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NATIONAL RIVERS AUTHORITY/

PO RIVER BASIN AUTHORITY

COLLABORATION PROGRAMME 'IMPROVED MONITORING SYSTEMS FOR RIVER WATER QUALITY'

COMPARISON OF EXPERIENCES

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SUMMARY

The purpose of this paper is to compare and contrast the river monitoring strategies adopted by the Po River Authority in Italy and the National Rivers Authority (NRA) in England and Wales.

Legislative and administrative aspects of water management

National legislation relating to river monitoring has been adopted in both Italy and England/Wales. In Italy the Law 10 Maggio 1976, Nº 319 provides a framework for water quality control in the country and assigns responsibility for river monitoring to the Regional Administrations. Subsequent enabling legislation (Decree 4/2/77) set out a number of specific requirements for river monitoring. Law 24/12/79 Nº 650 provides some amendments and improvements to Law 319/76. In Italy, Law 183/89, promulgated for the purpose of soil conservation and water resources management, provides guidelines for all the water policies, including environmental protection, and identifies the River Authority as the main body responsible for planning and co-ordination in the field of water resources management on protection. More recently, Law 36/94 provides specific criteria for water resources management and underlines the needs of control and monitoring activity. Conversely, in England and Wales the Water Resources Act 1991 defines only roles and responsibilities, specifically those relating to the NRA, for undertaking river monitoring but not prescriptive technical requirements.

Water management in Italy has traditionally been organised on the basis of administrative rather than geographical boundaries. Each Regional Environment Office is responsible for preparing a river monitoring strategy. However, implementation of these strategies is delegated to the Health Authorities of Provinces. In England and Wales water management is based on catchments, with both planning and implementation being undertaken by the NRA. Italy is now in the process of introducing a number of River Catchment Authorities. It is intended that these new bodies will assume many of the planning, but not operational, responsibilities relating to water management currently undertaken by Regional Administrations.

The political and water management structures in Italy are intrinsically linked. In England and Wales the split between the two structures is clearly defined. Only at the highest levels of policy development is there significant interaction between them. At an operational level, the NRA carries out river monitoring with virtually no political involvement.

The pollution problems that manifest themselves in Italy and England/Wales are broadly similar. These problems mainly relate to industrial effluents, inadequately treated sewage and agricultural runoff (i.e. pesticides and nutrients).

Both countries apply biological monitoring techniques to support the chemical monitoring of river waters. The preparation of a national biological classification scheme is nearing completion in England and Wales: Italy has yet to achieve this degree of progress with biological classification, with far less co-ordination of approach.

The design of monitoring programmes

The NRA is undertaking a fundamental review of its river monitoring activities. This has resulted in the preparation of two reports outlining the NRA's strategy on the design of national and permissive monitoring programmes, respectively. These reports aim to promote the harmonisation and rationalisation of all the NRA's monitoring activities with the goal of efficiently targeting limited resources and promoting the comparability of data. It is intended that the new River Authorities in Italy will implement a similar policy. More specifically, the Po River Authority has made significant progress in undertaking a comprehensive cost analysis of the water quality monitoring activities in the Po River Basin.

1. BACKGROUND

The purpose of this paper is to review the Surface Water Monitoring Strategies adopted by the National Rivers Authority (NRA) and the Po River Authority (PoRA). The paper will be based largely on the two reports: 'Po River Catchment Monitoring Activity' and the NRA's 'Programme for the Monitoring of Water Quality' which are already available. It will also include any key messages which have emerged from the questionnaire surveys on best practice.

This paper will cover the following aspects of monitoring:

- chemical;
- flow measurement;
- continuous monitoring;
- field instrumentation;
- biology (macro-invertebrates);
- microbiology.

The Paper will examine the legal framework in which river monitoring is undertaken in the two countries, the various requirements for monitoring data, the extent of the existing monitoring effort and the means by which these monitoring programmes are designed and evaluated.

Where possible basic comparisons have been made with the monitoring effort in France and Germany, respectively.

1.1 The Collaboration Programme

The Collaboration Programme between the NRA and PoRA addresses the common need to improve the efficiency of monitoring systems for river catchments and will result in 'best practice' being identified, evaluated and reported in the form of practical manuals for use in the two countries. The basis of the Collaboration Programme has been provided in the Definition Study Report (December 1993).

1.2 Legislative Framework for Surface Water Monitoring

The basic legal requirements for surface water monitoring are stipulated in framework legislation in both Italy and England and Wales: in the former case the Law of 10 May 1976, Nº 319, in the latter, the Water Resources Act 1991.

1.2.2 England and Wales

In England and Wales the legal framework for river monitoring is contained in the Water Resources Act 1991. Two Sections and one Schedule of the Act require the NRA to undertake river monitoring. These are outlined below:

- Schedule 10 of the Act covers the consent scheme that the NRA must apply to discharges of effluent in England and Wales. Although the Schedule does not place an explicit legal requirement on the NRA to monitor discharges to gauge compliance with consent conditions, in practice this is the approach the NRA has undertaken;

- Section 190 of the Act requires that details of any Water Quality Objectives (WQOs), designated under Section 83, must be maintained on a public register. WQOs are applied to protect certain uses of the aquatic environment and apply only to designated waters. River monitoring must be undertaken to gauge the degree of compliance with WQOs and to aid in the derivation of consent conditions for discharges in the vicinity of these designated waters. In practice most WQOs have arisen from the introduction of European Community (EC) legislation and as such will be discussed in more detail in Section 2 of this report relating to specific monitoring requirements;

- Section 84 of the Act requires the NRA 'to monitor the extent of pollution in controlled waters'. This basic requirement has been assumed to mean that the NRA must undertake river monitoring to gauge compliance with specific discharge consents and WQOs (see above) as well as carrying out general monitoring to ensure all uses and water classes are protected.

From these three basic legislative requirements the NRA has developed a comprehensive river monitoring programme.

1.2.3 Comparison

In Italy, the legislative framework for river monitoring would appear to be more prescriptive than that applied in England and Wales. Except for the implementation of EC legislation and some national EQSs, only very general requirements have been placed on the NRA with respect to river monitoring, in particular with respect to classification. This has enabled it to develop a comprehensive, practical and, to a large extent, effective, river monitoring strategy. However, in Italy a prescriptive, potentially conflicting, Regional legislation has been a contributory factor to preventing the development of an integrated approach to river monitoring, particularly in those larger catchments that extend over a several Regions.

a lesser extent, the Provinces. This local approach promotes a greater degree of electoral accountability than is possible in the UK and provides a greater degree of flexibility when approaching localised problems. However, the particular nature of the regional administrations may also lead to significant duplication of effort and may promote the development of a multitude of solutions that precludes harmonisation of approach.

1.4 Water Management Administration

1.4.1 Italy

Recently there has been a general move to rationalise the complex administrative structure for water management. Traditionally the Ministries of Public Works, Health, Agriculture, and the Interior have had the greatest influence, although in 1986 a dedicated Ministry of the Environment was formed. However, many of the main responsibilities for water management remained with the other Ministries and this, along with its relative lack of seniority in the new structure, has ensured that to date the Ministry of the Environment has had a limited impact.

