Estuarine/Coastal Water Classification

EHS has an extensive network of estuarine and coastal water monitoring points around Northern Ireland. There are more than forty stations of which seven form part of the UK National Marine Monitoring Programme (NMMP). This programme sets out protocols for best practice in marine monitoring. These protocols are applied at all EHS sampling sites. A copy of the *Northern Ireland Regional Report of the NMMP* can be obtained from EHS. In addition, the UK national report, *A Survey of the Quality of UK Coastal Waters*, can be viewed on the Scottish Executive, Fisheries Research Services website, www.marlab.ac.uk.

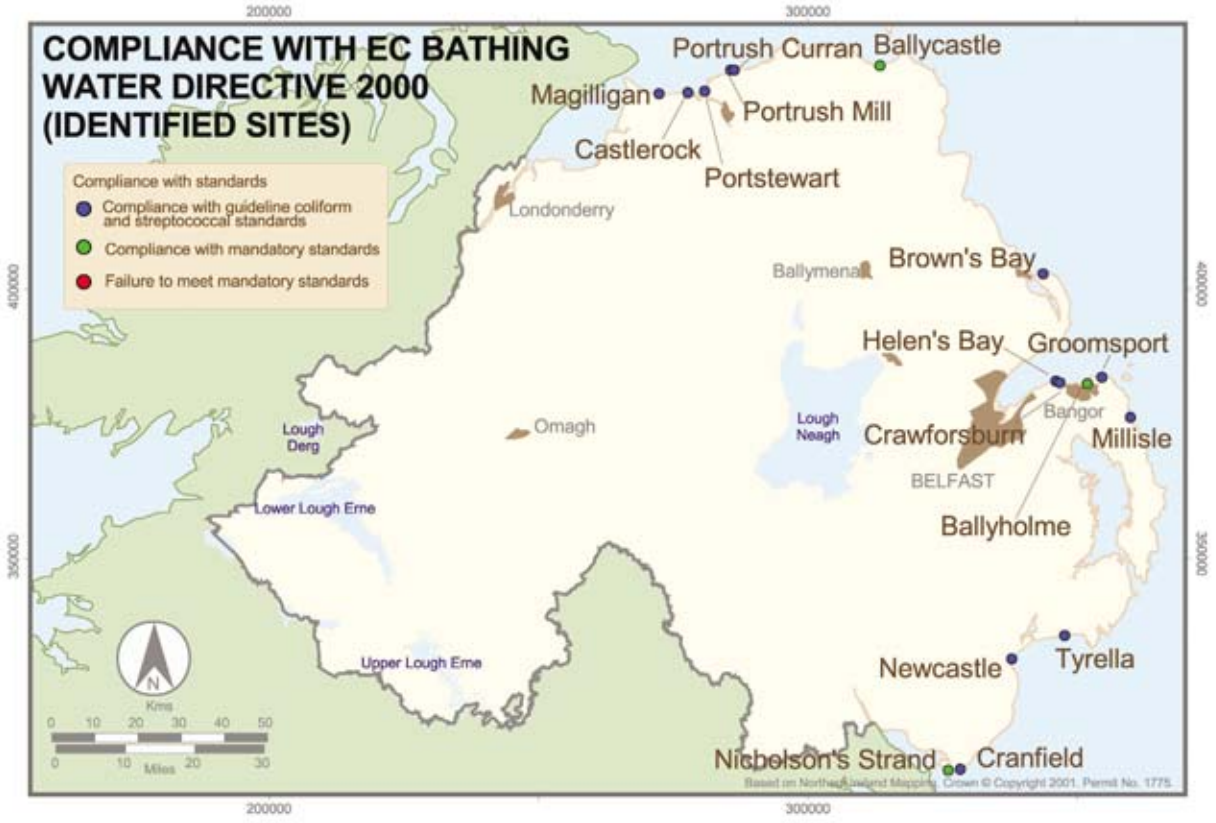
EHS has adopted the Scottish Environment Protection Agency (SEPA) Estuarine and Coastal Waters Classification Schemes (ECWCS) as the most appropriate current mechanism for managing the marine waters of NI. Historically, the National Water Council classification scheme had been used, but this is now considered to be inappropriate for management purposes. A classification report based on 1995-2000 data is currently being drafted and will be published separately.

The classification scheme for estuarine and coastal waters is summarised in Appendix 7. Parameters monitored are listed in Appendix 8.

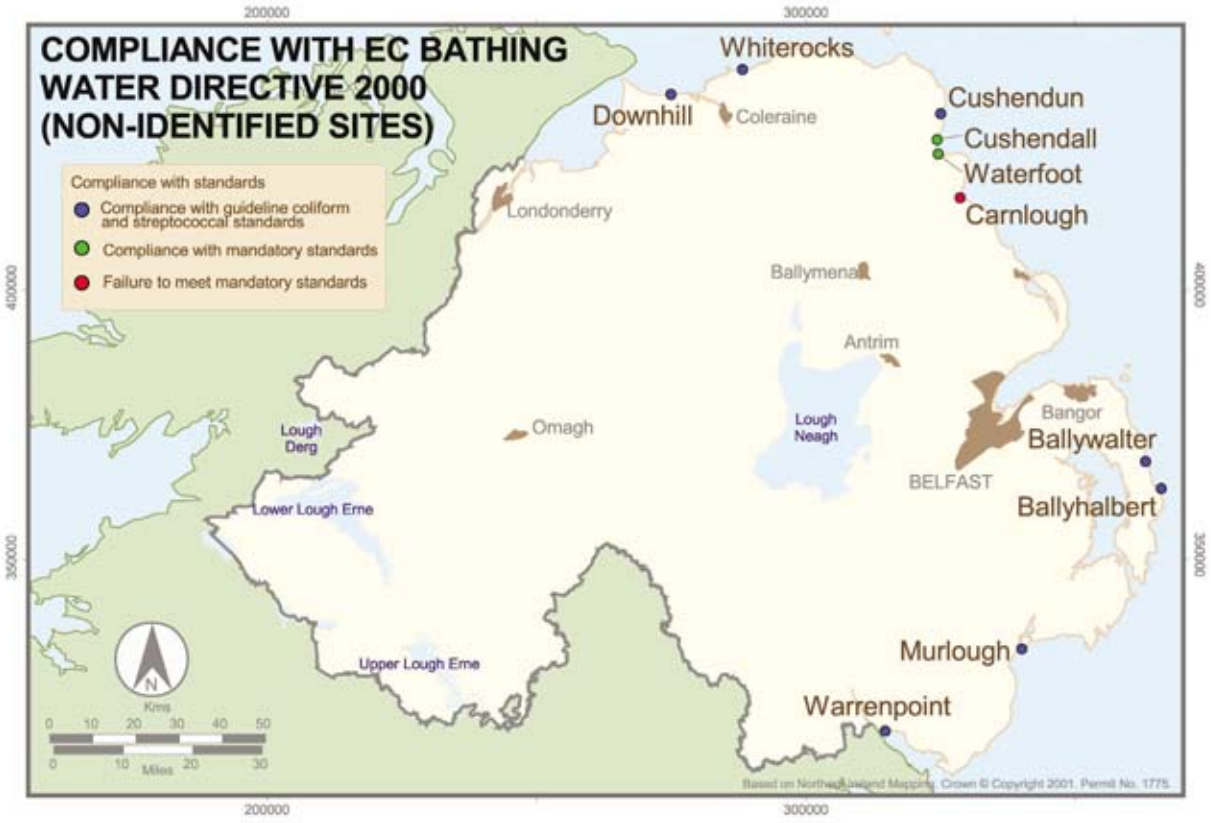
7.2 EC Bathing Water Directive

Under the terms of the EC Directive concerning the quality of bathing water (the Bathing Water Directive, 76/160/EEC), Member States are required to identify bathing waters and to monitor their compliance with quality standards laid down in the Directive. 'Bathing water' means all running or still fresh waters and sea water in which bathing is explicitly authorised or is not prohibited and is practised by a large number of bathers. In Northern Ireland, 16 bathing waters (Map 9A) were identified in 1988. Monitoring results for these are reported each year to the EC. A further 10 'non-identified' waters where bathing is practised less frequently (Map 9B) are currently monitored and it is envisaged that these may be formally identified in future.

MAP 9A



MAP 9B



The identified and non-identified waters are listed in Appendix 9.

The bathing season in Northern Ireland runs from June to mid-September. Water quality is tested at all identified and non-identified sites 20 times during this period.

The EC Bathing Water Directive sets quality standards for a number of parameters. The most important of these are the standards relating to the coliform and streptococcal groups of bacteria (total and faecal coliforms and faecal streptococci). In general, these can be taken as an indication of the amount of sewage or agricultural pollution present. *Salmonella* spp. and enteroviruses are also monitored twice during the season.

Any occurrence of algal blooms is noted. If a bloom is discovered, a sample is taken and the algae are identified. On one occasion during the season, pH is monitored. Field observations are recorded on all sampling occasions. This includes transparency, presence of visible oil, surfactants and phenolic compounds, aesthetic qualities, wind and weather. A litter assessment is also carried out at each site.

The parameters monitored on bathing waters are set out in Appendix 10.

As well as the bathing waters themselves, adjacent rivers, streams and any other possible sources of pollution which might adversely affect bathing water quality are monitored regularly during the season. Further surveys are undertaken at short notice in the event of pollution or suspected pollution.

The European Commission is proposing to revise the Bathing Water Directive in the future. The definition of bathing may be changed to include water contact sports, and waters identified would include areas, both inland and coastal, in which water sports are actively promoted. When the revision of the Directive has taken place, DOE will review, through a consultation process, all identified areas.

Bathing Water Compliance 2000

The EC Bathing Water Directive lays down two standards of compliance, the Mandatory (or 'Imperative') standards and the Guideline standards.

To comply with the Mandatory standards, 95% of samples taken must contain no more than 10,000 total coliforms and no more than 2,000 faecal coliforms per 100 ml of water. The more stringent Guideline standards require 80% of samples taken to contain no more than 500 total coliforms and no more than 100 faecal coliforms per 100 ml of water, and 90% of samples to contain no more than 100 faecal streptococci per 100 ml of water.

Alongside the monitoring of bathing waters under the Directive, the European Blue Flag Awards scheme for beaches is co-ordinated in the UK by the Tidy Britain Group on behalf of the Foundation of Environmental Education in Europe (FEEE). The scheme is promoted by Local Authorities in NI. To achieve a Blue Flag Award, bathing water must meet the Guideline water quality standards. To qualify for the award the beach must also have certain land-based facilities, including litter bins, life saving equipment, toilets and an information/education point.

Bathers at Downhill, Co. Londonderry

Annual compliance records for all of the identified bathing waters for the period 1996 to 2000 are set out in Appendix 9. Mandatory compliance was lower due to inclement weather conditions during 1997 and 1998 but reached 100% in the other three years. Guideline compliance was 88% in 1996 and dropped to about 50% in 1997 and 1998 before recovering to just over 80% in 1999 and 2000. Year 2000 compliance is shown in Map 9A (page 42).

There are currently 10 non-identified bathing waters. This number has varied over the past five years (see Table 6) because of varying demand for monitoring by local authorities and the public. These waters are monitored in exactly the same way as identified waters, and it is anticipated that they will be identified under the Directive in the future.

Table 6 Number of Non-identified Bathing Waters Monitored 1996-2000

Year	No of Waters Monitored
1996	10
1997	12
1998	11
1999	10
2000	10

Annual compliance records for all of the non-identified bathing waters for the period 1996 to 2000 are also set out in Appendix 9. Compliance with the Mandatory standards has been consistently good achieving 100% in 1996, 1998 and 1999, 92% in 1997 and 90% in 2000. Compliance with Guideline standards has been more variable, ranging from 80% in 1996, dropping to 45% in 1998 and recovering to 70% in 2000. Year 2000 compliance is shown in Map 9B (page 43).

7.3 EC Shellfish Waters Directive

The purpose of the EC Directive on the quality required of shellfish waters (the Shellfish Waters Directive, 79/923/EEC) is to ensure a suitable environment for shellfish growth. It is not intended, by itself, to protect the quality of shellfish for consumption, which in the UK is usually achieved by the practice of depuration after harvesting and by observing the standards set out in the EC Directive laying down the health conditions for the production and the placing on the market of live bivalve molluscs (the Shellfish Hygiene Directive, 91/492/EEC).

Under the EC Shellfish Waters Directive, Member States are required to designate coastal and brackish waters, which need protection or improvement in order to support shellfish. Pollution reduction programmes are to be established to enable the waters to conform to standards for a number of physical, chemical and bacteriological parameters. As with other Directives, Mandatory and Guideline standards are laid down in this Directive. The waters must be sampled at various frequencies depending on the parameter being monitored, but the frequency may be reduced when the quality of the water is known to be high.

In NI, one initial designation was made in 1983 and a further eight areas were designated in 1999. These areas are shown in Map 10 (overleaf).

MAP 10

Shellfish Waters Compliance 2000

A shellfish flesh monitoring programme was established in 1994, and this is currently operated as a joint monitoring programme between the Food Standards Agency, DARD and EHS. In addition, a shellfish waters monitoring programme was established in 2000. Parameters monitored and frequency are listed in Appendix 11. Waters achieved a high level of compliance with the Mandatory standards except for a few exceedances of the zinc standard. However, zinc concentrations in shellfish flesh do not exceed the safe limit for food, which is 100 mg per kg wet weight for molluscs[3].

3 Ministry of Food, 1953

8.1 EC Dangerous Substances Directive, and Oslo and Paris Convention Riverine Inputs and Direct Discharges (OSPAR RID) Programmes

8.1.1 EC Dangerous Substances Directive (76/464/EEC)

This Directive sets a framework for the elimination or reduction of pollution of inland, coastal and territorial waters by particularly dangerous substances. It sets out two lists (see Appendix 12) of potentially dangerous substances selected on the basis of their toxicity, persistence and capacity for bio-accumulation. List I substances are considered to be more dangerous, and a number of related 'daughter' Directives have been adopted which set out specific controls for these substances, covering, for example, mercury, cadmium and a range of pesticides and organic substances. These 'daughter' Directives set out EU-wide limit values for discharges and environmental quality standards for the substances. List II substances are less dangerous and are controlled via national quality standards.

The various Dangerous Substances Directives are transposed into NI legislation through the Surface Waters (Dangerous Substances) (Classification) Regulations (Northern Ireland) 1998. These Regulations require EHS to reduce the pollution of waters classified under them in relation to the substances listed.

Discharge of both List I and List II substances requires an authorization by EHS through the discharge consent process under the Water (NI) Order 1999.

EHS currently monitors List I and List II substances at 'background' points on 11 major rivers (see Table 7) and at three sites in the estuarine/marine environment, as well as in the effluent of a number of industrial discharges and WWTWs.

Table 7 Rivers where Dangerous Substances and OSPAR RID Parameters are Monitored

River	Sampling Point	Irish Grid Reference
Burn Dennet	Burndennet Bridge	C374048
Finn	Clady Bridge	H293940
Mourne	Strabane Bridge	H345975
Faughan	Mobuoy Bridge	C477193
Roe	Roe Bridge	C670296
Lower Bann	The Cuts	C855303
Bush	Bushmills	C939409
Lagan	Stranmillis Weir	J341709
Quoile	Quoile Bridge	J488465
Newry/Clanrye	Newry	J087267
Erne	Rosscor Viaduct	G987586

8.1.2 OSPAR RID

The aim of the Oslo and Paris (OSPAR) Convention is to protect the North-East Atlantic Ocean from pollution and other adverse effects of human activities, so as to safeguard human health and preserve marine ecosystems, and, when practicable, to restore marine areas which have been adversely affected. As a contracting party to the Convention, the UK is committed to carrying out a comprehensive and regular survey of selected substances discharged to the marine environment. The survey covers discharges that reach the marine environment via rivers or estuaries, as well as direct discharges from large WWTWs and a number of industries.

A total of ten rivers with the largest flows which discharge to the Irish Sea and the Atlantic Ocean are monitored at their tidal limits for a range of parameters (see Appendix 13). The River Erne, which flows via RoI to the Atlantic Ocean, is also monitored. These rivers are listed in Table 7.

All major direct discharges of industrial and WWTW effluent downstream of the above tidal-limit sampling points are monitored for mercury, cadmium, copper, zinc, lead, gamma-hexachlorocyclohexane and a number of polychlorinated biphenyls (PCBs).

The United Kingdom delivers much of its OSPAR monitoring through integration with the National Marine Monitoring Programme (see Marine Monitoring in Section 8.1.3).

There is also a close link between the monitoring required under the EC Dangerous Substances Directive and OSPAR RID, as some of the determinands are common to both, and therefore the sampling programmes are combined where possible.

8.1.3 Results of Surface Water and Effluent Monitoring for Dangerous Substances 2000

Riverine Inputs
A wide range of dangerous substances are measured at the tidal limit of a number of rivers in NI, under international and domestic control mechanisms, as described above.

No result for any substance monitored to date has exceeded international environmental quality standards. Most samples were, in fact, below the level of detection. A number of results have, however, exceeded national environmental quality standards, in particular, some pesticides. These included some sheep-dip pesticides and some crop protection products/herbicides, and, in general, were found in most rivers following the time of year when these substances are most widely used.

Marine Monitoring
The National Marine Monitoring Programme (NMMP) provides the primary mechanism for the United Kingdom to deliver its various commitments to monitor dangerous substances in the marine environment. The NMMP was created under the auspices of the Marine Pollution Monitoring Management Group (MPMMG), with the overall objective to set in place a programme of marine monitoring for significant contaminants and biological effects, to national standards, for all UK waters.

The NMMP has been undertaken annually, since the beginning of the 1990s, through a network of sampling stations that comprise estuarine, intermediate and offshore locations around the UK.

Sampling stations have been established around the Northern Ireland coast at 12 locations. EHS is the monitoring authority responsible for four of these stations, i.e. those at Lough Foyle, the River Bann estuary, inner Belfast Lough and outer Belfast Lough. DARD is the monitoring authority responsible for seven sampling stations, and the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) is responsible for one other.

The requirements of the Surface Waters (Dangerous Substances) (Classification) Regulations (Northern Ireland) 1998 are delivered through a sampling programme that incorporates three of the EHS NMMP sampling stations, i.e. those located at outer Belfast Lough, Lough Foyle and the River Bann estuary. Water and sediment samples are analysed for all List I determinands and 49 List II determinands. The results for all determinands at the Lough Foyle and River Bann sites have, to date, been below the level of detection. The Belfast Lough site has, on occasions, returned figures for dieldrin slightly above the level of detection but below the environmental quality standard (EQS).

Parties contracted to the OSPAR Convention are required to monitor the marine environment for contaminants in sediments and biota. Sediments and biota are monitored at each of the aforementioned NMMP sampling stations for a range of substances on the OSPAR List of Chemicals for Priority Action. The results to date for all determinands have not given any cause for concern.

A major assessment of all OSPAR Convention Waters was completed in 2000 entitled the *Quality Status Report 2000*. In addition, quality status reports were produced for five regional areas within the Convention Waters. NI waters are covered by Region III (Celtic Seas). These reports can be viewed on the OSPAR website, www.ospar.org.

WWTW Effluents
EHS carried out a monitoring project between 1997 and 2000 on the effluent discharges from 36 WWTWs to check for the presence of List I and List II substances in such discharges. Analyses were done for all List I substances and a range of List II substances. Results of these analyses are being assessed to enable the setting of discharge standards that will reduce the emission of these substances, and ensure that receiving waters meet the required water quality objectives.

Industrial Effluents
Nine industrial facilities have their effluent discharges analysed for a range of List I and List II substances under the Surface Waters (Dangerous Substances) (Classification) Regulations (Northern Ireland) 1998. This is undertaken, in some cases, in addition to the sampling programme carried out through OSPAR RID outlined above. There were no exceedances of international environmental quality standards during the period of this report.

Groundwater Monitoring
The results of groundwater monitoring have been described earlier in this report (see Section 6.3).

8.2 EC Nitrates Directive

The EC Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (the Nitrates Directive, 91/676/EEC) is designed to protect surface waters and groundwaters against nitrate pollution from agriculture. It aims to reduce nitrate concentrations in areas where the water is polluted, and to prevent additional pollution.

The Directive requires Member States to:

- designate as Nitrate Vulnerable Zones (NVZs) all known areas of land that drain into waters where the nitrate concentrations exceed, or are expected to exceed, 50mg/l or where there is evidence of eutrophication;
- establish action programmes which will become compulsory in these zones; and
- review the designation of NVZs at least every 4 years.

In accordance with the Directive, three NVZs were identified and designated in NI in March 1999. Two are located near Comber, Co Down, and the third is at Clogh Mills, Co Antrim (see Map 8B, page 38). Action Programmes were established in June 1999 setting out the measures which must be followed by those farming within the NVZs.

EHS reviews monitoring data from both groundwater and surface water networks in accordance with the criteria for designating NVZs. As previously mentioned, results from the groundwater monitoring in 2000 (Maps 8C and 8D, page 39) showed a small number of sites with elevated nitrate concentrations which are the subject of further investigations.

EHS monitors all primary river monitoring stations for nitrate concentrations. In addition, nitrate monitoring is carried out by the Water Service at 53 public drinking water supply abstraction points in NI. Analysis of all surface freshwater data to date does not currently indicate any need for the designation of additional NVZs when applying the criterion that the nitrate concentrations exceed, or are expected to exceed, 50mg/l.

Monitoring programmes have however indicated that eutrophication is a serious threat to the water quality of rivers, lakes and estuaries around NI. The results of these monitoring programmes, and the implications of these findings under the Nitrates Directive, are being reviewed, and will be the subject of a separate scientific report.

8.3 National Networks

EHS participates in a number of national water quality monitoring networks specifically targeted at particular issues.

8.3.1 UK Environmental Change Network

The Environmental Change Network (ECN) is the UK's long-term integrated monitoring network designed to aid in the detection, interpretation and forecasting of environmental changes resulting from natural and human causes. It is a multi-agency initiative which currently has 14 sponsoring organizations and a network of 54 terrestrial and freshwater sites across the UK. At these sites regular measurements are made, to agreed protocols, to assess the main drivers of environmental change (e.g., climate, atmospheric chemistry, land use) and associated ecosystem responses (e.g., soil, flora, fauna and water quality).

ECN is designed to address a wide range of contemporary and emerging environmental issues. It is particularly relevant to some of the key pressures on ecosystems (e.g., the impacts of climate change, atmospheric pollutants, changing land-use and land management) and their effects on those ecosystem aspects related to biodiversity, water quality and quantity, soil quality and landscapes. However, these pressures and related issues can rarely be considered independently, and it is one of the strengths of ECN that its long-term, integrated approach enables it to investigate the complex interactions between these ecosystem pressures.

The objectives of ECN are:

- to establish and maintain a selected network of sites within the UK from which to obtain comparable long-term data sets through the monitoring of a range of variables identified as being of major importance;
- to provide for the integration and analysis of these data, so as to identify natural and man-induced environmental changes and improve understanding of the causes of change;
- to distinguish short-term fluctuations from long-term trends, and predict future changes;and
- to provide, for research purposes, a range of representative sites with good instrumentation and reliable environmental information.

EHS sponsors two river stations:

- the River Faughan at Mobuoy Bridge (Irish Grid Reference C477193), and
- the Garvary River at Larkhill (Irish Grid Reference H009630)

Both rivers are sampled monthly for the same chemical determinands as primary river sites with the addition of a range of heavy metals and major ions. These sites are also sampled for macroinvertebrates and classified on a three-season basis like other primary river sites. In addition, the macroinverterate samples are preserved and sent to the Centre for Ecology and Hydrology (CEH) where they are identified to species level. Both sites are also surveyed for macrophytes annually and diatoms three times a year. The parameters monitored are listed in Appendix 14.

The results of all analyses are electronically transferred to ECN where they are validated and incorporated into a database with the results from 41 other freshwater sites across the UK. Direct access to the ECN Summary Database, which incorporates monthly and yearly summary statistics derived from the raw data for all the freshwater sites, is available through the ECN website, www.ecn.ac.uk.

8.3.2 UK Acid Waters Monitoring

In 1986 the UK Acid Waters Review Group drew attention to the urgent need for more detailed guidelines for future monitoring of acidity in fresh waters. This led to the establishment in 1988 of the UK Acid Waters Monitoring Network (UKAWMN) with the objective of providing long term, high quality chemical and biological data, in conjunction with the UK Precipitation Monitoring Network, to assess trends in surface water quality. The network originally consisted of

10 stream sites and 10 lakes situated in parts of the UK most susceptible to acidification. Two of the stream sites were located in NI at Beaghs Burn (Co Antrim) and the Bencrom River (Co Down). In 1990, the Blue Lough (Co Down) and Coneyglen Burn (Co Tyrone) were added to the network with the support of EHS. Monthly water samples are taken from the river sites and quarterly samples from Blue Lough for chemical analysis. Epilithic diatoms, benthic invertebrates, macrophytes and fish numbers are monitored once a year at all sites. Monitoring results for the UK are stored in a database managed by the CEH and ENSIS Ltd. Interpretation of data is carried out at periods of five to six years by an advisory group of experts, and the data are also used for calibration of critical load mapping for the UK Critical Load Advisory Group.

An interpretative report covering the first ten years of monitoring (1988-1998) concluded that:

- Coneyglen Burn is not chronically acidified but can become acidic during high flows. The only changes observed in stream chemistry over the decade have been increases in dissolved organic carbon (DOC) and labile aluminium.

- Beaghs Burn is relatively unimpacted and not severely acidified, but experiences acidic episodes during high flows. DOC has increased substantially over the period from an already high baseline.

- The Bencrom River is severely acidified by a combination of high sulphate and nitrate concentrations.

- Blue Lough is highly acidic with pollutant anion concentrations similar to the nearby Bencrom River. The only clear trend observed over the period is a rise in DOC concentrations, but there is a suggestion of a decrease in acidification over the period.

Details of the acid waters monitoring sites and parameters monitored as well as the ten year interpretative report are available through the website, www.geog.ucl.ac.uk/ukawmn.

The acid waters monitoring points in NI and parameters monitored are listed in Appendix 15.

Table 8 summarises the results of pH and soluble aluminium monitoring for the NI sites between 1990 and 2000.

Table 8 pH Value and Soluble Aluminium at Acid Waters Monitoring Sites

Site	Summary of monitoring results 1990 - 2000					
	pH Value			Soluble Aluminium (ug/l)		
	Mean	Max	Min	Mean	Max	Min
Coneyglen Burn	6.46	7.44	4.60	42.1	264.0	6.0
Beagh's Burn	5.74	7.12	4.31	57.1	117.0	2.5
Bencrom River	5.17	6.27	4.41	203.1	400.0	16.0
Blue Lough	4.71	5.11	4.51	355.5	520.0	234.0

9 REGULATION

9.1 Water (NI) Order 1999

For over 25 years DOE has had a duty, under the Water Act (NI) 1972, to promote the conservation of the water resources of NI and the cleanliness of water in waterways and underground strata. This legislation has been reviewed and amended to take account of changes in Government policies, increased public awareness, scientific advances and EC Directive requirements.

With effect from 21 August 2001, the new Water (Northern Ireland) Order 1999 repealed and re-enacted, with amendments, the Water Act. The new Water Order in particular:

- gives the Department powers to charge application fees and annual subsistence charges for discharge consents, and if necessary, for abstraction licences, to recover regulatory costs;
- provides for public inquiries into applications for discharge consents to discharge to waterways or groundwaters;
- extends powers to secure pollution prevention or remedial measures and to make additional pollution prevention regulations;
- revises procedures for advertising applications for discharge consents;
- extends the data on the public register of consents; and
- widens existing powers to license water abstraction to enable controls to be introduced, if necessary, to protect the aquatic environment in specific catchments or to control particular uses or individual abstractions.