To a large extent Regional administrations in Italy are responsible for drafting and introducing policy and strategic programmes for water management, with the National Government confining itself to the harmonisation of legislation among different Regions and reaching agreements on a European Community level and adopting legislation with a national significance. The Regional authorities are also responsible for the practical implementation of these measures, including undertaking surface water monitoring, although in practice this responsibility is usually delegated to the Provincial authorities. The Municipalities are responsible for local service provision, including water supply and sewerage. In general water and sewerage services are provided by several municipalities grouping together to form co-operative associations. A small proportion of the services are provided by private companies, although the Italian authorities are in the process of investigating the feasibility of more widespread privatisation of drinking water supply.

Merli Law 319/76 assigned responsibility for monitoring surface water quality to the Regional Authorities. The Public Health Services and District Health and Prevention Presidia have been assigned the task of monitoring surface water quality to ensure compliance with State and Local Legislation (mandatory monitoring) as well as that undertaken for more general water management purposes (local operational monitoring). Those responsible for sampling and analysis, specifically the Public Health Services, have to comply with the official technical guidance on these activities from the Water Research Institute (IRSA).

The processing of monitoring data is undertaken by either the Provincial or Regional Environment Departments. In the longer term it is expected that the River Authorities (see below) will assume a greater responsibility for this activity.

- organisation of the waterways police, related infrastructures and flood emergency service;
- maintenance of hydraulic works and plants;
- regulation of those areas represented by the above practices assessment of criteria for the conservation of State areas other than water bodies; protection of natural parks and reserves;
- optimisation of the Public Services in the field of water resources, on the basis of efficiency and cost;
- re-definition of the areas covered by hydro-geological constraints;
- co-ordination of prevention and warning activities carried out by the local authorities.

The River Authorities carry out no water quality monitoring; they collect and process data useful to their planning programmes; at the same time they provide scientific co-ordination to the Regions ensuring that homogeneous standards are set at a catchment scale.

Although Law 183/89 was adopted over five years ago, only the Po River Authority has made significant advances regarding the management of the aquatic environment in Italy.

The more recent Law 36/94 (known as Galli Law after the name of the Member of Parliament who proposed it), aimed at the national exploitation of available water resources, underlines the importance of proper monitoring procedures.

1.4.2 England and Wales

The present administrative structure for water management in England and Wales was adopted in 1989, with the privatisation of the service provision responsibilities of the public water authorities and the amalgamation of their regulatory and water management responsibilities to form the NRA.

The NRA is charged with protecting and improving the water environment in England and Wales and providing protection against flooding from rivers and the sea. It is a Non Departmental Public Body sponsored by the Department of the Environment. Its roles and responsibilities are detailed in the Water Resources Act 1991. For operational reasons it is broken down into eight Regions based on major river catchments. The management structure of each of the Regions is similarly based on smaller sub-catchments.

The NRA has a number of core functions, these are summarised below:

(e) **Recreation and conservation responsibilities include:**

- the conservation and enhancement of the natural beauty and amenity of inland and coastal waters and of the land associated with such waters;
- the conservation of flora and fauna which are dependent on an aquatic environment
- the use of such waters and land for recreational purposes.

(f) **Navigation responsibilities include:**

- improving and maintaining those inland waterways where the NRA is the responsible authority.

The NRA is responsible for all river monitoring undertaken in England and Wales. However, it is only responsible for consenting and monitoring certain effluent discharges. Her Majesty's Inspectorate of Pollution (HMIP) is responsible for consenting effluent discharges from the most polluting industries (for example those associated with the chemical, oil, metals and waste disposal sectors) under the system of integrated pollution control (IPC). Industries covered by IPC are required to self-monitor their discharges and submit the results to HMIP for verification. However, the NRA is expected to monitor river quality in the vicinity of these discharges.

1.4.3 Comparison

A single independent authority, the NRA, is responsible for virtually all aspects of water management in England and Wales. The management structure of the NRA is based on catchment boundaries, with little or no political involvement except at the highest levels. The NRA must operate within the confines of the policy and dictates of the Government of the day; thus its resources, powers and, perhaps more obtusely, confidence may vary from time to time. However, within these constraints there remains a high degree of confidence amongst the public, politicians and industry that the NRA is both impartial and technically proficient.

In Italy the situation is quite different, with roles and responsibilities for water management assigned on the basis of complex distribution of responsibilities among four political and administrative levels. Although Regional Administrations are largely responsible for drafting water management plans, the Provinces with their implementation duties and the Municipalities with their service duties, there is still a considerable degree of overlap of responsibilities. The problems implicit in this overlap are compounded by the roles assigned to the separate Health and Environment administrations at each level of government with respect to river monitoring. These preclude, to a certain degree, harmonisation and rationalisation of approach. The gradual introduction of River Authorities is likely to address these issues.

Average rainfall in the Po Catchment is 1070 mm $year^{-1}$, ranging from 2000 mm $year^{-1}$ in mountain areas to 700 mm $year^{-1}$ in parts of the Adriatic Coast. Approximately 80% of the Catchment's drinking water requirements are satisfied by groundwater resources.

1.6.2 England and Wales

England and Wales are characterised by a large number of short fast flowing rivers, which present only a limited threat from flooding. Average altitude and precipitation tend to decrease and population increase from North West to South East. This has resulted in concerns that certain areas of the South East of England may face a shortage of resources in the medium to long term.

Pollution problems are largely associated with industrial discharges, inadequate treatment of urban waste water and diffuse pollution from agriculture.

1.6.3 Comparison

Although the hydrology of the Po Catchment exhibits greater extremes than that of England and Wales, there is a certain degree of similarity in the pollution problems faced by both the Po River Authority and the NRA.

2. REQUIREMENTS FOR RIVER MONITORING

River monitoring may be undertaken to satisfy the following types of requirement:

- the implementation of European Community legislation:
- the implementation of International Agreements:
- the implementation of National legislation;
- classification schemes.
- to support local water management activities.

All the monitoring requirements relevant to Italy and England and Wales are summarised below.

2.1 European Community (EC) Requirements for Water Quality Monitoring

A number of European Community (EC) Decisions and Directives have been adopted that require the monitoring of rivers as a part of their implementation. These include:

- **Surface Water for Abstraction Directive** (75/440/EEC) sets minimum standards for the quality of water abstracted for potable supply. A subsequent daughter Directive (79/869/EEC) outlines the methods of measurement and the frequency of sampling and methods of analysis;
- **Dangerous Substances Directive** (76/464/EEC) sets both end-of-pipe limit values and environmental quality standards for the most polluting (List I) substances;
- **Decisions on the Exchange of Information on the Quality of Surface Freshwaters** (77/795/EEC **and 86/574/EEC**) were adopted to facilitate the exchange of data on river and lake quality between the Member States and the European Commission;
- **Freshwater Fisheries Directive** (78/659/EEC) sets environmental quality standards to be applied in designated freshwater fisheries;
- **Urban Waste Water Treatment Directive** (91/271/EEC) sets minimum standards of collection, treatment and discharge of urban waste water. The standards applied depend on the size of the discharge and sensitivity of the receiving waters;
- **Nitrate from Agricultural Sources Directive** (91/676/EEC) requires the implementation of programmes to reduce the application of nitrates to agricultural land in designated vulnerable zones (defined as land draining into waters prone to nitrate pollution).

2.1.2 England and Wales

The NRA has been designated as the competent authority for the implementation of a number of EC Directives in England and Wales. These Directives are summarised below:

- Section 104 of the Water Act (subsequently re-enacted in Section 82 of the Water Resources Act 1991) was used to implement the Surface Waters (Classification) Regulations 1989 (SI 1148/1989) in the UK. These Regulations have been used to implement the Surface Waters for Abstraction Directive (75/440/EEC) and its subsequent daughter Directive (78/869/EEC) in the UK. However, the Regulations contain certain errors which the Department of the Environment is in the process of rectifying and the NRA has yet to receive a formal request to implement the Regulations. In the interim it has been assumed that the NRA should continue to monitor all existing waters designated for abstraction for potable supply;

- No specific Regulations have been introduced via the Water Resources Act 1991 to formally implement the Freshwater Fisheries Directive (78/659/EEC) in England and Wales. However, the NRA has assumed that it should continue to monitor all the parameters listed in the Directive at the specified frequencies in all designated freshwater fisheries. Detailed guidance on the implementation of the Directive, in particular relating to the use of the derogations offered by the Directive with respect to pristine waters, will be issued in the near future. The NRA has noted that less than one third of the freshwater fisheries in England and Wales have actually been designated for the purposes of the Directive;

- Of all the EC Directives, implementation of the Dangerous Substances Directive in England and Wales has perhaps been the most problematical. Two Regulations have been used to implement the Directive. The Surface Waters (Dangerous Substances) (Classification) Regulations 1989 (SI 2286/1989) were adopted via the Water Act 1989 and were used to establish the classification system necessary for implementation of the Directive. The Regulations also defined the environmental quality standards (EQSs) for the thirteen substances that had at the time been assigned List I status. Additional Regulations - the Surface Waters (Dangerous Substances) (Classification) Regulations 1992 (SI 337/1992) - were used to implement the EQSs for four additional substances assigned List I status in 1990. The Regulations require the NRA to monitor surface waters in the vicinity of all discharges of designated dangerous substances and to carry out more general background monitoring for these substances in the aquatic environment;

- Implementation of the Decision on the Exchange of Information on the Quality of Surface Freshwaters (77/795/EEC), and a subsequent Decision (86/574/EEC) amending some of its technical requirements, has proved to be relatively straightforward. The NRA has used the existing Harmonised Monitoring Scheme to collect data for the purposes of complying with the Decision;

2.2.1 Italy

The Italian authorities have reached agreements with their Alpine neighbours covering the management of small transboundary watercourses and lakes.

Italy is also a signatory to the Barcelona Convention on the Mediterranean (including the Adriatic) which requires signatory states to undertake monitoring to assess inputs to the marine environment.

2.2.2 England and Wales

The control of marine pollution is assigned a high priority in England and Wales due to the influence of the Convention on the Marine Environment of the North East Atlantic (administered by the Paris Commission) and the North Sea Ministerial Conferences. These requirements are summarised below.

Paris Commission

The NRA is responsible for undertaking an annual monitoring programme for the Paris Commission on the pollutant load discharged from the main estuaries in England and Wales as well as any major effluent discharges direct to the marine environment. The monitoring of esturial discharges is usually achieved via the Harmonised Monitoring Scheme (see Section 2.3.2).

North Sea Conferences

Similar requirements are placed on the NRA to collect data as a part of the UK's commitments under the North Sea Conferences. An annual survey of the inputs to the North Sea from the major river systems and direct dischargers to the North Sea is undertaken. As with the Paris Commission requirements, data is primarily gathered from the Harmonised Monitoring Scheme (HMS) (see Section 2.3.2).

2.2.3 Comparison

Neither Italy or England and Wales have significant freshwater monitoring requirements arising from International Agreements. The Italian Government has reached a number of minor agreements with its Alpine neighbours on the management of small transboundary watercourses. The NRA is expected to undertake monitoring at the tidal limits of main rivers to satisfy the requirements of two major International Agreements on the protection of the marine environment.

Further inconsistency was added to the scheme as use-related standards were applied in some areas as an additional means of classification.

Adoption of the Water Act 1989 (subsequently consolidated into the Water Resources Act 1991) enabled a new approach to be adopted for the management of water resources. The use-related and classification elements were separated into two new systems: Statutory Water Quality Objectives (SWQOs) (yet to be fully implemented) incorporating the use-related elements, and a General Quality Assessment (GQA) for classification purposes.

It is intended that the GQA be implemented in a consistent manner by the eight regions of the NRA, enabling objective comparisons to be made of water quality across the country. The GQA is to consist of at least the four components listed below:

- chemical;
- biological;
- aesthetics; and
- nutrients.

The chemical component has now been finalised and the first classification of water quality in England and Wales made on its basis. Trial classifications have been made using the biological component but further work is to be done before it is finalised. The latter components are still under development.

Harmonised Monitoring Scheme (HMS)

The Harmonised Monitoring Scheme (HMS) was set up in 1974 with a twofold purpose: firstly to provide data on the total pollutant load discharged to the marine environment, and secondly to harmonise monitoring practices across the country. As was outlined above, a significant diversity of approach evolved amongst the then ten public Water Authorities with respect to their monitoring programmes for classification purposes. This diversity was duplicated in the HMS with the result that the NRA is currently reviewing the operation of the scheme, with the aim of harmonising the monitoring strategies applied at the scheme's various constituent sampling sites.

Environmental Change Network (ECN)

In 1992 the Natural Environment Research Council (NERC) co-ordinated the setting up of an Environmental Change Network (ECN) to monitor trends in environmental quality at relatively pristine sites. The NRA is undertaking a limited river monitoring programme to support the ECN.

Liguria Region

This Region has not adopted any legislation relating to river monitoring. It undertakes monitoring campaigning to investigate the quality of water for potable use and the pollution problems of River Bormida.

Lombardy Region

Lombardy has adopted its own legislation with respect to surface water monitoring. Regional Law Nº 32 of 20 March 1980 covers Water Classification and Survey Plans for Protecting Water Resources from Pollution. This Law was subsequently modified via Regional Laws Nº 58 of 26 November and Nº 62 of 27 May 1985, respectively. This Regional legislation is to a large extent based upon National legislation, i.e. Del 4/2/77.

The Regional Law outlines the monitoring procedures to be adopted and the collection and dissemination of the information gathered. The data has been used to aid in the formulation of a Regional Plan for the Protection of Water Resources based on the designation of stretches of water for particular uses.

Emilia Romagna Region

Emilia Romagna Region has adopted a Regional Law (Nº 9 of 1 February 1983) requiring the preparation of a Regional Plan for the Protection of Water Resources. The Law outlines the surface water monitoring requirements necessary to provide the data upon which the Plan is based. The Plan requires quality objectives to be set for each water body, with the attendant requirement to undertake monitoring to assess compliance with the defined objectives.

Veneto Region

This Region transposed Del 4/2/77 into Regional legislation via the Law of 7 September 1979. This Law was also used to set up a Regional Centre for the Environment with the task of promoting the harmonisation of monitoring procedures adopted by the Region's constituent Provinces. The Region's Deliberative Committee subsequently adopted a Resolution (Nº 5571 of 17 October 1986) approving a Plan for Surveying the Quality of Surface Waters.