The main provisions of the Order came into effect on 24 August 2001, and charging for applications for discharge consent has applied since 29 October 2001.

In exercising its duties under the Water (NI) Order 1999 in relation to pollution control, EHS's objectives are as follows:

- to ensure the protection of water quality and abatement of pollution in the aquatic environment; and

- to control effluent discharges to waterways and underground strata through the process of granting consents under Article 9 of the Water Order.

9.2 Industrial Discharges

Under the Water (NI) Order 1999, it is an offence to discharge effluent to waterways or groundwater without the consent of DOE. Discharge consents lay down conditions relating to the quality and quantity of effluent that may be discharged. The conditions are formulated to ensure that the discharge can be sustained by the receiving water without damage to the aquatic environment and without breaching domestic or EC Directive standards.

When consent conditions are being drawn up account is taken of the following:

- composition and volume of the proposed discharge;
- water quality target for the receiving water;
- existing receiving water quality;
- available dilution; and
- relevant EC Directive emission standards.

Formulation of consent conditions for trade discharges usually involves the use of some form of mathematical modelling. Numerical discharge standards are usually set as absolute limits, i.e., a maximum figure that must not be exceeded at any time.

Compliance with absolute limits is challenging for the discharger. For example, if an industrial effluent was sampled 12 times in 2000, it had to comply with all the numerical discharge standards on all 12 occasions before it could be recorded as compliant. Typically, discharge consents have numerical standards for between three and five determinands.

9.2.1 Effluent Monitoring

Once a consent has been issued, compliance assessment monitoring is normally carried out for discharges that exceed five cubic metres per day or are significant site drainage discharges, such as those from quarries. This approach to sampling has been adopted to target resources cost effectively at those discharges which, because of their volume or composition, have the greatest pollution potential. Where discharges are found to be non-compliant, appropriate enforcement action is taken. For those discharges not routinely sampled, the Department has established a supplementary inspection/sampling programme. All active discharge consents are therefore subject to compliance assessment.

Sampling an industrial effluent.

Compliance monitoring normally includes the routine collection of samples, or visual inspections, or both. The sampling is organised by the WMU and carried out on its behalf by WQIs or EH(R)Os based at a number of locations throughout NI. Sampling frequency depends upon the nature and volume of the discharge, but is usually 4 or 12 times per year. Dischargers are notified when their discharge is found to be non-compliant, and are asked to explain the reason for the exceedance, and to supply details of their plans to remedy the situation.

Failure to comply with the conditions of a consent is an offence under the Water Order which can on summary conviction lead to a maximum fine of £20,000 or a maximum prison sentence of three months (two years on conviction on indictment) or both. Where compliance is consistently poor, or there is an associated pollution incident, statutory samples may be collected with a view to prosecution for breaches of consent.

9.2.2 Year 2000 Industrial Discharge Consent Compliance

In 2000 there were 875 active discharge consents, covering a wide variety of effluent types, ranging from vehicle washes to large-scale industrial sites. Some 533 of these discharges were included in the annual compliance assessment monitoring programme, and samples were collected from 419 of them. There are a number of reasons why compliance samples cannot be collected. These range from consented premises not yet being in operation to there being no discharge at the time of the site visit.

Table 9 (overleaf) shows 2000 compliance figures, broken down by industrial sectors, and the overall compliance figure for all the discharges monitored.

Table 9 2000 Industrial Discharge Consent Compliance (Absolute Limits)

Industrial Sector	No of Discharges	Percentage Compliance
Aggregates and concrete	139	49.6
Private sewage[1]	120	50.0
Fuel depots	61	59.0
Site drainage	48	64.6
Fish farms	30	63.3
Food processing	30	30.0
Other	105	52.4
All Sectors	533	52.3

[1] Sewage discharges from privately owned sewage treatment plants

Compliance with consent conditions has improved gradually over the last few years, and was 52% in 2000. Table 10 shows overall percentage compliance in the years 1997 to 2000.

Table 10 Compliance with Consent Conditions 1997-2000*

Year	No of Discharges Assessed	Overall % Compliance
1997	451	49.9
1998	469	47.3
1999	518	53.9
2000	533	52.3

* Compliance reported in accordance with UK methodology

9.3 Discharges from Sewerage Systems and Water Treatment Works

In fulfilling its duties under the Water (NI) Order 1999 to promote the conservation and cleanliness of water resources, EHS sets consents for discharges from privately operated sewage treatment works in the same manner as described under industrial discharges (above). Sewage and other waste water discharges made by the Water Service (WS) of the Department for Regional Development (DRD) also require discharge standards. However, being part of the Crown, the WS is not bound by the statutory discharge consent requirements of the Water (NI) Order, and a separate but similar regulatory system has been established to control WS discharges. WS is also subject to the requirements of the EC Directive concerning urban waste water treatment (the Urban Waste Water Treatment Directive, 91/271/EEC) and the Regulations that implement that Directive.

WS discharges are regulated by standards and conditions set out in what are termed ‘registered standards’, that are placed on a public register, along with compliance information. The normal procedure for determining discharge standards involves assessing the assimilative capacity of the receiving water for the proposed discharge flow, using simple mass balance models, and taking into account the water quality objectives of the receiving water. Such standards are known as Environmental Needs Standards (ENS). However, as most of the WS waste water treatment works (WWTWs) had been in operation for many years with a variety of standards in force, it was decided in 1993 to review the standards in order to normalise the situation. This was partly in preparation for a proposed privatisation in 1995/96. The review was done taking into account the past performance of the works and the impact on the receiving waterway. Because of the number of discharge standards needing to be addressed (approximately 1000), a phased approach was adopted based on the populations served by the works.

Dunmurry WWTW discharges effluent to the River Lagan *(picture by Esler Crawford Photography)*

The review of WWTWs serving a population equivalent (PE) greater than 1000 was completed in 1997 and standards for 155 works were placed on the public register in April of that year. Standards for further WS discharges have gradually been added to the register since then, and the last major group comprising WWTWs serving a PE of between 250 and 1000 was completed at the beginning of 2001. Standards have therefore been set for a total of 296 WWTWs. In addition to standards for WWTWs, standards for discharges from 20 water treatment works (WTWs) were placed on the register in 1998. This has since increased to 24 WTWs.

9.3.1 Compliance with Discharge Standards

Waste Water Treatment Works
The standards for WWTWs normally include discharge limits for biochemical oxygen demand (BOD) and suspended solids. In some cases, where it is considered necessary, ammonia and/or nutrient limits are also set. Controls on the minimum volume to be treated and the maximum volume to be discharged are also included in the standard.

Details of the types of standard employed, and of how compliance is assessed, will be presented in the forthcoming *EHS Report to the Northern Ireland Assembly on the Regulation of Water Service Discharges*.

Compliance is assessed by EHS against the appropriate standards using data provided by WS to a sampling programme agreed in advance.

Compliance of WS WWTWs with the registered standards applied from 1997 to 2000 is summarised in Table 11, and the individual WWTWs that failed to comply with their numeric standards during this period are listed in Appendix 16.

Table 11 WWTW Compliance with Discharge Standards 1997-2000

	1997	1998	1999	2000
Number of works on Register	133	134	159	160
Number of works with numeric discharge standards	111	112	130	133
Number of works complying with numeric discharge standards	75	90	110	102
Percentage of works complying with numeric discharge standards	68%	80%	85%	77%
Number of works with descriptive discharge standards*	22	22	29	27
Number of works complying with descriptive discharge standards*	22	21	28	27
Percentage of works complying with descriptive discharge standards*	100%	95%	97%	100%
Overall compliance with standards	73%	83%	87%	81%

* A descriptive discharge standard describes the type of treatment to be provided, and controls the operational and maintenance requirements necessary to maintain that type of treatment.

It should be noted that tighter standards were introduced in 2001 for a number of works to meet the requirements of the Urban Waste Water Treatment Directive. This means that percentage compliance in 2001 will be lower than previously. Percentage compliance will also be affected by the addition of 107 WWTWs to the register for the first time.

Water Treatment Works
The treatment of water for the supply of mains drinking water requires the disposal of waste water generated during the various treatment processes. These waste waters are often discharged to a nearby waterway and require discharge standards to protect the receiving water. Discharge standards for 20 WTWs were placed on the public register on 1 April 1998. This has since increased to 24 WTWs.

The discharge standards for WTWs normally include limits for suspended solids, aluminium, iron, and chlorine. Controls on the volume and pH value of the discharge are also applied.

The standards applied to WTWs allow for one exceedance in 12 samples. A second exceedance constitutes a failure of the discharge to comply with its standards.

WTW compliance with discharge standards for the years 1998 to 2000 is summarised in Table 12. Assessment is based on monitoring data provided by WS.

Table 12 WTW Compliance with Discharge Standards 1998-2000

	1998	1999	2000
No of discharges* monitored	22	26	24
No of discharges* complying	4	8	11
% of discharges* complying	18%	31%	46%

*A WTW may have more than one discharge.

9.3.2 WWTW Discharges and the EC Urban Waste Water Treatment Directive

The EC Urban Waste Water Treatment (UWWT) Directive (91/271/EEC) lays down minimum standards for the discharge of treated effluent from WWTWs. The Directive was transposed into legislation in NI by the Urban Waste Water Treatment Regulations (NI) 1995, which are implemented by EHS.

The Regulations require that all significant discharges of sewage be treated whether the discharge is to inland surface waters, groundwater, estuaries or coastal waters. Significant discharges are those to freshwaters or estuaries from works with a PE of more than 2000 or to coastal waters from works with a PE of more than 10,000. The standards to be met depend on the PE and on whether the receiving waters are classified as normal, sensitive or less sensitive, and the Directive specifies the appropriate treatment for each case. In addition, the Regulations have already led to the cessation of the sea-disposal of sewage sludge. Further details will be set out in the forthcoming *EHS Report to the Northern Ireland Assembly on the Regulation of Water Service Discharges.*

Waste Water Treatment Works

In Northern Ireland all WWTWs with PE greater than 2000 discharging to freshwaters already have secondary treatment, although some older ones will require upgrading. Considerable investment has been, and will be, required for some coastal and estuarine discharges.

In 1995 the Department identified the Lough Erne and Lough Neagh catchments as sensitive to eutrophication under the UWWT Directive (Map 11). As a result, nutrient removal (specifically phosphorus) in addition to secondary treatment was required at 15 of the largest WWTWs (Table 13, overleaf) in these catchments by the end of 1998. The Department has more recently identified Inner Belfast Lough, the Tidal Lagan and the Quoile Pondage as sensitive to eutrophication by nitrogen. Nitrogen removal has already been incorporated into the design of the two major WWTWs which serve the Greater Belfast area.

MAP 11

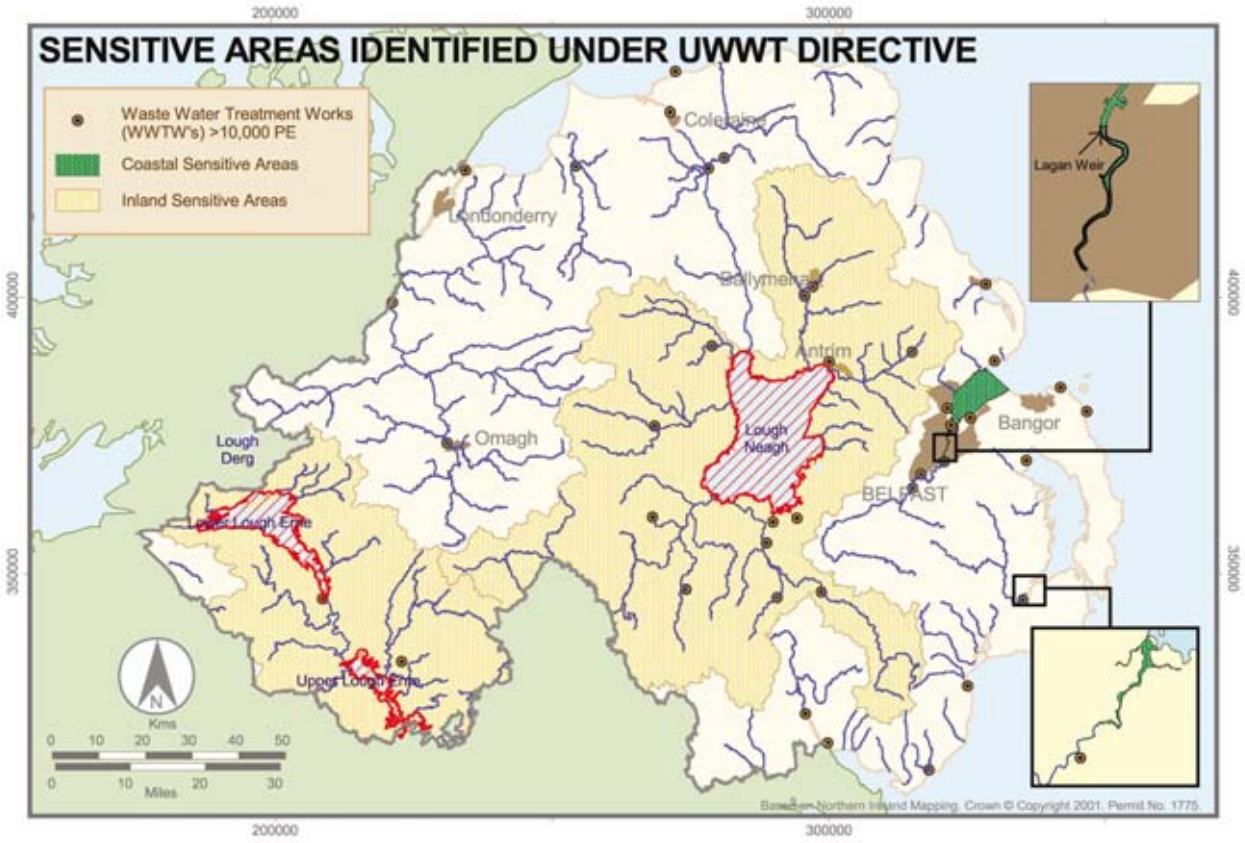


Table 13 WWTWs Discharging into Areas Sensitive to Eutrophication where UWWT Directive Standards Applied from 1 January 1999.