Autonomous Province of Trento

The Autonomous Province of Trento has adopted a Collected Text covering the Protection of the Environment from Pollution. The Text was approved by Provincial Council Resolution Nº 10050 of 9 September 1988 and subsequently modified via Provincial Laws Nº 3 of 15 January 1990 and Nº 21 of 27 August 1993, respectively.

- **National and Regional Research and Development** often require specific monitoring programmes to support their implementation. For example the special monitoring programme on the incidence of blue-green algae blooms;

- **Defensive studies** would be used to collect water quality data on issues assigned a high profile by the media and public, thus enabling the NRA to react to local pressures;

- **Post pollution incidents** would be used to provide follow-up data after pollution incidents, identifying the progress made in the recovery of polluted rivers;

- **Real time water quality management** would support the development of continuous monitoring techniques, in particular for the management of specific watercourses, e.g. the River Thames;

- **Model development and validation** would support the development of new models to aid in water management.

The Guidance Note will be used to rationalise the NRA's monitoring effort at the Regional level, by ensuring that wherever possible existing statutory and classification data and/or sampling sites be used to satisfy these Regional requirements.

2.4.3 Comparison

Many water management tasks must be devolved to a relatively low level of administration if they are to be effectively implemented. However, in the case of monitoring this can lead to a considerable degree of duplication of effort and prevent the necessary harmonisation and rationalisation of approach. The NRA has recently issued guidelines to its operational Regions in an attempt to prevent these problems arising when they implement their own local monitoring programmes.

In theory in Italy, the Merli Law should allow Regional, and at a lower level Provincial, Administrations to achieve a similar harmonisation of the monitoring effort within their boundaries. However, a similar mechanism to harmonise the monitoring effort of the Regions on a national basis, that is the national water quality reclamation plan promoted by the same Merli Law is not yet in operation, and in practice it is often the case that even within the same Region or Province harmonisation and rationalisation is not achieved. It is hoped that the introduction of SINA and the Catchment Authorities will circumvent these problems.

In addition, the collection of data on the basis of administrative, rather than geographical, boundaries may not be appropriate for the support of water management activities.

3. CURRENT SCALE OF MONITORING

This Section of the Paper will address the technical aspects of the monitoring requirements outlined in Section 2. Wherever possible, the issues listed below will be addressed:

- the number of monitoring sites, sampling frequencies and number of parameters analysed;
- sampling locations;
- parameters monitored;
- sampling and analytical techniques;
- why the monitoring programme evolved in this manner (e.g. for geographical, operational or political reasons) and the extent to which factors such as public opinion influence the amount of monitoring undertaken.

However, it is important to note that in many cases an exhaustive breakdown of the individual monitoring requirements will not be possible and only global data on the overall monitoring programmes used to satisfy several different requirements will be presented.

As far as is possible, this discussion will address the current scale of monitoring relating to each of the following types of requirement:

- the implementation of EC legislation adopted in each country;
- International Agreements;
- the implementation of national legislation;
- classification schemes (including biological assessment);
- local operational monitoring.

3.1 Number of Monitoring Sites, Sampling Frequencies and Number of Parameters Analysed

3.1.1 Po River Basin

In Italy most of the monitoring activities are regulated by Laws or other administrative Acts. So-called "Statutory Monitoring" are those activities carried out to comply with the requirements of:

Almost all of the Regions of the Po Catchment established, in their RPWR, criteria for internal water classification.

Many of the stations which descend from Del 4/2/77 (which in itself doesn't cover water classification) and from the RPWR (about 90 044 sites, 60% of the total) are used for the Regional Classification.

The Regional approaches to the water quality monitoring for classification purposes vary case-by-case, since the RPWR were conceived separately in the different regions. As a result, the number of sites, frequency of sampling and the type and number of parameters analysed also vary throughout the Po Catchment.

For instance, Piedmont, Lombardy and Emily defined water quality classes related to the use of water (potable (3 classes), fishery, bathing, agricultural, industrial, recreation); while the Autonomous Province of Trento, classifies the internal waters through a balanced indicator taking into account chemical, biological and microbiological characteristics.

The Po River Authority has recently undertaken a monitoring programme to provide a preliminary classification of the water quality of the Po River. A total of 58 monitoring stations (12 on the Po, 36 on its tributaries and 10 on significant lakes) were used to provide data for this classification programme. A restricted number of significant stations were chosen because the purpose of the activity undertaken by the Authority and related to its planning and co-ordination responsibilities, is to obtain a comprehensive general classification at a catchment scale (microscale) and to check and compare the approaches to the water quality monitoring adopted by the different Regions of the Po Valley. This programme showed, that even at the important monitoring sites on the Po, significant differences in approach were apparent.

The classification scheme adopted is based on the criteria suggested by the Italian Water Research Institute (IRSA), and will be described in detail in Section 3.3.

In 1992 the first report of the Po River Authority, regarding only the Po main course, identified the following situation:

Class 1 (good)	0%	Class 3 (poor)	3%
Class 1-2	8%	Class 3-4	1%
Class 2 (fair)	58%	Class 4 (bad)	0%
Class 2-3	29%	Not Classified	1%

c. Local Monitoring

Besides the statutory monitoring, some of the Po Catchment have undertaken local activities related to particular problems, installing new stations and/or analysing parameters not included in the official lists.

The actual consistency of the local network will only be known at the end of the data collection, which is currently in progress.

available on the average distance between monitoring stations on the Po's tributaries. The Po River Authority has organised the data available on the stations of the catchment in terms of the average area of catchment per monitoring site: in England and Wales, the stations are defined and classified in terms of average river length. A simple comparison can be made in terms of the density of monitoring stations used in England and Wales for classification purposes. However, caution should exercised when making this comparison, not least because the NRA operate additional monitoring sites to satisfy other, mainly statutory, requirements. The number of classification monitoring stations in England and Wales is outlined in Table 14. By comparison, in the Po River Basin the density of all monitoring stations is approximately 46 km^2.

It is important to emphasis that the situation in the two Countries to date is different in relaton to the implementation of the EC Directives.

In fact, in the Po River Basin a significant part of the sampling stations (419, 26%) have been selected in order to carry out water monitoring for bathing purposes (Directive 76/160/EEC), implemented by Decree of the President of the Republic DPR 470/82) and are situated mainly on the banks of the lakes, on some rivers and on sea coasts (25 are situated in the section of the Adriatic Sea intersecting the Po Basin); this type of site common in the Po River Basin, does not exist in England and Wales.

On the contrary, only 89 stations have been selected in the Po basin in compliance with the EEC Directives 75/440, and 78/659 received respectively by D.P.R. 515/82 and Law Decree (D.L.) 130/92. It is important to note that that the sites in which surface water is monitored for potable use are very few with respect to the entire territory. Currently D.L. 130/92 is fully implemented only by Piemonte Region.

(In the Po delta 60 stations, designated by Veneto Region, have been identified in relation to molluscs and other fishing species culture sites. These stations can be considered to implement D.L. 131/92, which transposes EC Directive 79/923 into national legislation.

On the contrary, the implementation of directives concerning discharges of dangerous substances into surface waters, Italy is at a disadvantage with respect to other EC State Members.

In particular in England and Wales a considerable number of sampling sites have been designated in compliance with the EC directive on Dangerous Substances and with the provisions of the Paris Commission and North Sea Conference.

The above mentioned differences have repercussions on the number of stations, determinands and on the frequency of sampling and they condition the results of the comparison between the two Authorities.

A basic comparison can also be made with the number of monitoring stations used and sampling frequencies applied in France and Germany, respectively.

Agence Seine-Normandie (one of six Agences) is responsible for monitoring for classification and planning purposes over an area of 97 000 Km^2. It has 350 monitoring sites for these purposes, with a sampling frequency of approximately of 8 samples per year, although there are plans to increase this 12 samples per year in the near future.

Classification Monitoring

As previously stated many of the stations which result from Del 4/2/77 and from the RPWR (944, 60% of the total) are used also for Regional classification purposes where appropriate.

As a consequence, the criteria for the positioning of the sites vary throughout the Po Catchment.

As remarked in Section 3.1.1, the Po River Authority has undertaken a monitoring programme related to its responsibilities in planning and co-ordination of the catchment Regions.

The 58 monitoring stations of the network were chosen among the the existing sites for their particular characteristics; they are situated:

- in significant situations along the main Po river;
- at the confluence of major tributaries;
- on the Alpine Lakes.

To date it is not possible to define a standard classification for all the water courses in the Po Catchment: the strategy of PoRA aims to optimise the existing Regional networks adapting them at the Catchment scale.

PoRA defined also 34 sub-catchment areas and related sampling sites, from which it will be possible in the future to evaluate the local contribution to the total polluting load in the Po Catchment.

Local Monitoring

The stations of the local Provincial networks are chose according to the following criteria:

- Regional stations where non-statutory parameters are investigated for local purposes;
- Additional sites in which monitoring is felt to be necessary due to particular local environmental problems.

As previously stated, the actual consistency of the local network will be known only at the end of the data collection which is currently in progress.

3.2.2 England and Wales

The criteria for selecting monitoring locations for statutory (European Community legislation, National Requirements and International Agreements), classification and permissive monitoring requirements are outlined below.

0.05 $m^3 s^{-1}$ immediately above their confluence with main rivers. Sampling sites should be positioned upstream and downstream of critical effluent discharges. Critical discharges being defined in terms of:

- the river quality objective or water quality objective is not achieved, in part because of the discharge;
- the discharge is close to the boundary of two stretches in different classes and may cause the boundary to move;
- the effluent discharges upstream of, and may, adversely affect the water quality, at a point where potable water is abstracted;
- the effluent may adversely affect a Site of Significant Scientific Interest (SSSI) or a designated freshwater fishery;
- the receiving water is in the lower quarter of the Grades A-D and may be adversely affected by the discharge;
- the effluent contains significant quantities of substances listed in Annex IA of the Third North Sea Conference Declaration;
- the effluent had been the source of repeated public complaint which may have some justification;
- the combined effect of several separate discharges causes in excess of a 10% deleterious change in a significant quality parameter.

NRA Regions are expected to use these guidelines to remove any sites from the GQA that are obviously redundant. The river quality data analysis program LAPWING should then be applied to ensure whether sites in close proximity could be reduced in number.

Local Operational Monitoring

The NRA has issued guidance on the location of monitoring sites to satisfy local operational requirements.

3.2.3 Comparison

The criteria traditionally used in England/Wales and the Po Catchment for the selection of sampling locations are broadly similar. However, the NRA has recently provided guidance to rationalise the number of sampling sites currently used in England and Wales.

The lack of co-ordination of the monitoring activities in the Po Catchment has been frequently underlined by PoRA in its Acts. The 58 station PoRA network is a first attempt to establish homogeneous monitoring standards in the Po Catchment. In addition, a common databank (SIBAPO) is being established by PoRA which describes in detail the existing networks of the Po Catchment.

These parameters are considered at suitable depths, on surface level and on the bottom of the lake.

Regions, in implementing DEL 4/2/77 by means of their reclamation plans, and referring to fresh waters, increased the number of the parameters reported in Table 15. Some regions (e.g. Lombardy and Emilia), in establishing the number of the parameters, are deeply affected by the local subregional situations.

The parameters analysed in order to implement EC monitoring programmes and the receiving laws are reported in Table 15.

Parameters used for classification purposes

The classification systems, adopted by the Regions, distinguish waters according to their possible uses: the values of the parameters used for the classification are mainly those requested by the EEC Directives (75/400 and 78/659) that establish some specific limits water have to meet.

The Po River Authority's initial classification of the Po was base on a classification based on a scheme suggested by the Italian Water Research Centre (IRSA), consisting of seven parameters and four classes. This classification is summarised in Table 16.

Parameters to be adopted for local monitoring

PoRA is assessing, by means of data provided by the Regions, the statutory local monitoring. This study aims to provide data useful for the research which will be carried out at the end of stage 2.

Among the parameters commonly investigated there are: EBI (Extended Biotic Index) and some families of pesticides and herbicides. These are taken into consideration in agricultural and industrial areas, whereas they appear in great concentrations, while in the lakes the parameters commonly investigated are phytoplankton and zooplankton.

3.3.2 England and Wales

The parameters analysed during the implementation of monitoring programmes in England and Wales are largely dependent on the dictates of European Community legislation and other International Agreements. The UK has also set statutory monitoring requirements for certain other parameters. Only three core parameters have been selected for use in the new GQA classification scheme.

Statutory Requirements

The NRA is required to monitor a large number of parameters, although many of these need only be monitored at the tidal limits of a small number of estuaries. For the purposes of brevity, these requirements have been summarised in Table 17.

The policy on the selection of parameters for monitoring purposes in Germany is similar to that adopted in the UK, i.e. a core of basic parameters that are monitored at a large number of monitoring sites in conjunction with the monitoring of a large number of parameters at a very small number of monitoring sites, mainly those associated with the collection of data on inputs to the marine environment. France appears to monitor a similar range of parameters as Italy, i.e. a small core of parameters that are monitored extensively and a slightly larger number of dangerous substances that are monitored at fewer sites.

3.4 Sampling and Analytical Techniques

3.4.1 Italy

As has been outlined above, a considerable degree of diversity has arisen in the approaches adopted in Italy with respect to number of monitoring sites, sampling frequencies and the parameters monitored. This diversity also manifests itself in the sampling and analytical techniques applied by the Provincial Health Authorities, despite the guidance provided by IRSA and the Institute of Health.

Despite this diversity most Provincial Health Authorities in the Po Catchment reported using at least some of the following techniques:

1. **Sampling equipment** (Del 4/2/77 recommends that samples should be taken from mid-stream at a depth of approximately 15 cm):
   - sampler (with telescopic arm);
   - portable refrigerator;
   - two thermometers (one for water temperature, one for air temperature);
   - pH meter;
   - glass or polythene containers for samples;
   - sterilised glass containers for microbiological samples; and
   - dark glass containers for dissolved oxygen samples.
2. **Analytical equipment**
   - pH meter;
   - conductometer;
   - spectrophotometer;
   - gas chromatography;

- **environmental variables** were recorded for each site. These included measurements at the sampling site, i.e. channel width, water depth and substrate composition and data derived from maps or other sources, i.e. alkalinity, latitude and longitude, altitude, distance from source, slope, discharge information and temperature;

- **sample sorting** was based on either live or preserved samples (with 4% formaldehyde or 10% alcohol). Samples were washed through a 0.5 mm sieve to remove silt. Large stones and debris were discarded after inspection for attached organisms. Samples were sorted in white trays, sub-sampling was allowed when large amounts of organic material were present. Representatives of each taxa were removed for counting and the abundance of each recorded on a logarithmic scale;

- **identification of organisms** was based on the Biological Monitoring Working Party (BMWP) score system;

- **auditing** was undertaken to check the accuracy of the scheme by sending random samples to a reference laboratory.