WWTW		
Antrim	Banbridge	Magherafelt
Armagh	Bullay's Hill	Moygashel
Ballyclare	Cookstown	Seagoe
Ballymena	Enniskillen	Tandragee
Ballynacor	Lisnaskea	Tullaghgarley

Standards for WWTWs with PE greater than 10,000 discharging to sensitive areas are set out in Appendix 17.

UWWT Regulations Performance 1999 - 2000
Compliance of WWTWs with the requirements of the UWWT Regulations is assessed by EHS using monitoring data supplied by WS. Compliance for the period 1 January 1999 to 31 December 2000 has been assessed for the 15 works that discharge to sensitive areas and are required to provide nutrient reduction.

Table 14 lists the works that have complied during 1999 and 2000.

Table 14 UWWT Directive Compliant WWTWs in 1999 and 2000

Compliant in 1999	Compliant in 2000
Seagoe	Seagoe
Antrim	Antrim
Moygashel	Moygashel
Magherafelt	Magherafelt
Tullaghgarley	Tullaghgarley
Bullay's Hill	Enniskillen
Ballymena Filtration.	Banbridge
Tandragee	Armagh

Table 15 lists the non-compliant works and the reasons for failure.

Table 15 UWWT Directive Non-compliant WWTWs in 1999 and/or 2000 with Failing Parameters

WWTW	Failing Parameters 1999[1]			Failing Parameters 2000[1]			
	BOD	COD	Total P	BOD	COD	Total P	Sampling Requirements
Lisnaskea	U tier	U tier	***			***	
Cookstown	U tier		***		**	***	
Ballynacor	U tier	U tier	***	U tier	U tier	***	Insufficient sampling
Ballyclare			***			***	
Enniskillen	**						
Banbridge	U tier						
Armagh			***				
Tandragee				U tier			
Ballymena					U tier	***	
Bullay's Hill							Insufficient sampling

[1]Reasons for failure
U tier - Exceeds the UWWT Directive upper-tier limit and percentage reduction standard
** - Exceeds the permitted number of failures for both the 95%-ile limit and percentage reduction requirements for either BOD or COD.
*** - Fails to meet the annual average value for total phosphorus.
BOD - Biochemical oxygen demand
COD - Chemical oxygen demand
Total P - Total phosphorus

Some 53% of WWTWs complied in both years and, although there is some variation in the works that fail, Lisnaskea, Cookstown, Ballynacor and Ballyclare have been non-compliant in both assessment years.

Collection Systems

As well as standards of treatment, the UWWT Directive also applies to collection systems (more commonly known as sewerage systems). The Directive requires that collection systems for WWTWs are provided by the same compliance dates as improvements to the WWTWs and that they are designed, constructed and maintained in accordance with best available technology not entailing excessive cost (BATNEEC). Guidance on the requirements of the Directive and compliance with them is set out in the Guidance Note to the UWWT Regulations, published by EHS.

Most collection systems are 'combined' in that they deal with rainwater run-off as well as domestic and industrial wastewater. Such systems are fitted with combined sewer overflows (CSOs) that allow storm sewage to discharge directly to waterways during storm events that would normally overwhelm the system and risk damage to the sewer itself and any ancillary equipment. Such discharges are intermittent and, when subject to good engineering design, and providing they discharge into waters with adequate dilution, do not normally cause significant adverse environmental effects.

In NI, some collection systems date back to the 1800s and have suffered from a lack of investment. This has resulted in an accumulation of unsatisfactory CSOs. EHS and WS are currently working together in a number of project working groups not only to identify and rectify unsatisfactory CSOs, but to rationalise sewer systems and reduce the total number of CSOs in the system.

CSOs will be considered unsatisfactory if they discharge in dry weather conditions, cause environmental problems, cause failure of environmental standards or lead to public complaints. These unsatisfactory CSOs need to be upgraded to ensure they operate properly, and meet UWWTD requirements, and EHS are working closely with WS to progress this work using the Urban Pollution Management (UPM) Manual methodology developed on a UK-wide basis under the auspices of the Foundation for Water Research.

As of 30 April 2001, ten UPM studies have been accepted by EHS and are now awaiting completion of scoping studies or construction of the improvement works themselves (see Table 16).

Table 16 Areas where UPM Studies have been Accepted by EHS

Area	
West Belfast	Moira
Limavady	Enniskillen
Strabane	Dunmurry
Bangor	Seahill/Helen's Bay
Lurgan	Greyabbey

Improvements to the sewerage infrastructure in Newry and Banbridge were agreed between WS and EHS prior to the commencement of the present UPM study programme. Proposals for improvements in Carrickfergus and Ballyclare are at an advanced stage, and a number of other areas are currently under consideration.

9.4 Food and Environment Protection Act 1985

The DOE has a statutory duty to control the deposit of articles in the sea under Part II of the Food and Environment Protection Act 1985 (FEPA). The purpose of Part II of the Act is to protect the marine environment and human health, and to minimise nuisance to, or interference with, other legitimate uses of the sea by controlling inputs into the sea up to the High Water Mean Spring (HWMS) tide mark. This part of the Act is implemented and regulated by EHS on behalf of the Department. EHS, through its FEPA licensing process, regulates the deposit of substances, or articles, in the sea or under the seabed, including the disposal at sea of dredged material. EHS controls deposits in the sea through a licensing system for:

- the disposal of dredged material, or fish processing waste; and
- construction work which involves the deposition of material below the HWMS tide mark, such as the building of harbours and jetties, the laying of sea outfall pipes and land reclamation.

9.4.1 The Disposal of Dredged Material

Ports and harbours continually carry out dredging operations to maintain the depth and width of navigation channels. Dredged material may be deposited in the sea at a licensed disposal site if the material is deemed suitable following assessment, and after a process of consultation. In addition, the licence applicant must demonstrate that sea disposal is the Best Practicable Environmental Option. As part of its assessment, the dredged material is analysed to determine whether it contains anything that might be harmful to the marine environment. If concentrations of contaminants, such as tributyltin (TBT), exceed acceptable levels, a licence will be refused. If analysis shows the material to be uncontaminated, and no objections are raised by the Department's consultees, a licence will be issued for its disposal at a designated sea disposal site.

Sewage sludge disposal to sea was phased out at the end of 1998 under the terms of the EC Urban Waste Water Treatment Directive.

Monitoring of designated sea disposal sites is another important aspect of the control of deposits to sea. Chemical, biological and microbiological surveys are regularly carried out to assess the effects of the disposed material, and to provide information to inform decisions about future licence applications.

Harbour improvement works at Glenarm were licensed under FEPA.

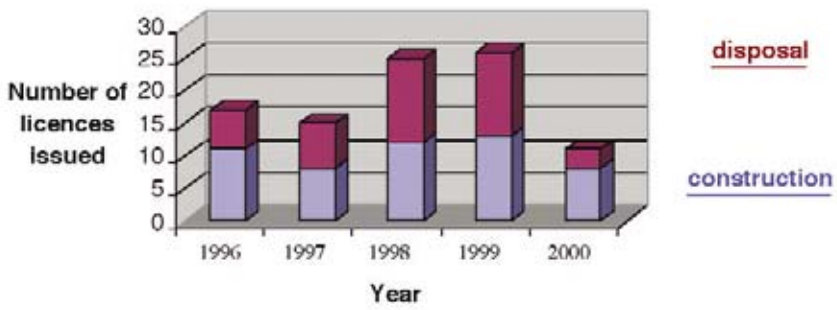
9.4.2 Construction Licences

EHS also licenses marine construction works, land reclamation and beach replenishment (the replacement of sand that has been eroded from beaches). Applications for such licences are subjected to a similar assessment and consultation process as those for disposal licences. The aim is to protect the marine environment and human health, and to minimise nuisance to, or interference with, other legitimate uses of the sea.

There are, however, certain exemptions from the licensing requirement. These are listed in the Deposits in the Sea (Exemptions) Order (NI) 1995. This Order lists activities, such as the deposition of fishing gear, moorings, aids to navigation and scientific equipment, as well as some coastal maintenance works and shellfish cultivation.

Over the past five years there has been a constant demand for FEPA licences from applicants seeking either to dispose of dredged material or to carry out construction activities below the HWMS tide mark (Figure 4).

Figure 4: Combined Number of Disposal and Construction Licences Issued 1996 - 2000



EHS has authorised a wide range of activities such as:

- disposal of dredged material from maintenance dredging of ports and harbours to keep navigation channels to the required depth;
- disposal of dredged material arising from capital dredging schemes involving the excavation of additional seabed material to increase the width, depth or reaches of navigation areas;
- new harbour development and coastal protection works;
- the laying of submarine pipes and cables such as for cross-channel gas pipelines, telecommunication cables and electricity interconnector cables; and
- beach replenishment programmes.

The licensing process has recently been reviewed. Procedures, assessments, charges and fees associated with licensing have been amended to meet current demands. This will enhance the effectiveness of the licensing system and add to the protection of the marine environment and its uses.

9.5 Groundwater Authorisations

The EC Directive on the protection of groundwater against pollution by certain dangerous substances (the Groundwater Directive, 80/68/EEC) sets a framework for preventing or limiting the pollution of groundwater by dangerous substances released from both point and diffuse sources. The Directive specifies two categories of substances: List I for the most dangerous, and List II for other, slightly less dangerous substances. The Directive has been transposed into NI law through the Groundwater Regulations (NI) 1998.

The purpose of the Regulations is to prevent the direct or indirect discharge of List I substances to groundwater and to control pollution resulting from the direct or indirect discharge of List II substances to groundwater. The Regulations require that disposal (and tipping for the purpose of disposal) of List I and List II substances to land be subject to a formal system of authorisation. Conviction for an offence under the Regulations may result in a fine of up to £20,000.

Following the issuing of application forms and guidance notes to sheep farmers and other agricultural pesticide users throughout NI in February 1999, approximately 1160 applications for authorisations had been received up to end of 2000. Under regulation 22, applications submitted to the Department before 1 April 1999 were deemed (i.e., were automatically approved) unless they related to a new activity. There were 1039 deemed applications. A map based computer system which, among other factors, takes account of groundwater vulnerability, soil type, and proximity of waterways, has been developed to assess the suitability of the proposed land areas for pesticide disposal. Applications are continuing to be assessed using this system. The first authorisations were issued in 2001.

10 POLLUTION INCIDENTS AND PROSECUTIONS

When a pollution incident occurs EHS aims to:

- locate the pollution source, identify the polluter and, if appropriate, collect sufficient evidence to secure a prosecution;
- secure from the polluter the necessary action to prevent the continuation, or the repetition, of pollution; and
- recover costs, where possible, from the polluter.

Pollution incident investigations are undertaken in response to reports from various sources, in most cases from members of the public. Although sometimes it is not possible to determine the cause or source of pollution, where such information is available there can be many contributing factors in the pollution incident. All reports of water pollution are investigated, and every effort made to substantiate and identify the cause and nature of the incident.

Laying a boom to trap oil following a coastal pollution incident

The Department may take emergency action to prevent water pollution or, where pollution has occurred, to remedy or mitigate the effects on waterways. The cost of such action may be recovered from the polluter as a contract debt. Plans for dealing with water pollution incidents are set out in EHS's *Water Pollution Incident Response Procedures* which also form a component part of the UK's National Contingency Plan for dealing with marine pollution from shipping and offshore installations.

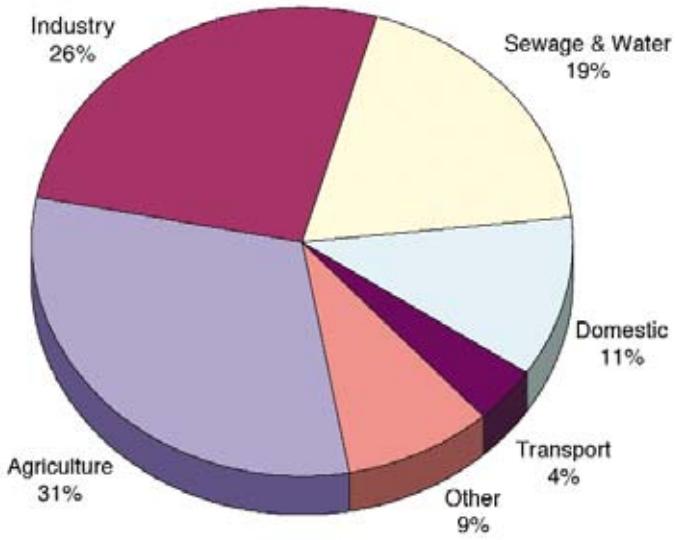
EHS operates a pollution response system which is available to the public at all times. To encourage the reporting of incidents, EHS has a **freephone 'Water Pollution Hotline' number, 0800 80 70 60**. All pollution incidents are recorded on EHS's Pollution Incident Logging and Tracking System (PILOTS), a computerised management information system networked to all field agents.

10.1 Pollution Incident Statistics 2000

EHS has set response targets which are routinely monitored as a performance measure. During 2000 a total of 2582 pollution incidents were reported to EHS, an increase of 7.1% from 1999. Of the total number of pollution incidents reported, 1701 (65.8 %) were substantiated.

EHS aims to identify the source of any pollution. The source of pollution is reported in six categories: Agriculture, Industry, Sewage and Water Industry, Domestic, Transport and Other. 'Other' sources include incidents where the source was not determined. Figure 5 illustrates the distribution of pollution incidents by source for 2000. Agriculture and industry were the source of most incidents in 2000, accounting for 31% and 26% respectively. It is encouraging to note a 7% decrease between 1999 and 2000 in pollution incidents attributable to the Sewage and Water Industry.