Other components of the GQA covering nutrients and aesthetics are also under development.

Analytical Quality Control (AQC)

The NRA's specifies the approach to Analytical Quality Control in England and Wales for water quality monitoring purposes.

Laboratories must carry out the following procedures in sequence and obtain satisfactory results before any analytical system is used for routine analysis:

(a) Select an analytical system capable of producing results of the required accuracy for the determinand in question (see below). The analytical method must describe unambiguously and in sufficient detail, the full analytical procedure.

(b) Estimate the within-laboratory total standard deviation of individual results for a range of sample types or matrices and concentrations representative of the samples and sample types of interest.

(c) Estimate spiking recovery achieved using the chosen analytical system for the sample matrix or matrices of interest.

(d) Establish a fully documented, routine AQC system based on quality control charts, as a continuing check on analytical performance when the system is in routine use. Any problems indicated by the routine control system must be investigated immediately and remedial action taken.

4. CURRENT APPROACHES TO DESIGN, IMPLEMENTATION AND INTERPRETATION

The requirements for monitoring data are many. In the past monitoring programmes to satisfy these requirements were usually designed, implemented and interpreted in isolation. This has resulted in considerable duplication of effort whilst precluding the collection of data comparable on a national basis. Both the Po River Authority and the NRA are in the process of addressing these shortcomings.

4.1 Italy

Traditionally in Italy the design of monitoring programmes has been undertaken by the Environment Authorities of the Regional Administrations. Subsequent implementation of these programmes was then usually delegated to the Health Authorities of each Region's constituent Provincial Administrations. As has been outlined earlier in this Paper, this has sometimes prevented the comparability of data on a national level.

This problem is being addressed by transferring many of the responsibilities for planning and designing monitoring programmes to the new River Authorities. Implementation of the monitoring programmes would remain the responsibility of Regional Administration, although in line with existing practice this role will usually be delegated to the level of Provincial Administration. It is intended that this will promote the harmonisation and rationalisation of monitoring programmes on a Catchment basis.

4.2 England/Wales

In England and Wales, the NRA is currently re-assessing the design and implementation of its monitoring activities with the aims outlined below:

- to clarify the differentiation between monitoring undertaken to satisfy statutory, classification and permissive requirements, respectively;
- to rationalise the monitoring effort by using single sites to satisfy as many different requirements as possible;
- to harmonise monitoring procedures to obtain more consistent and comparable data;
- to expand monitoring beyond the traditional chemical component to take in biological, nutrient and aesthetic monitoring.

All this must be achieved without any expansion of the current NRA budget for monitoring.

To aid in achieving these goals the NRA has published two guidance documents to be used by its operational Regions in implementing monitoring programmes. These documents cover National and Permissive monitoring, respectively.

- **post pollution incidents.** These are also usually associated with point sources and should be planned in a manner similar to that outlined for discharge assessment

- **'Real time' (continuous) water quality monitoring.** This should be applied only in areas where it is of operational use and for determinands capable of being measured in this manner;

- **model development and validation.** Monitoring should be restricted to those parameters covered by the model. Data collection should be restricted to the minimum amount needed to validate the model.

The recurring theme of the guidance for all permissive monitoring is to minimise the need for chemical monitoring by utilising existing monitoring sites, in particular those associated with the GQA. In addition, wherever possible biological monitoring should be used to minimise chemical monitoring.

4.3 Comparison

Both the Po River Authority and the National Rivers Authority recognise the need to rationalise their monitoring activities by improving the design and implementation of monitoring programmes. The NRA is relatively well advanced in this process but the Po River Authority has a significant way to go in achieving the necessary rationalisation.

5. STAFFING, FACILITIES AND EQUIPMENT

5.1 Po River Basin Authority

5.1.1 Staff

Staff employed for river flow management

Staff of the Regions and the Autonomous Province of Trento are required to control, process and register water quality and quantity data and to manage future monitoring activities. The Provinces of Lombardia and Emilia Romagna have been given the task by the Regions to survey flow measurements and to co-ordinate monitoring activity. Staff carriy out flow measurements and in some cases this is subcontracted to outside organisations. The Po Magistracy is concerned with flood control and defence and water courses are automatically monitored and controlled. The Hydrographic Service undertakes flow surveys.

Staff employed for water quality management

Public Health Services (SIP) and District Health and Prevention Presidia (PMP) carry out controls and direct actions on the territory; as regards water monitoring activity SIP staff carries out periodical sampling, while PMP staff undertake the analysis of the samples.

5.1.2 Equipment

Flow measurements are commonly undertaken by current meters with water quality sampling being predominantly by hand. Authorities making use of permanent equipment for flow measurements are the Po Magistracy, irrigation consortia Adda, Oglio and Ticino River Consortia and principally the Hydrographic Service. Among the Regions only Piemonte and the Autonomous Province of Trento make use of permanent automatic equipment for water quality and quantity measurements.

Permanent flow measurement stations

The Po Magistracy monitoring network is composed only of permanent stations:

- **22 stations,** placed along the main course of River Po and close to some Alpine and Apennine river confluences. The equipment comprises 18 stations equipped with floating sensors, 3 with ultrasound sensors and 1 with a pressure sensor.
- **20 stations,** placed along the main Alpine and Apennine tributaries at important locations in the upland basins. The equipment is provided with an ultrasonic system to avoid the utilisation of mechanical equipment in contact with water.

Total staff (FTE) in NRA	7420
of which	
Water quality	1176
Water Resources	762
Flood Defence	2912
Fisheries, conservation, navigation and recreation	690
Laboratories	397

5.2.2 Expenditure

The planned expenditure for 1995/96 for water quality is £86 387 000. This is funded through Grant in Aid and from NRA's income fro Charging for Discharges, IPC, Waste Site Licensing and recovery of costs associated with pollution incidents. The expected income for 1995/96 is £46 311 000.

5.2.3 Monitoring

NRA spends around £40 M annually on water quality monitoring and undertakes around 5.1 million analyses per year.

Table 1. continued

No.	BASIN	A: Catchment Area (Km²) (*)	A: Equivalent Inhabitants (**) ('1000)	A: Industrial Load (**) ('1000)	A: %	A: Farming (**) ('1000)	A: %	B: Main Course	B: Length of the main course (Km)	B: Average Outlet Flow rate (***) (m³/s)	C: Water Quality stations Related to (+): L. 319/76	C: EEC 76/160 (DPR 470/82)	C: EEC 78/659 (DPR 515/82)	C: EEC 75/440 (DL 130/92)	C: Water use (DL 155/93)	D: Bodies Interested (++): CEE	D: SIIA (Min. of the Environment)	D: PORA	D: Reg	D: Prov ++++	E: Hydrometric Stations (+++): Reg	E: Prov	E: MAGISPO	E: SIMN	Of which for flood warning emergency
16	OLTREPO PAVESE	1374	1421	444	31%	774	54%				16	0	0	0	0	0	1	0	13	3	3	8	1	0	1
17	TREBBIA - NURE - CHIAVENNA - ARDA	2276	1647	217	13%	1259	76%				29	0	2	0	0	0	4	3	21	12	25	6	2	5	2
18	TARO	2024	1873	373	20%	1355	72%	TARO	125	33	16	0	0	0	0	0	3	1	13	3	0	16	5	4	5
19	PARMA	812	1695	603	30%	876	68%	PARMA	100	11	23	0	0	0	0	0	1	1	18	5	0	24	1	6	2
20	ENZA - CROSTOLO	1487	2765	722	26%	1626	69%				14	0	2	0	0	0	2	2	16	0	14	0	2	2	2
21	SECCHIA	2088	3569	683	19%	2690	73%	SECCHIA	172	23	14	0	4	0	0	0	3	1	16	1	10	3	2	2	2
22	PANARO	1783	3714	847	23%	2432	65%	PANARO	148	20	11	0	2	0	0	0	2	1	13	0	10	0	2	4	2
23	BURANA - PO DI VOLANO	2884	2710	860	32%	1505	56%				32	0	0	0	0	0	2	0	31	1	2	30	0	0	0
24	DELTA DEL PO	405	267	79	30%	161	60%	PO	-		16	0	4	0	60	0	0	0	80	0	2	0	3	8	3
	TOTALE BACINO	*71,894*	*102,077*	*32,241*	*32%*	*51,400*	*50%*	*PO*	*652*	*1,580*	*1,033*	*419*	*28*	*55*	*60*	*6*	*100*	*58*	*1,483*	*84*	*145*	*359*	*57*	*108*	*61*

(*) SURFACE ASSESSMENT (NOT STILL CONFIRMED)
(**) EVALUATIONS ASSESSED ACCORDING TO PO MASTER PLAN DATA
(***) GENERAL EVALUATIONS

(+) SOME STATIONS HAVE VARIOUS PURPOSES
(++) CEE, SIIA AND PORA DO NOT CONTROL DIRECTLY THE NETWORK, THEREFORE THE REAL QUANTITY IS CALCULATED BY THE SUM OF REGIONS AND PROVINCES
(+++) SOME OF THESE CORRESPOND TO THOSE ONES REQUIRED BY L. 319/76, OTHERS ARE USED FOR HYDROLOGICAL PURPOSES
(++++) THE TOTAL NUMBER OF LOCAL STATIONS WILL BE AVAILABLE AT THE END OF THE ACTIVITIES OF STAGE 2 (SEE QUESTIONNAIRES)

Table 3. Number of sites and samples used in the Po Catchment river to implement the surface water directive (75/440/EEC) in 1991 (39 determinands per sample analysed)

PoRA sub-basin per year		Number of sites		Number of samples (assuming 12 samples per site)
01	"ASTA PO"	4		48
02	SARCA - MINCIO	9		111
03	OGLIO	0		0
04	ADDA	0		0
05	LAMBRO - OLONA	0		0
06	TICINO (IT)	0		0
07	TERDOPPIO - AGOGNA	0		0
08	SESIA	0		0
09	DORA BALTEA	0		0
10	ORCO - MALONE - STURA DI LANZO	0		0
11	DORA RIPARIA	0		0
12	PELLICE - CHISOLA	0		0
13	ALTO PO - VARAITA - MAIRA	0		0
14	TANARO	1		12
15	SCRIVIA-CURONE	0		0
16	OLTREPO PAVESE	0		0
17	TREBBIA - NURE - CHIAVENNA - ARDA	2		24
18	TARO	0		0
19	PARMA	0		0
20	ENZA - CROSTOLO	2		24
21	SECCHIA	4		48
22	PANARO	2		24
23	BURANA - PO DI VOLANO	0		0
24	DELTA DEL PO	4		48
	TOTAL	28		339

Table 5. Number of sites and samples used to implement the Bathing Water Directive (76/160/EEC) in Po River in 1993 (12 determinands per sample analysed)****

PoRA sub-basin per year		Number of sites		Number of samples (assuming 12 samples per site)
01	"ASTA PO"	1		12
02	SARCA - MINCIO	122		1464
03	OGLIO	48		576
04	ADDA	73		876
05	LAMBRO - OLONA	19		228
06	TICINO (IT)	132		1584
07	TERDOPPIO - AGOGNA	0		0
08	SESIA	5		60
09	DORA BALTEA	14		168
10	ORCO - MALONE - STURA DI LANZO	1		12
11	DORA RIPARIA	4		48
12	PELLICE - CHISOLA	0		0
13	ALTO PO - VARAITA - MAIRA	0		0
14	TANARO	0		0
15	SCRIVIA-CURONE	0		0
16	OLTREPO PAVESE	0		0
17	TREBBIA - NURE - CHIAVENNA - ARDA	0		0
18	TARO	0		0
19	PARMA	0		0
20	ENZA - CROSTOLO	0		0
21	SECCHIA	0		0
22	PANARO	0		0
23	BURANA - PO DI VOLANO	0		0
24	DELTA DEL PO	0		0
	TOTAL	419		5028

**** Sampling tobe carried out every two weeks from may to october on rivers and lakes known as bathing waters

Table 8. Number of Sites and Samples used in England and Wales to Implement the Surface Water Directive (75/440/EEC) in 1991 (21 determinands analysed in each sample)

NRA Region	Number of sites	Number of samples (assuming 4 samples per site per year)
Anglian	36	144
Northumbria/Yorkshire	84	336
North West	90	360
Severn Trent	32	128
Southern	22	88
South Western	88	352
Thames	33	132
Welsh	127	508
TOTAL	512	2048

Table 11. Number of Sites and Samples used to Implement the Dangerous Substances Directive in England and Wales in 1992 - National Network Monitoring and List II Monitoring (variable number of determinands analysed in each sample)

Region	National Network		List II Monitoring	
	Number of sites	Sampling frequency*	Number of sites	Sampling frequency**
Anglian	13	52	82	984
Northumbria/Yorkshire	24	96	338	3 108
North West	6	24	40	480
Severn Trent	11	44	420	5 040
Southern	7	28	52	624
South Western	35	140	178	2 136
Thames	20	80	21	252
Welsh	2	8	56	672
TOTAL	118	472	860	10 320

Notes

* assuming 4 samples per year
** assuming 12 samples per year

Table 12. Number of Sampling Sites and Samples taken for the Implementation of the Harmonised Monitoring Scheme in England and Wales (HMS - 115 determinands per sample; EQI - 19 determinands; ECN - 59 determinands)

	Harmonised Monitoring Scheme		Exchange of Information Decision		Environmental Change Network	
Northum/Yorks	Nº Sites	Nº Samples*	Nº Sites	Nº Samples*	Nº Sites	Nº Samples*
Anglian	15	180	0	0	5	60
Northum/Yorks	25	300	4	48	2	24
North West	22	264	3	36	1	12
Severn Trent	15	180	3	36	2	24
Southern	11	132	0	0	0	0
South Western	28	336	3	36	2	24
Thames	15	180	1	12	0	0
Welsh	39	468	0	0	1	12
TOTAL	170	2040	14	168	13	156