Figure 5: Source of Pollution Incidents, 2000



A Key Performance Target for EHS in its 1999/2002 Business Plan was to 'bring about a 10% reduction in the number of "high" and "medium" severity water pollution incidents by the year 2000 on 1996 figures'. Table 17 shows the total number of substantiated pollution incidents, recorded by category, for the years 1996 to 2000. Table 18 shows, for the same period, a breakdown of these incidents on the basis of severity by each of EHS's Pollution Control Areas. The definitions of severity are listed in Appendix 18. The reduction in the number of incidents achieved since 1996 was 17.2%. EHS's new target is to achieve a 20% reduction in the number of 'high' and 'medium' severity incidents by 2003 based on 1996 figures.

Table 17 Substantiated Pollution Incidents 1996-2000

Source	1996	1997	1998	1999	2000
Industry	525	365	435	347	448
Agriculture	502	549	467	438	524
Sewage & Water	371	351	276	347	322
Domestic	186	205	227	155	190
Transport	40	53	64	53	64
Other	431	300	172	166	153
Total	2055	1823	1641	1506	1701

Table 18 Severity of Pollution Incidents by Pollution Control Area* 1996 - 2000

	High					Medium					Low				
Area*	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
1	7	6	3	0	8	14	32	34	16	23	422	491	283	289	421
2	2	3	8	8	4	29	28	42	35	53	88	85	93	55	78
3	8	4	6	2	6	28	27	38	42	42	162	110	136	152	152
4	15	6	3	5	4	52	33	38	29	32	212	71	84	81	112
5	10	20	5	2	1	43	107	70	29	29	145	90	112	117	155
6	11	18	13	12	10	59	62	61	72	50	175	146	181	150	143
7	16	9	13	6	8	57	76	81	50	33	103	84	68	68	54
8	4	2	3	1	5	65	28	26	24	22	152	101	52	49	53
9	2	5	0	2	5	21	8	23	31	52	153	171	165	179	146
Total	75	73	54	38	51	368	401	413	328	336	1612	1349	1174	1140	1314

*Areas are depicted in Map 1 (page 4).

10.2 Prosecutions 2000

Under the Water (NI) Order 1999, a polluter shall be liable on summary conviction to imprisonment for a term not exceeding three months, or to a fine not exceeding £20,000, or both. The Magistrates Court will usually award costs against the defendant for the expenses incurred by the Department in analysing statutory samples and the costs incurred by the Court in serving the summons. The Magistrate also has discretionary powers to award compensation for restocking rivers if the pollution has caused a fish kill.

The costs and fines imposed by the Courts for pollution incidents that occurred between 1 January 2000 and 31 December 2000 are set out in Table 19.

Table 19 Costs and Fines - January to December 2000

Category	Chemical Analysis Costs	Court Costs	Fines	Total
Agriculture	£6,850.84	£937.20	£11,350.00	£19,138.04
Breach of Consent	£79.00	£46.00	£500.00	£625.00
Chemical	£1,577.70	£174.00	£10,000.00	£11,751.70
Non-agricultural Waste Discharge	£1,155.40	£94.00	£10,000.00	£11,249.40
Oil	£670.00	£78.00	£2,500.00	£3,248.00
Sewage	£116.50	£16.00	£250.00	£382.50
Total	£10,449.44	£1,345.20	£34,600.00	£46,394.64

In addition to instigating court action against polluters, the Department may issue warning letters. The purpose of warning letters is to deal with cases where prosecution may not be the appropriate course of action, for example in relation to less severe cases. Polluters are informed that they are committing an offence and warned that remedial action must be taken to prevent any other polluting discharges from entering the waterway, or water contained in an underground stratum. If the warning letter fails to have any effect, and pollution is still occurring, a prosecution will be considered and the fact that the offender has received written warnings will be mentioned in any subsequent court case.

Table 20 sets out the numbers of prosecutions taken and warning letters issued for the period 1996 to 2000.

Table 20 Prosecutions and Warning Letters 1996-2000

Year	Water Act Prosecutions	Warning Letters
1996	109	52
1997	85	49
1998	91	304
1999	67	225
2000	78*	243

*Four prosecutions outstanding for 2000

Further details of pollution incident statistics and prosecutions can be found in the EHS report *Water Pollution Incident and Prosecution Statistics 2000* which can be viewed on the website, www.ehsni.gov.uk.

The enforcement and prosecution policy for environmental protection is set out in Appendix 19.

10.3 Proactive Pollution Prevention

As already mentioned, a key performance target for EHS was to bring about a 10% reduction in pollution incidents between 1996 and 2000. This was achieved by a number of proactive pollution prevention activities detailed below. These initiatives will be continued in order to meet the new target of a 20% reduction in pollution incidents by the year 2003.

Pollution Prevention Guidelines

The Environment Agency for England and Wales (EA) has produced pollution prevention guidelines (PPGs) aimed at a wide range of target audiences. EHS has developed a partnership with EA and the Scottish Environment Protection Agency (SEPA), which provides an opportunity for EHS to contribute to this valuable series of guidelines. The leaflets, which are now being issued under the three agencies' logos, give EHS and the other agencies an opportunity to provide authoritative advice on a wide range of subjects with consistency across the UK. The full list of titles available is given in Appendix 20. This series of guidelines is complementary to DARD's forthcoming revised *Code of Good Agricultural Practice for the Prevention of Pollution of Water.*

Industrial Estate Surveys

EHS field agents have always spent a considerable amount of time working in industrial estates, undertaking reactive work following pollution incidents. Increasingly, time is being spent on proactive work aimed at reducing the chance of pollution through risk assessment and education programmes. More than 450 premises were visited in 2000. Considerable improvements were made in recording data on computer and generating site-specific letters, so that occupiers of individual premises can be advised exactly what they can do on their site to reduce the threat of pollution.

Timber Treatment Plants

The year 2000 saw many changes in this industrial sector, with the termination of the oil-based tributyl tin oxide/lindane treatment process. Residual treatment material was used up before the deadline of 1 January 2001. While changing their processes, many firms upgraded their plant and improved their containment facilities. This trend is expected to continue.

Construction Sites

Construction sites continue to be a significant cause of pollution. EHS now requests earthworks management plans at the preliminary planning stage at sites where there is a risk of pollution. This has raised awareness of the problem.

Sustainable Urban Drainage Systems

EHS has been involved in the development of a design manual for sustainable urban drainage systems (SUDS) for NI and Scotland. Sustainable urban drainage systems are structures designed to manage surface water run-off. They work by providing storage or flow attenuation, and by exploiting the natural processes of sedimentation, filtration and biodegradation to remove pollutants. The manual, launched in May 2000, sets out a number of methods to prevent pollution arising from urban drainage, i.e., from roads, housing, and industrial estates. EHS is currently developing a strategy to promote and implement SUDS in NI. Staff members took the opportunity to promote SUDS when speaking at a series of industry seminars in 2000. Roads Service (DRD) took up the concept and included SUDS requirements in several contracts for new road bypasses. Valuable experience is expected to be gained from these projects.


www.ehsni.gov.uk
ENVIRONMENT AND HERITAGE SERVICE
Water Pollution Hotline
FREEFONE 0800 807060
The 24 hour hotline for reporting all environmental incidents relating to water pollution in Northern Ireland
An Agency within the Department of the Environment

APPENDIX 1

Current Key Primary Legislation and Regulations Enforced by EHS to Protect the Quality of the Water Environment in NI

Primary Legislation

The Food and Environment Protection Act 1985
The Industrial Pollution Control (NI) Order 1997
The Waste and Contaminated Land (NI) Order 1997
The Water (NI) Order 1999

Regulations

The Sludge (Use in Agriculture) Regulations (NI) 1990
The Quality of Bathing Water Regulations (NI) 1993
The Prevention of Pollution (Erne System) Regulations (NI) 1994
The Urban Waste Water Treatment Regulations (NI) 1995
The Conservation (Natural Habitats, etc.) Regulations (NI) 1995
The Protection of Water Against Agricultural Nitrate Pollution Regulations (NI) 1996
The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations (NI) 1996
The Protection of Water Against Agricultural Nitrate Pollution (Amendment) Regulations (NI) 1997
The Surface Waters (Fishlife) (Classification) Regulations (NI) 1997
The Surface Waters (Shellfish) (Classification) Regulations (NI) 1997
The Groundwater Regulations (NI) 1998
The Surface Waters (Dangerous Substances) (Classification) Regulations (NI) 1998
The Action Programme for Nitrate Vulnerable Zones Regulations (NI) 1999

APPENDIX 2

Water Framework Directive Key Implementation Deadlines

Action	Deadline
Directive enters into force	2000
Transpose the Directive into NI law Identify river basin districts and the competent authority which will be empowered to implement the Directive	2003
For each river basin district, complete analysis of characteristics of surface and groundwaters, review impact of human activity (industry, farming, etc.) and prepare economic analysis of water use Establish register of protected areas	2004
Establish environmental monitoring to ensure comprehensive view of water quality in each river basin district Publish a work programme for producing River Basin Management Plans (RBMPs) for each river basin district	2006
Publish an interim overview of the significant water management issues for each river basin district	2007
Publish draft RBMPs for six-month consultation period	2008
Finalise and publish RBMPs Establish programmes of measures in each river basin district to meet environmental objectives	2009
Ensure proper pricing policies are in place	2010
Programmes of measures to be fully operational Interim progress reports to be prepared on progress in implementing planned programmes of measures	2012
Main environmental objectives to be met Every six years thereafter review and update RBMPs	2015

APPENDIX 3

The Chemical General Quality Assessment (GQA) Scheme

Definition

The chemical grade of the GQA scheme is defined by standards for the concentrations of BOD, ammonia and dissolved oxygen. These have been selected as indicators of the extent to which waters are affected by waste water discharges and rural land use run-off containing organic, biodegradable material. The quality of rivers is affected by discharges from waste water treatment works and industries, and by diffuse drainage and discharges from agriculture. These three determinands give the most useful chemical assessment of river water quality for the purposes of the GQA, and their use provides some continuity with the National Water Council's (NWC) classification system used previously.

Chemical Classification

A summary of the class limiting criteria is given in Table A. The overall class assigned to a river reach is determined by the worst of the three classes for the individual determinands.

Table A Standards for the Chemical GQA

GQA Class	Dissolved Oxygen (% saturation) 10-percentile	BOD (mg/l) 90-percentile	Ammonia (mg N/l) 90-percentile
A (Very Good)	80	2.5	0.25
B (Good)	70	4	0.6
C (Fairly Good)	60	6	1.3
D (Fair)	50	8	2.5
E (Poor)	20	15	9.0
F (Bad)	less than 20	-	-

The new classes are defined in terms of the 90-percentile for BOD and ammonia and the 10-percentile for dissolved oxygen; in other words, the river reach should contain less than the specified concentrations of BOD and ammonia for at least 90 per cent of the time, whilst the concentration of dissolved oxygen must not fall below the prescribed limit for more than 10 per cent of the time.

The use of measures of water quality based on estimates of percentiles is well established; the NWC system was based on 95-percentile values for BOD and ammonia and 5-percentile for dissolved oxygen. Percentiles have the advantage that they combine a measure of the general concentration of a determinand with a measure of variability and hence are able to respond to the large fluctuations in quality common in rivers, as well as indicating the overall quality. The move from 95-percentiles to 90-percentiles allows the river grade to be determined more reliably from the inevitably limited numbers of samples which result from realistic sampling programmes, yet does not lose sight of the greater environmental significance of higher concentrations of pollutants.

Table B sets out the likely uses and characteristics of water in the various chemical classes.

Table B Likely Uses and Characteristics of Classified Waters

Chemical Class	Likely Uses and Characteristics[1]
A (Very Good)	• All abstractions • Very good salmonid fisheries • Cyprinid fisheries • Natural ecosystem
B (Good)	• All abstractions • Salmonid fisheries • Cyprinid fisheries • Ecosystem at or close to natural
C (Fairly Good)	• Potable supply after advanced treatment • Other abstractions • Good cyprinid fisheries • A natural ecosystem, or one corresponding to a good cyprinid fishery
D (Fair)	• Potable supply after advanced treatment • Other abstractions • Fair cyprinid fisheries • Impacted ecosystem
E (Poor)	• Low grade abstraction for industry • Fish absent, sporadically present, vulnerable to pollution[2] • Impoverished ecosystem[2]
F (Bad)	• Very polluted rivers which may cause nuisance • Severely restricted ecosystem

1 Provided other standards are also met

2 Where the Class is caused by discharges of organic pollution

APPENDIX 4

Chemical Parameters Currently Measured on Primary, Secondary and Minor Rivers

Parameter	Primary Rivers Designated under FFD*	Primary Rivers not Designated under FFD*	Secondary Rivers	Minor Rivers
Temperature	Yes #	Yes	Yes	
Visible oil	Yes #	Yes	Yes	
pH value	Yes #	Yes	Yes	
Dissolved oxygen	Yes #	Yes	Yes	
Dissolved oxygen per cent saturation	Yes	Yes	Yes	
BOD	Yes #	Yes	Yes	
Ammoniacal nitrogen	Yes #	Yes	Yes	
Non-ionised ammonia	Yes #			
Suspended solids	Yes #			
Nitrite	Yes #			
Total hardness	Yes #			
Total zinc	Yes #			
Dissolved copper	Yes #			
Nitrate	Yes	Yes		
Soluble reactive phosphorus	Yes	Yes		
Reactive aluminium	Selected sites	Selected sites		
Conductivity	Selected sites	Selected sites		
Alkalinity			Yes	Yes

*FFD - EC Freshwater Fish Directive (78/659/EEC)
- EC Freshwater Fish Directive parameter

Lakes

In the monitoring exercise referred to in Section 5.1, lakes were monitored for the same parameters as primary rivers designated under the EC Freshwater Fish Directive, as well as for chloride, total phosphorus and chlorophyll *a*.

APPENDIX 5

The Biological General Quality Assessment (GQA) Scheme

Rationale

Northern Ireland (NI) rivers support over 1,500 species of aquatic macroinvertebrates (such as insect larvae, molluscs and shrimps) which vary in their sensitivity to pollution and in particular to different types of pollution. For example, shrimps and mayfly larvae tend to be sensitive to the effects of acidification, whereas stonefly nymphs are highly sensitive to depressed dissolved oxygen concentrations that might result from pollution by organic wastes. Molluscs are sensitive to metal pollution which interferes with their shell forming processes.

Unpolluted waters contain a wide diversity of these organisms but usually with no single species in great abundance. The effect of pollution is to selectively remove certain types of organisms, possibly resulting in certain other species becoming excessively abundant. For example, the discharge of biodegradable organic matter to a river can selectively remove the pollution sensitive stonefly nymphs while encouraging the productivity of pollution insensitive organisms such as the oligochaete worms, midge larvae and hog-lice. Moreover, when invertebrate communities are damaged by environmental stress, complete recovery can take several months. Macroinvertebrates can therefore act as an in-line monitoring system for pollution events.

Because of their relative lack of mobility in rivers, these organisms are exposed to the full effects of pollution. For these reasons, the identification of imbalances in the diversity and abundance of macroinvertebrates within river reaches offers a ready means of detecting intermittent pollution and the effects of substances such as pesticides and acids which may not be detected by GQA chemical monitoring. Because of the relatively small range of chemical determinands routinely monitored, rivers can be classified as of good chemical quality while supporting an impoverished macroinvertebrate community. The effects of pollution can therefore be underestimated if reliance is placed on one classification system in isolation.

In the same way, the abundance and diversity of aquatic plants and algae can provide valuable information regarding nutrient enrichment in river waters and sediments. Taken together with GQA chemistry, the evaluation of macroinvertebrates and plants can give a much more holistic assessment of river water quality and improve the detection of intermittent or insidious pollution.

Summary Statistics in the Assessment of Biological Quality

Macroinvertebrate data are summarised throughout the United Kingdom using the Biological Monitoring Working Party (BMWP) **biotic score** system. This method of data collation separates invertebrate groups or taxa on the basis of their relative sensitivity to pollution with the more pollution sensitive taxa being allocated higher scores and the more pollution tolerant taxa lower scores. The overall community is described by the sum of the individual taxon scores. In general, higher total biotic scores describe better quality invertebrate communities reflecting the better end of the water quality spectrum.

Two other measures which describe biological quality are the **number of BMWP scoring taxa** present and the average pollution sensitivity of the macroinvertebrate community as described by the **Average Score per Taxon** (ASPT), which is derived from the community biotic score divided by the number of taxa represented. In general, the higher the number of taxa present, the better the biological quality of the reach, especially where the ASPT values are high (greater than 5.5)

Biological Classification

Since the late 1970s, a computer model called RIVPACS (River Invertebrate Prediction and Classification System) has been under development in the United Kingdom. Using the physical, geographical and chemical characteristics of a monitoring site, RIVPACS can predict what the natural macroinvertebrate fauna of that site would be in the absence of environmental stress of which pollution is an important form. The computer model was modified prior to the 1995 quinquennial survey to take account of factors that are peculiar to NI. For example, certain macroinvertebrates found in

high quality waters in England, Scotland and Wales may be absent from NI waters not because the waters are polluted, but because the organisms in question have not colonised Irish waters. This modification has improved the accuracy of biological water quality classification in NI. Further modifications are being carried out to improve the accuracy with which smaller streams and headwaters can be classified.

Comparison of the predicted macroinvertebrate communities with those observed during the biological sampling and analytical programme allows the calculation of ecological quality indices (EQIs). The most relevant EQIs in describing biological quality are those based on the number of macroinvertebrate taxa and on ASPT. These are derived from the equations:

$$EQI_{taxa} = \frac{\text{BMWP Observed Number of Taxa}}{\text{BMWP Predicted Number of Taxa from RIVPACS}}$$

and

$$EQI_{ASPT} = \frac{\text{BMWP Observed ASPT}}{\text{BMWP Predicted ASPT from RIVPACS.}}$$

An EQI value of approximately one indicates that the observed macroinvertebrate fauna is what would be expected in an unstressed river reach, whereas lower EQI values reflect communities that are stressed to a lesser or greater degree. The EQI bandings agreed nationally for the range of biological qualities are set out in Table 1.

Table 1 Biological Classification Bandings

Biological Class	EQI for ASPT	EQI for Taxa
A (Very Good)	1.00 or above	0.85 or above
B (Good)	0.90-0.99	0.70-0.84
C (Fairly Good)	0.77-0.89	0.55-0.69
D (Fair)	0.65-0.76	0.45-0.54
E (Poor)	0.50-0.64	0.30-0.44
F (Bad)	Less than 0.50	less than 0.30

Class A - Very Good

The biology is similar to (or better than) that expected for an average, unpolluted river of this size, type and location. There is a high diversity of taxa, usually with several species in each. It is rare to find a dominance of any one taxon.

Class B - Good

The biology shows minor differences from Class A and falls a little short of that expected for an unpolluted river of this size, type and location. There may be a small reduction in the number of taxa that are sensitive to pollution, and a moderate increase in the number of individuals in the taxa that tolerate pollution (like worms and midges). This may indicate the first signs of organic pollution.

Class C - Fairly Good

The biology is worse than that expected for an unpolluted river of this size, type and location. Many of the sensitive taxa are absent or the number of individuals is reduced, and in many cases there is a marked rise in the numbers of individuals in the taxa that tolerate pollution.

Class D - Fair
The biology shows considerable differences from that expected for an unpolluted river of this size, type and location. Sensitive taxa are scarce and contain only small numbers of individuals. There may be a range of those taxa that tolerate pollution and some of these may have high numbers of individuals.

Class E - Poor
The biology is restricted to animals that tolerate pollution with some taxa dominant in terms of the numbers of individuals. Sensitive taxa will be rare or absent.

Class F - Bad
The biology is limited to a small number of very tolerant taxa, often only worms, midge larvae, leeches and the water hog-louse. These may be present in very high numbers but even these may be missing if the pollution is toxic. In the very worst case there may be no life present in the river.

APPENDIX 6

Groundwater Monitoring Parameters

(1) Quarterly Monitoring

Field Measurements

Temperature
Alkalinity
Ammonia
Cyanide
Nitrite
Dissolved oxygen
Electrical conductivity
pH
Eh -Redox potential

Laboratory Measurements

(a) Chemical

Bicarbonate
Calcium
Chloride
Dissolved iron
Dissolved manganese
Magnesium
Nitrate
Nitrite
Potassium
Sodium
Sulphate
Total organic carbon
Electrical conductivity
pH

(b) Microbiological

Total coliforms
Faecal coliforms
Total viable colony count at 37°C and 22°C.

Groundwater Monitoring Parameters

(2) Annual Monitoring

Nitrogen ammoniacal
Aluminium
Antimony
Arsenic
Barium
Beryllium
Boron
Cadmium
Chromium
Cobalt
Copper
Cyanide (Total)
Hydrocarbons
Fluoride
Lead
Mercury
Molybdenum
Nickel
Phosphorus
Tellurium
Thallium
Titanium
Selenium
Silica
Silver
Uranium
Vanadium
Zinc
Dichlorobromomethane
Dibromochloromethane
Tetrachloromethane
Trichloroethene
Tetrachloroethene
1,1,1 Trichloroethane
Trichloromethane
Tribromomethane
Trihalomethanes - total
Benzene
Toluene
m,p-xylene
o-xylene
Ethylbenzene
Methyl-tert.butyl-ether (MTBE)
Fluoranthene
Benzo 1,12 perylene
Benzo 11,12 fluoranthene
Indeno(1,2,3-cd)pyrene
Benzo 3,4 fluoranthene
Benzo 3,4 pyrene
PAH
Tributyl tin
Triphenyl tin
Pentachlorophenol
Pentachlorophenol
2-Chlorophenol
4-Chlorophenol
2,4-Dichlorophenol
2,6-Dichlorophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
o-Cresol
m-Cresol
p-Cresol
Phenol
Diquat
Glyphosate
Flumethrin
Triadimefon
Fluazifop-p-butyl
Pendimethalin
Bromacil
DDD (op)
DDE (op)
Quintozene
Propham
Azinphos-methyl
Bifenox
Carbophenothion
Chlorfenvinphos
Cyanazine
Desmetryne
Diazinon
Dichlorvos
Coumaphos
Fenitrothion
Fenchlorphos
Fenpropidin
Fenpropimorph
Iprodione
Malathion
Oxadixyl
Parathion
Prometryne
Propazine
Propetamphos
Propyzamide
Terbuthylazine
Terbutryn
Atrazine
Chlorpyriphos
Dichlorbenil
EPTC
Flutriafol
Phosalone
Propiconazole
Simazine
Dimethoate
Triallate
Triazophos
Trietazine
2,4 DB
2,4-D
2,4,5-T(acid)
Bentazone
Bromoxynil
Clopyralid
Dicamba
Dichlorprop
2,4,5 TP
Fluoxypyr
Imazapyr
Ioxynil
MCPA
MCPB
MCPP
Triclopyr
Carbetamide
Chlorpropham
Chlorotoluron
Diuron
Isoproturon
Linuron
Monuron
Aldrin
Chlordane
Chlorothalonil
TDE (pp)
DDE (pp)
DDT (op)
DDT (pp)
Dieldrin
Endosulphan a
Endosulphan b
Endrin
Hexachlorobenzene
Hexachloro 1,3 butadiene
HCH - alpha
HCH - beta
HCH - delta
HCH - gamma
Heptachlor
Heptachlor epoxide
Isodrin
Methoxychlor
Tecnazene
Trifluralin
Benzene
1,2 Dichloroethane
PCB's (7 Congeners)

APPENDIX 7

Summary of the Northern Ireland Estuarine and Coastal Waters Classification Schemes (NIECWCS)

Estuary Classification Scheme

1. Introduction

The purpose of the scheme described below is to classify estuarine waters in Northern Ireland. A classification scheme is required for national reporting purposes and to measure quality for water quality management purposes. The scheme described below is based on the scheme developed and revised by the Association of Directors of River Inspectors in Scotland (ADRIS) and now implemented by the Scottish Environment Protection Agency.

2. Basis of the Scheme

The Estuary Classification Scheme is modelled on the Coastal Scheme and is designed to:

(a) be as simple as possible;
(b) be readily applicable to all Northern Ireland estuarine waters;
(c) comprise four class categories for compatibility with the existing coastal classification scheme;
(d) recognise areas affected by existing developments; and
(e) recognise areas and discharges subject to EC Directives.

3. Application of the Scheme

Estuary boundaries as agreed under the EC Urban Waste Water Treatment Directive should be used at all times.

The classification scheme:

(a) embraces all parameters and effects, regardless of whether Environment and Heritage Service is empowered to control them (e.g., industrial effluent discharges) or not (e.g., marine garbage and debris), including the effects of eutrophication; and

(b) for compatibility with the coastal scheme and to increase sensitivity, should be 'default based' rather than 'points based' like the old NWC Estuarine Classification Scheme.

A relatively small unit of resolution of 0.1 km^2 is proposed. This may result in some small areas of class C or D around outfalls, but this is considered reasonable and matches the unit of resolution used in the coastal scheme. It is also considered reasonable to ignore affected areas smaller than 0.01 km^2. Where an impact is greater than this then the whole 0.1 km^2 is downgraded.

It is also considered appropriate to assume the presence of intermediate zones between, for example, class C areas and class A areas even if no actual data exists to substantiate this. Therefore an appropriate buffer zone may be added according to local knowledge.

It may be that class A estuarine waters abut class B or C coastal waters. This is a consequence of the few parameters included in one scheme but not in the other (i.e., microbiology in the coastal scheme, migratory fish in the estuary scheme). Abrupt transitions between estuary and coastal classification were therefore considered to be inevitable but acceptable.

When using colours to depict coastal and estuary classifications the following colours have been adopted:

Class A	Blue
Class B	Green
Class C	Orange
Class D	Red

The main provisions of the Northern Ireland Estuary Classification Scheme are tabulated opposite. For each of the four quality classes (A, B, C and D) there are criteria covering aesthetic condition, biological condition and chemical condition. Guidance notes and tables exist to aid the application of these criteria.

A given area of estuary is classified by allocating it to the highest class to which all of its condition criteria conform. An estuarine area satisfying class B aesthetic and chemical criteria but which is class C on the basis of one of the biological criteria would be classified as class C overall.

Where only limited data on chemical and biological quality are available, estuaries will be classified according to that data together with information on, for example, known discharges, pollution complaints, etc., and additional survey work may not be required. Where no discharges occur, no pollution complaints have been substantiated and other pollution sources are absent, an estuary will normally be class A.

NI Estuary Classification Scheme

Class	Description	Aesthetic Condition	Fish Migration	Resident Biota and/or Bioassay	Resident Fish	Persistent Substances (Biota)	Water Chemistry	
							Dissolved Oxygen (DO)	UK Red List and EC Dangerous Substances
A	Excellent	Unpolluted	Water quality allows free passage	Normal	Resident fish community normal	< Guideline Standard NI Shellfish Waters	Minimum DO > 6 mg/l	100% compliance of samples with EQS
B	Good	May show signs of contamination	Water quality allows free passage	Normal	Resident fish community normal	< Mandatory but > Guideline Standard NI Shellfish Waters	Minimum DO < or = 6 mg/l but > 4 mg/l	Annual compliance of samples with EQS
C	Unsatisfactory	Occasional observations or substantiated complaints of pollution	Water quality restricts passage	Modified	Resident fish community modified	> Mandatory Standard NI Shellfish Waters	Minimum DO < or = 4 mg/l but > 2 mg/l	One or more List II substances fail to comply with EQS. List I and Red List all comply
D	Seriously polluted	Frequent observations or substantiated complaints of pollution	Water quality prevents passage	Impoverished or severely modified	Resident fish community impoverished	> 2 x Mandatory Standard NI Shellfish Waters	DO < 2 mg/l	One or more List I or Red List substances fail to comply with EQS

Coastal and Territorial Waters Classification Scheme

1. Introduction

The purpose of the scheme described below is to classify coastal waters in Northern Ireland. A classification scheme is required for national reporting purposes and to measure quality for water quality management purposes. The scheme described below is based on the scheme developed and revised by the Association of Directors of River Inspectors in Scotland (ADRIS) and now implemented by the Scottish Environment Protection Agency.