Notes: * all assuming 12 samples per site per year

Table 14. Density of Monitoring Stations used for Classification Purposes in England and Wales

Region	Area (km^2)	Number of sites	Sites per area
Northumbria/Yorkshire	22 967	870	26.4
Severn Trent	21 856	1255	17.4
Anglian	27 697	759	36.5
Southern	10 985	526	20.9
Thames	12 362	565	21.9
South Western	20 344	1306	15.6
Welsh	21 135	853	24.8
North West	14 420	937	15.4
TOTAL	151 115	7071	21.4

Table 15. continued/2

PARAMETRI	Statutory monitoring requirements (see below)															
	1	2	3	4	5a	5b	6	7	8a	8b	8c	8d	8e	8f	8g	9
CLORURI	•			•	•	•	•	•		•						
CLORO ORGANICO TOTALE	•															
CLORO RESIDUO TOTALE			•													
CIANURI	•					•	•				CN^-					
FLUORURI	•				•		•				F^-					
FOSFATI (P)	•			•		•	•	•		•						
FOSFORO REATTIVO					•											
FOSFORO TOTALE (P)			•	•	•			•		•						
CLOROFILLA a																
SILICE REATTIVA					•											
SOLFATI	•			•	•	•	•	•		•						
TENSIOATTIVI NON IONICI				•	•	•		•		•						
TENSIOATTIVI ANIONICI	•	•	•	•	•	•	•	•		•						•
ENTERO COLI															•	
COLIFORMI TOTALI	•	•		•	•	•		•						•		
COLIFORMI FECALI	•	•		•	•	•		•						•		•
SALMONELLE	•	•			•	•	•	•						•	•	
STREPTOCOCCHI FECALI	•	•						•						•		•
YERSINIE*														•		
SODIO							•				NA^+					
POTASSIO							•				K^+					
RAME	•		•	•	•	•	•	•				•				•
RAME FILTRATO				•												
ARGENTO				•												
MAGNESIO							•				MG^{++}					
CALCIO							•				CA^{++}					
ZINCO	•		•	•	•	•	•	•				•				•
CADMIO	•		•	•	•	•	•	•				•				•
ALLUMINIO				•			•									
PIOMBO	•		•	•	•	•	•	•				•				•
PIOMBO FILTRATO				•												
VANADIO	•					•	•									
CROMO TOTALE	•		•	•	•	•	•	•				•				•
CROMO VI				•								•				
MANGANESE	•			•	•	•	•	•								
FERRO				•			•	•			Fe^{++}					
FERRO DISCIOLTO	•					•										

Table 15. continued/4

PARAMETRI	Statutory monitoring requirements (see below)															
	1	2	3	4	5a	5b	6	7	8a	8b	8c	8d	8e	8f	8g	9
IDROCARBURI POLICICLICI AROMATICI						•										
SOSTANZE OLEOSE TOTALI										•						
OLI MINERALI		*														

* IN FUNZIONE DELLA TIPOLOGIA INDUSTRIALE LOCALE

** ZONE IRRIGUE

Notes

1 Surface Water (75/440/EEC) (DPR 515/82)
2 Bathing Water (76/160/EEC) (DPR 470/82)
3 Freshwater Fisheries (78/659/EEC) (D. Legisl. 130/92)
4 List Water bodies Census of Piedmont Region
5a List of Parameters of Emilia Romagna Monitoring (Circular 5/90)
5b List of Parameters applied in Emilia Romagna to monitorate surface water bodies for drinking use (Circular 5/90)
6 List of Parameters for Provincia Autonoma di Trento monitoring
7 List of Parameters for Lombardia monitoring (Regional Recovery Plan, 1985)
8a List A of Parameters for Veneto monitoring (Census Water bodies)
8b List B of Parameters for Veneto monitoring (Census Water bodies)
8c List C of Parameters for Veneto monitoring (Census Water bodies)
8d List D of Parameters for Veneto monitoring (Census Water bodies)
8e List E of Parameters for Veneto monitoring (Census Water bodies)
8f List of Parameters for Veneto microbiological monitoring (Census Water bodies)
8g List of Parameters for Veneto Acuaculture monitoring (Census Water bodies)
9 List of Parameters for Valle D'Aosta monitoring

Table 17. Summary of Parameters to be Monitored in England and Wales

Parameter	Statutory monitoring requirements (see below)									
	1	2	3	4	5	6	7	8	9	10
pH		x		x			x	x		x
Turbidity				x				x		
Colour	x			x				x		
Temperature	x			x			x	x		x
Conductivity				x				x		
Dissolved oxygen				x			x	x		x
Oxygen saturation				x						
BOD_5				x			x	x		x
COD				x						x
Total dissolved organic C				x						
Ammoniacal nitrogen	x			x			x	x		x
Nitrogen TON								x		
Nitrate	x			x	x			x		x
Nitrite				x			x	x		
Suspended solids				x	x		x	x		
Total hardness				x				x		
Total alkalinity				x				x		
Chloride				x				x	x	
Residual chlorine							x			
Cyanide	x			x				x		
Fluoride	x			x				x		
Orthophosphate				x	x		x	x		x
Total phosphate				x						
Chlorophyll				x						
Dissolved reactive silicate				x				x		
Sulphate	x			x				x		
Anionic detergent				x						
Non-ionic detergent				x						
Surfactants										x
Confirmed *E. coli*								x		
Confirmed total coliforms				x				x		x
Faecal coliforms				x						x
Salmonella				x						x
Faecal streptococci				x						x
Sodium				x				x		
Potassium				x				x		
Total copper	x	x		x	x	x	x	x		

Table 17. continued

Parameter	Statutory monitoring requirements (see below)									
	1	2	3	4	5	6	7	8	9	10
Dieldrin				x		x		x	x	
Dioxins						x				
Endosulphan			x			x		x		
Endrin				x		x		x	x	
Fenitrothion			x			x		x		
Fenthion						x				
Flucofuron		x								
Hexachlorobenzene						x		x	x	
Hexachlorobutadiene						x		x	x	
Heptachlor				x						
Hydrocarbons	x			x			x			
Isodrin									x	
Lindane					x	x		x	x	
Malathion			x			x		x		
Parathion						x				
Parathion-methyl						x				
PCBs				x	x			x		
PCSDs		x								
Pentachlorophenol						x		x	x	
Perchloroethylene						x			x	
Pesticides	x									
Permethrin		x								
Phenols	x			x			x			
Simazine			x			x		x		
Sulcofuron		x								
Trichlorobenzene						x		x	x	
Trifluralin			x			x		x		
Triphenyltin		x				x				
Tributyltin		x				x				
Trichloroethylene						x			x	
Trichloroethane						x				

Table 18. Chemical Component of the GQA Scheme for Rivers and Canals

Grade	Dissolved O_2 (% Sat) (10 percentile)	BOD (ATU) (mg l^{-1}) (90 percentile)	Total ammonia as N (90 percentile)
A	80	2.5	0.25
B	70	4	0.6
C	60	6	1.3
D	50	8	2.5
E	20	15	9.0
F	<20	-	-