2. Basis of the Scheme

The Scheme is designed to:

(a) be simple;
(b) be readily applicable to all controlled Coastal Waters around Northern Ireland;
(c) recognise the generally unpolluted status of Coastal Waters around Northern Ireland;
(d) recognise areas affected by existing developments; and
(e) recognise areas and discharges subject to all relevant EC Directives.

3. Application of the Scheme

Coastal boundaries with defined estuaries should use the same limits as have been agreed for the EC Urban Waste Water Treatment Directive.

The classification takes account of all features up to 12 miles seawards of the territorial waters baseline. Where an offshore discharge or disposal site causes a reduction in the quality in comparison with the quality at the shore (i.e., more than 200 metres offshore), then an additional length should be included in the classification, corresponding to the longest axis of the area affected by the activity.

It was recognised that there was a need to classify offshore areas in addition to the shoreline where there was some deterioration in quality. (It is assumed that water quality within a mixing zone is acceptable if the associated discharge does not breach its consent conditions.)

It was also agreed that the classification Scheme should:

(a) embrace all quality-influencing parameters and effects, regardless of whether Environment and Heritage Service was empowered to control them (e.g., effluent discharges) or not (e.g., marine garbage and debris); and

(b) for the sake of simplicity, and to accord with a revised estuary classification scheme, be 'default based' rather than 'points based'.

The relatively small unit of resolution of the proposed scheme (0.1 km) results in some very small lengths (0.1 or 0.2 km) of classes C or D coastline around some outfalls, but this has been shown to be realistic in practice. It is also considered reasonable to ignore affected lengths less than 0.01 km. Where a length is greater than this, the whole 0.1 km length is downgraded.

It is also considered reasonable to assume the presence of intermediate zones between, for example, class C and class A waters even if no data exist to substantiate this. Therefore an appropriate buffer zone of class B may be assumed unless there is a clear hydrographic boundary which would explain a major sudden change in quality.

It may be that class A coastal waters abut a class C estuarine water. This may be a consequence of the few parameters included in one scheme but not in the other (i.e., microbiology in the coastal scheme, migratory fish in the estuary scheme). Abrupt transitions between coastal and estuarine classification are therefore considered to be inevitable and acceptable.

The following colours are used to depict classes:

Class A	Blue
Class B	Green
Class C	Orange
Class D	Red

The main provisions of the Northern Ireland Coastal Waters Classification Scheme are tabulated overleaf. For each of the four quality classes (A, B, C and D) there are criteria covering aesthetic condition, biological condition, bacteriological condition and chemical condition. Guidance notes exist to aid the application of these criteria.

A given water body is classified by allocating it to the highest class to which all of its condition criteria conform. For example, a water which is Class A on the basis of the aesthetic, biological and bacteriological condition criteria but fails one or more of the quality standards applied as a consequence of the EC Dangerous Substances Directive, would be classified as Class D overall.

Where only limited data on chemical and biological conditions are available, coastal waters will be classified according to those data together with information on, for example, known discharges, pollution complaints, etc., and additional survey work may not be required. Where no discharges occur, no pollution complaints have been substantiated and other pollution sources are absent, a stretch of coast will be assumed to fall into class A.

NI Coastal and Territorial Waters Classification Scheme

Class/Description	Aesthetic Condition	Biological Condition	Bacteriological Condition	Chemical Condition
A Excellent	Near pristine	Flora and fauna normal	Likely to meet quality standards no less stringent than the guideline standards for coliforms and faecal streptococci in the EC Bathing Water Directive or the guideline standards of the EC Shellfish Waters Directive in Designated Shellfish Waters.	Likely to meet all quality standards applied as a consequence of the EC Dangerous Substances Directive and the guideline standards of the EC Shellfish Waters Directive.
B Good	Unpolluted, but may show traces of contamination	Flora and fauna normal	Likely to meet quality standards no less stringent than the mandatory coliform standards of the EC Bathing Water Directive.	Likely to meet all quality standards applied as a consequence of the EC Dangerous Substances Directive and the mandatory standards of the EC Shellfish Waters Directive.
C Unsatisfactory	Occasional observations or substantiated complaints of sewage solids, smell, nuisance or oil	Flora and/or fauna modified by effluent discharges	Likely to occasionally fail to meet quality standards no less stringent than the mandatory standards of the EC Bathing Water Directive.	Likely to meet all quality standards applied as a consequence of the EC Dangerous Substances Directive but fails to meet the mandatory standards of the EC Shellfish Waters Directive.
D Seriously Polluted	Frequent observations or substantiated complaints of sewage solids, smell, nuisance or oil	Flora and/or fauna impoverished or absent	Likely to frequently fail to meet quality standards no less stringent than the mandatory standards of the EC Bathing Water Directive	Likely to fail any one or more of quality standards applied as a consequence of the EC Dangerous Substances Directive.

APPENDIX 8

Parameters Measured in Estuarine and Coastal Waters

Parameters Measured in Water
Salinity
Temperature
Dissolved oxygen
pH value
Transparency
Total coliforms
Faecal coliforms
Nitrite
Total soluble nitrogen
Total oxidised nitrogen
Total soluble phosphorus
Soluble reactive phosphorus
Silicates
Ammonia
Suspended solids
Chlorophyll-a
Conductivity
Depth

Parameters Measured in Sediment
Faecal streptococci
Clostridia
Particle size analysis
Benthos
Carbon/hydrogen/nitrogen
Aluminium
Arsenic
Cadmium
Chromium
Copper
Iron
Lead
Lithium
Manganese
Mercury
Nickel
Vanadium
Zinc
Selected pesticides
Organotins

Compliance with the Bathing Water Directive 1996 - 2000

Identified Bathing Waters

Site	2000	1999	1998	1997	1996
Benone					
Castlerock					
Portstewart					
Portrush (Mill) West					
Portrush (Curran) East					
Ballycastle					
Browns Bay					
Helens Bay					
Crawfordsburn					
Ballyholme					
Groomsport					
Millisle					
Tyrella					
Newcastle					
Cranfield (Nicholson's)					
Cranfield Bay					

Non-Identified Bathing Waters

Site	2000	1999	1998	1997	1996
Downhill					
Portrush (Whiterocks)					
Cushendall					*
Cushendun					
Waterfoot					
Carnlough					
Glenarm	*	*	*	*	
Ballywalter					
Ballyhalbert					
Rossglass	*	*			
Murlough					
Kilkeel	*	*	*		*
Warrenpoint					*

Meeting Guideline standard
Meeting Mandatory standard
Failing to meet Mandatory standard
Not sampled *

APPENDIX 10

Parameters Monitored on Bathing Waters

Parameter monitored	Frequency of monitoring per year
Total coliforms	20
Faecal coliforms	20
Faecal streptococci	20
Salmonella	2
Enteroviruses	2
pH value	1
Colour	20
Mineral oils	20
Surface active substances	20
Phenols	20
Transparency	20
Tarry residues and floating materials (litter)	20
Dissolved oxygen	When required
Ammonia	When required
Kjeldahl nitrogen	When required

APPENDIX 11

Parameters Monitored on Shellfish Waters

Parameters measured	Frequency of sampling
pH value	Quarterly
Temperature	Quarterly
Coloration	Quarterly
Suspended solids	Quarterly
Salinity	Monthly
Dissolved oxygen	Monthly
Petroleum hydrocarbons	Quarterly
Organohalogenated substances	Half-yearly
Silver	Half-yearly
Arsenic	Half-yearly
Cadmium	Half-yearly
Chromium	Half-yearly
Copper	Half-yearly
Mercury	Half-yearly
Nickel	Half-yearly
Lead	Half-yearly
Zinc	Half-yearly
Faecal coliforms	Quarterly

APPENDIX 12

EC Dangerous Substances Directive

List I of families and groups of substances

List I contains certain individual substances which belong to the following families and groups of substances, selected mainly on the basis of their toxicity, persistence and capacity for bioaccumulation, with the exception of those which are biologically harmless or which are rapidly converted into substances which are biologically harmless:

1. organohalogen compounds and substances which may form such compounds in the aquatic environment;
2. organophosphorus compounds;
3. organotin compounds;
4. substances in respect of which it has been proved that they possess carcinogenic properties in or via the aquatic environment (where certain substances in List II are carcinogenic, they are included in this category);
5. mercury and its compounds;
6. cadmium and its compounds;
7. persistent mineral oils and hydrocarbons of petroleum origin;

and, for the purposes of implementing Articles 2, 8, 9 and 14 of this Directive:

8. persistent synthetic substances which may float, remain in suspension or sink, and which may interfere with any use of the waters.

List II of families and groups of substances

List II contains:

- substances belonging to the families and groups of substances in List I for which the limit values referred to in Article 6 of the Directive have not been determined,
- certain individual substances and categories of substances belonging to the families and groups of substances listed below,

  and which have a deleterious effect on the aquatic environment, which can, however, be confined to a given area and which depend on the characteristics and location of the water into which they are discharged.

Families and groups of substances referred to in the second indent:

1. The following metalloids and metals and their compounds:

Zinc	Antimony	Uranium
Copper	Molybdenum	Vanadium
Nickel	Titanium	Cobalt
Chromium	Tin	Thallium
Lead	Barium	Tellurium
Selenium	Beryllium	Silver
Arsenic	Boron	

2. Biocides and their derivatives not appearing in List I

3. Substances which have a deleterious effect on the taste and/or smell of products for human consumption derived from the aquatic environment, and compounds liable to give rise to such substances in water

4. Toxic or persistent organic compounds of silicon, and substances which may give rise to such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances.

5. Inorganic compounds of phosphorus and elemental phosphorus

6. Non-persistent mineral oils and hydrocarbons of petroleum origin

7. Cyanides, fluorides

8. Substances which have an adverse effect on the oxygen balance, particularly: ammonia, nitrites.

APPENDIX 13

Parameters Monitored in Northern Ireland Rivers under the OSPAR RID Programme

Mercury
Cadmium
Copper
Zinc
Lead
gamma-hexachlorocyclohexane (lindane)
Polychlorinated biphenyls (7 congeners monitored)
Ammoniacal nitrogen
Nitrate
Total oxidised nitrogen
Soluble reactive phosphorus
Total phosphorus
Suspended solids

Parameters Monitored and Frequency under ECN

pH value	Monthly
Suspended solids	Monthly
Temperature	Monthly
Conductivity	Monthly
Dissolved oxygen	Monthly
Ammonia (NH_4-N)	Monthly
Total nitrogen	Monthly
Nitrate (NO_3-N)	Monthly
Nitrite (NO_2-N)	Monthly
Alkalinity	Monthly
Chloride	Monthly
BOD	Monthly
Total phosphorus	Monthly
Soluble reactive phosphorus	Monthly
Silicate (SiO_2)	Monthly
Sulphate (SO_4-S)	Monthly
Sodium (dissolved)	Monthly
Potassium (dissolved)	Monthly
Calcium (dissolved)	Monthly
Magnesium (dissolved)	Monthly
Copper (dissolved)	Monthly
Zinc (dissolved)	Monthly
Cadmium (dissolved)	Monthly
Aluminium (total)	Monthly
Tin (total)	Monthly
Vanadium (total)	Monthly
Manganese (total)	Monthly
Iron (total)	Monthly
Nickel (total)	Monthly
Mercury (total)	Monthly
Chlorophyll-a	Monthly
Arsenic (total)	Monthly
Lead (total)	Monthly
Invertebrates	Three times per year
Macrophytes	Annually (summer)
Periphyton	Three times per year

APPENDIX 15

Acid Waters Sampling Points and Parameters Monitored

Monitored Water	Geographic Location	Irish Grid Reference
Coneyglen Burn	Sperrins	H641884
Beaghs Burn	Glens of Antrim	D178297
Bencrom River	Mournes	J305250
Blue Lough	Mournes	J327252

Chemical Parameters

(Rivers monthly and Blue Lough quarterly)

Flow
Temperature
pH value
Hydrogen ion
Alkalinity
Conductivity
Nitrate
Soluble aluminium
Non-labile aluminium
Labile aluminium
Dissolved organic carbon
Sodium
Potassium
Calcium
Magnesium
Silicate
Manganese
Iron
Fluoride
Chloride
Bromide
Sulphate
Excess sulphate (sulphate not attributable to sea salt inputs)
Total nitrogen

Biological Parameters

macroinvertebrates to species level (sampled each spring)
epilithic diatoms (sampled each summer)
aquatic macrophytes (sampled each summer)
trout density (electrofishing each October)

APPENDIX 16

WWTWs Failing to Comply with their Discharge Standards 1997-2000

The following WWTWs with numeric registered standards failed to comply with their standards during the years shown. Action has been requested to improve the performance in each case although in most cases major capital works will be required to achieve compliance.

1997	1998	1999	2000
Annahilt	Ballygowan	Annahilt	Annahilt
Ballygowan	Crossgar Filtration	Crossgar Filtration	Aghanloo New
Ballykinler	Greyabbey	Kilkeel	Ardglass
Ballynahinch	Kilkeel	Moneyreagh	Ballygowan
Crossgar Aeration	Antrim	Antrim	Crossgar Filtration
Crossgar Filtration	Ballymena Filtration	Cookstown	Kilkeel
Drumaness	Castledawson	Magherafelt	Kircubbin
Hillsborough	Cookstown	Tullaghgarley	Moneyreagh
Kilkeel	Kilrea	Ballynacor	Ballyclare
Kircubbin	Macosquin	Banbridge	Ballymena Filtration
New Holland	Magherafelt	Bessbrook	Cookstown
Antrim	Moneymore	Dromore	Kilrea
Ballymena Filtration	Stewartstown	Lawrencetown	Magherafelt
Cookstown	Tullaghgarley	Tandragee	Antrim
Magherfelt	Banbridge	Clogher	Stewartstown
Moneymore	Bessbrook	Greysteel	Tullaghgarley
Stewartstown	Castlewellan	Kesh	Ballynacor
Tullaghgarley	Crossmaglen	Lisnaskea	Banbridge
Armagh	Ballinamallard	Omagh	Bessbrook
Banbridge	Greysteel	Seagate/Aghanloo	Blackwatertown
Bessbrook	Lisnaskea		Dromore
Donaghmore	Omagh		Maghaberry
Gilford			Moira
Markethill			Moygashel
Rathfriland			Mullaghbawn
Tandragee			Rathfriland
Ballinamallard			Tandragee
Castlederg			Clogher
Clogher			Lisnaskea
Irvinestown			Omagh
Kesh			Strabane
Lisbellaw			
Lisnaskea			
Newtownstewart			
Omagh			
Strabane			

APPENDIX 17

UWWT Directive Standards for WWTWs

Standards for WWTWs with PE greater than 10,000 Discharging to Sensitive Areas

Parameter	95 Percentile Limit	Annual Average Limit	Upper Tier Limit	Percentage Reduction
BOD	25 mg/l O_2		50 mg/l O_2	70%
COD	125 mg/l O_2		250 mg/l O_2	75%
Total Phosphorus		2 mg/l P		80%

APPENDIX 18

Degrees of Severity of Pollution Incidents

High

A major incident involving one or more of the following:

a. potential or actual persistent effect on water quality or aquatic life;
b. closure of potable water, industrial or agricultural abstraction if necessary;
c. extensive fish kill;
d. excessive breaches of consent conditions;
e. need for extensive remedial measures;
f. major effect on amenity value.

Medium

A significant pollution incident involving one or more of the following:

a. notification to abstractors necessary;
b. significant fish kill;
c. measurable effect on invertebrate life;
d. water unfit for stock;
e. bed of waterway contaminated;
f. amenity value to the public, owners or users reduced by odour or appearance.

Low

A minor incident resulting in localised environmental impact only. Some of the following may apply:

a. notification of abstractors not necessary;
b. fish kill of fewer than 10 fish (species of no particular importance to the affected water);
c. no readily observable effect on invertebrate life;
d. water unfit for stock watering;
e. bed of waterway only locally contaminated;
f. minimal environmental impact and amenity only marginally affected.

Unsubstantiated

A reported pollution incident which, on investigation, proves to be unsubstantiated, i.e., no evidence can be found of a pollution incident having occurred.

APPENDIX 19

Enforcement and Prosecution Policy for Environmental Protection

1. Introduction and Scope

1.1 The aims of the Environment and Heritage Service (EHS) are to protect and conserve the natural and built environment and to promote its appreciation for the benefit of present and future generations. Within EHS, the Environmental Protection Directorate has regulatory responsibilities for pollution control, control of the use and disposal of radioactive substances and waste management.

1.2 The regulatory functions of the Environmental Protection Directorate aim to protect the environment by consistent and fair application of the legislation we enforce. We will work co-operatively with those we regulate in order to secure improved performance, and will offer information and advice where appropriate. We acknowledge, however, that enforcement action also needs to be taken to ensure compliance with legislative requirements.

1.3 This Policy sets out the general principles which the Environmental Protection Directorate intends to follow in relation to enforcement and prosecution. It is to be used in conjunction with more detailed specific guidance for staff in respect of each regulatory function. The implementation and effectiveness of the Policy will be monitored by the Director of Environmental Protection.

2. Principles governing decisions on enforcement action

In taking enforcement action we intend to be:

- Consistent
- Proportionate
- Transparent

2.1 **Consistency:** We aim to be consistent in the advice we provide, in our response to pollution and other incidents, in the use of our enforcement powers and in taking decisions on whether to prosecute. Any decision regarding enforcement action will be impartial and will not be influenced by any view with regard to the race, politics, gender, sexual orientation or religious beliefs of any offender, complainant or witness.

2.2 **Proportionality:** Enforcement action taken will be proportionate to the risks posed to the environment and to the seriousness of the breach of the law.

2.3 **Transparency:** We need to be transparent in our regulatory activities so that the public can be confident that we will be effective in protecting the environment and so that those we regulate know what is expected of them.

In dealing with those we regulate we will:

- provide an opportunity, where appropriate, to discuss what is required to comply with the law before formal enforcement action is taken; (This would not be appropriate if urgent action is required to protect the environment or to prevent evidence being destroyed, or, in some cases, where there are serious or repeated breaches – see section 4.)
- confirm in writing where remedial action is found to be necessary; (In cases where urgent action is required, confirmation and explanation will be issued as soon as practicable after the event.)
- provide written confirmation of any rights of appeal against formal enforcement action at the time the action is taken.

3. Methods of enforcement

A range of enforcement tools is available to our regulatory staff, including warning letters, enforcement and prohibition notices and prosecution. The choice of enforcement action taken will depend on the individual case, but we

acknowledge that there will be circumstances where immediate prosecution will be appropriate.

4. Prosecution

4.1 Prosecution is an important part of any enforcement system. Prosecution acts as a punishment, as a deterrent to others and as a means of avoiding a recurrence.

4.2 We recognise that the initiation of a prosecution is a serious matter and should only be taken after appropriate consideration of the implications and consequences.

4.3 **Sufficiency of evidence:** A prosecution will not be commenced or continued unless we are satisfied that there is sufficient, admissible and reliable evidence that the offence has been committed and that there is a realistic prospect of conviction. If the case does not pass this evidential test, it will not go ahead. (Where cases are brought by the Director of Public Prosecutions, he/she will make the final decision about whether a case will be brought to court.)

4.4 **Public interest:** In deciding whether to prosecute, we will consider the following factors:

- the effect of the offence on the environment;
- whether the offence was foreseeable;
- the intent of the offender;
- the history of the offender.

Other factors may be considered on a case by case basis where appropriate. These may include:

- the attitude of the offender;
- the deterrent effect of prosecution on the offender and others;
- the personal circumstances of the offender.

4.5 If there is sufficient evidence, we will normally initiate prosecution under circumstances where one or more of the following occur:

- incidents or breaches have significant consequences for the environment;
- someone knowingly carries out activities without a relevant licence;
- someone fails to comply with formal remedial requirements, such as enforcement and prohibition notices;
- there are excessive or persistent breaches of regulatory requirements;
- there is reckless disregard for management or quality standards;
- someone fails to supply information when legally required without reasonable excuse or knowingly or recklessly supplies false or misleading information;
- our staff or authorised officers are obstructed in carrying out their duties.

4.6 Criminal proceedings will be taken against those persons responsible for the offence. Where a Company is involved, it will be usual practice to prosecute the Company where the offence resulted from the Company's activities. However, it may be necessary to consider any part played in the offence by the officers of the Company, including Directors, Managers and the Company Secretary. Action may also be taken against such officers (as well as the Company) where it can be shown that the offence was committed with their consent, was due to their neglect or that they 'turned a blind eye' to the offence or the circumstances leading to it.

4.7 Where our regulatory staff and another enforcement body both have the power to prosecute, we will liaise with that other body to ensure effective co-ordination, to avoid inconsistencies, and to ensure that any proceedings initiated are for the most appropriate offence.

APPENDIX 20

Joint EA/SEPA/EHS Pollution Prevention Guidelines (PPG)

PPG1	General guide to the pollution of controlled waters
PPG2	Above ground oil storage tanks
PPG3	The use and design of oil separators in surface water drainage systems
PPG4	Disposal of sewage where no mains drainage is available
PPG5	Works in, near, or liable to affect, waterways
PPG6	Working at demolition and construction sites
PPG7	Fuelling stations: construction and operation
PPG8	Safe storage and disposal of used oils
PPG10	Highway depots
PPG11	Industrial sites
PPG13	The use of high pressure water and steam cleaners
PPG14	Boats and marinas
PPG15	Retail premises
PPG16	Schools and other educational establishments
PPG17	Dairies and other milk handling operations
PPG18	Managing firewater and major spillages
PPG19	Garages and vehicle service centres
PPG20	Dewatering underground ducts and chambers
PPG21	Pollution incident response planning
PPG22	Spillages on highways
PPG23	Maintenance of structures over water
PPG24	Stables, kennels and catteries
PPG25	Hospitals and health care establishments
PPG26	Storage and handling of drums and intermediate bulk containers
PPG27	Techniques for the installation, decommissioning and removal of underground storage tanks

Additional Advisory Documents

In addition to the PPGs, there are also a number of advisory leaflets and posters relating to oil handling, timber treatment plants, sustainable urban drainage systems and general pollution prevention.

GLOSSARY

algae: Simple plants, usually aquatic. May be unicellular or consist of single cells joined end to end.

ammonia: A water soluble chemical compound, produced by the decomposition of organic material, which is used widely to characterise water quality. Ammonia affects the quality of fisheries and the suitability of abstractions for potable water supply.

average score per taxon (ASPT): A summary statistic to describe the results of monitoring rivers for the presence of benthic macro-invertebrates. The score refers to the BMWP Score.

benthic: Pertaining to the bed of a river or other body of water.

biochemical oxygen demand (BOD): A measure of the amount of oxygen consumed in water (over five days, in the dark), usually by the decomposition of organic material. Used to grade water quality.

biodegradable: Capable of being decomposed by bacteria or other living organisms.

biotic score: See BMWP Score.

BMWP Score: BMWP is an abbreviation for Biological Monitoring Working Party. Some invertebrates are more susceptible than others to pollution, and the presence of such sensitive species is a sign that water quality is good. This fact was taken into account by the BMWP when it established a method of summarising biological information in the form of a simple index. This became known as the BMWP Score. It assigns points to each taxon according to its sensitivity to pollution. For example, many mayfly nymphs and caddis larvae score ten points, water beetles score five, molluscs three, and worms one. The BMWP Score for a site is the sum of all the scores of all the taxa found.

catchment: The area of land that drains to a particular watercourse.

consented discharge: An effluent discharge which is subject to conditions laid down in a Consent (permission to discharge) issued under the terms of the Water (Northern Ireland) Order 1999.

cyprinid fisheries: Waters in which coarse fish (i.e., fish belonging to the cyprinids, or other species such as pike, perch and eel) are found.

determinand: Literally ‘that which is to be determined’. A general term for any numerical property of a sample (e.g., the concentration of ammonia or copper) whose value is required.

diffuse pollution: Pollution which does not arise from an easily identifiable source (such as an effluent discharge pipe). Usually refers to leaching from land. See also point source pollution.

dissolved oxygen (DO): The amount of oxygen dissolved in water. Oxygen is vital for aquatic life, so this measurement is a test of the health of a river. Used to grade water quality.

ecological quality index (EQI): A summary of the ecological health of a river usually expressed as a simple numeric score.

ecosystem: A biological community of interacting organisms and their physical environment.

environmental quality objective (EQO): The quality required to enable water to be used for a specific purpose (such as for salmonid fisheries or for the abstraction of drinking water).

environmental quality standard (EQS): The maximum and/or minimum permitted concentration of a determinand in water which will enable the water to achieve a particular environmental quality objective.

eutrophication: The EC Urban Waste Water Treatment Directive defines eutrophication as 'the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned.'

fauna: The animals found in a particular physical environment.

flora: The plants found in a particular physical environment.

INTERREG: A European Union funding initiative.

invertebrates: Animals which lack a vertebral column. A combination of many groups of animals used for biological grading, including insects, crustaceans, worms and molluscs.

macro-invertebrates: Invertebrate animals of sufficient size to be easily visible to the unaided eye and to be retained in a net with a specified mesh (1 millimetre).

macrophytes: Plants easily visible to the unaided eye.

mode (modal value): The value that occurs most frequently in a given set of data.

nutrient: A substance which provides nourishment for living organisms.

organic pollution: A general term used to describe the type of pollution which, through the action of bacteria, consumes the dissolved oxygen in rivers. It applies to the effects of sewage, treated sewage effluents, farm wastes and the waste from many types of industry like dairies, breweries and abattoirs. The effects of organic pollution are described by the concentrations of biochemical oxygen demand, ammonia and dissolved oxygen.

percentile standard: A level of water quality, usually a concentration, which must be achieved for a certain percentage of the time. In the Chemical General Quality Assessment scheme, class limiting percentile standards are specified for BOD, ammonia and dissolved oxygen. In the cases of BOD and ammonia where the lower the concentrations the better the quality class, 90-percentile standards are specified, i.e., to achieve the quality class, the concentrations must be lower than the specified standards for at least 90 per cent of the time. In the case of dissolved oxygen where the lower the value the worse the quality class, 10-percentile standards are specified, i.e., to achieve the quality class, the value must not fall below the specified standards for more than 10 per cent of the time.

phosphorus removal: A tertiary treatment process designed to remove phosphorus from industrial and sewage effluent.

point source pollution: Pollution which arises from an easily identifiable source, usually an effluent discharge pipe. See also diffuse pollution.

population equivalent (PE): Many waste water treatment works treat both domestic sewage and industrial effluent. Depending on the quantity and quality of the effluent which it discharges to public sewer, an industry produces an effluent loading comparable to that produced by a certain number of people. For example, if a dairy produces an effluent loading equivalent to that arising from 5,000 people, the dairy is said to have a population equivalent of 5,000. If a waste water treatment works serves a population of 10,000 and also treats the effluent from an industry with a population equivalent of 5,000, the works is said to cater for a population equivalent of 15,000.

RIVPACS: An acronym for the River Invertebrate Prediction and Classification System, a mathematical model used to predict the invertebrate life in a river under conditions of natural water quality. RIVPACS is used to calculate the Ecological Quality Indices.

salmonid fisheries: Waters in which game fish (such as salmon, trout, grayling and whitefish) are found.

taxon (plural taxa): A term for a sub-unit of the taxonomic classification system applied to living organisms. Organisms may be grouped together in, for example, classes, families, genera and species. Any of these groupings may be called a taxon.

Water Order Consent (formerly Water Act Consent): A permit to discharge effluent issued under the terms of the Water (Northern Ireland) Order 1999. A Consent usually lays down conditions relating to the quality and quantity of the effluent to be discharged.

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