

**NRA PROGRAMME FOR THE MONITORING OF  
WATER QUALITY**

**PART 1:  
REQUIREMENTS ARISING FROM EXISTING LEGISLATION  
AND OTHER COMMITMENTS**

**PART 2:  
DESIGN OF MONITORING PROGRAMMES FOR  
GENERAL QUALITY ASSESSMENTS**

**PART 3:  
MANAGEMENT AND DESIGN OF REGIONAL OPERATIONAL  
MONITORING PROGRAMMES**

**NOVEMBER 1994**



all the world's water  
is now under threat  
of pollution and  
the world's water  
resources are being  
depleted at an  
alarming rate.

Water is the lifeblood of our planet.

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## **REVISION CONTROL PAGE**

### **FOR NOVEMBER 1994 VERSION**

This is the third national release (November 1994) of the **NRA Programme For The Monitoring Of Water Quality** and supersedes all previous drafts. The document will be updated as further information becomes available, and new and revised pages will be issued. Footers on revised material will display the Month and year of revision. Any revisions will be accompanied by updated revision control pages listing the revised material. The latest version of the revision control pages should be substituted for this one and retained within the document.

### **RELEASES**

#### **FEBRUARY 1993 First National Release**

**Part 1: Requirements Arising From Existing Legislation And Other Commitments**

#### **JANUARY 1994 Second National Release**

Section on effluent monitoring removed from **Part 1**. The detail in it has since been incorporated into the discharge consents manual.

Addition of **Part 2: Design Of Monitoring Programmes For General Quality Assessments**.

#### **NOVEMBER 1994 Third National Release**

Addition of **Part 3: Management And Design Of Regional Operational Monitoring Programmes**

### **UPDATES TO THIRD RELEASE**

Details of updates to the third release will be set out here in new revision control pages and will accompany any update material

Future updates will be forwarded to registered holders of this document





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# **NRA PROGRAMME FOR THE MONITORING OF WATER QUALITY**

## **INTRODUCTION**

The water quality monitoring activities of the NRA are diverse and existing sampling programmes vary widely between Regions. The need to rationalise the NRA's monitoring activities was recognised in the Water Quality Strategy (Ref: NRA 1993a) which includes the aim to 'review NRA monitoring programmes to ensure a cost effective and consistent level of service for all controlled waters'. The National Water Quality Monitoring Project has provided the framework under which new national policy on a number of different aspects of monitoring has been defined.

This document contains guidelines for water quality monitoring to meet both statutory requirements and the need to assess and report upon the state of the water environment through the General Quality Assessment (GQA) Scheme. It also contains guidelines for water quality monitoring to meet individual Regional needs. Sampling programmes are being reviewed in each Region in accordance with these guidelines. When this review is complete it will be possible for the first time in England and Wales to produce a statement of the National Monitoring Programme with an inventory of sites and costs.

Part 1 of this document sets out the monitoring requirements which arise from the existing obligations imposed by UK or European legislation, or by existing national and international commitments. Attention is therefore primarily focused on those monitoring activities which must be carried out to demonstrate compliance with particular standards or conditions relating to environmental quality. Some other sampling requirements, for example those associated with the North Sea programme, are also included because they arise from specific national or international agreements.

Part 2 focuses on the sampling requirements of the new General Quality Assessment Scheme. Sampling programmes defined according to the guidelines set out here will also fulfil the needs of statutory Water Quality Objectives (WQOs) when they are introduced.

Part 3 extends NRA guidance on monitoring to cover that undertaken to meet local, as opposed to national, needs. Such monitoring is referred to as 'Regional Operational' or 'Permissive'.





## BACKGROUND

The existing programmes for the monitoring of water quality in NRA Regions have been built up progressively over time to meet the requirements of new national and European obligations, and the more local needs associated with pollution control management. National classification systems and the Harmonised Monitoring Scheme have resulted in the development of a network of sampling points on main rivers across the country. The introduction of EC Directives since the 1970s has also driven sampling needs for assessing compliance with Environmental Quality Standards (EQSs).

This progressive evolution in practice has resulted in Regional sampling programmes which are very different in nature. This is partly because there are genuine differences in local needs associated with patterns of land use, population density and the different types of pollution problems encountered. There are also Regional differences in the number of locations and stretches designated under EC Directives. However, a major factor underlying these differences is the way that sampling programmes developed in the separate Water Authorities. Each had different approaches which reflected different priorities, mechanisms for management control, resource allocation and so on.

Since the formation of the NRA the outstanding need for greater convergence in practice has been recognised as a priority issue. There are real opportunities for improving effectiveness, efficiency and value for money through the building up of a consistent national monitoring programme. This issue was addressed by four sub-groups of the former Environmental Quality Committee (EQC) which produced sets of guidelines for monitoring of freshwaters, tidal waters, groundwaters and discharges. Some changes in practice followed. Changes were also brought about through the 1990 River Quality Survey in which some Regions increased the coverage of their monitoring networks. Overall there has been a general trend of increases in numbers of sampling locations, frequencies and number of determinands analyzed since 1989. The 1990 Survey also resulted in a substantial increase in the number of sites at which biological quality is assessed on a routine basis. Thus although steps have been taken to improve monitoring practice in the NRA the net effect has been an overall increase in effort and resources allocated to this activity.

The assessment of the Regional sample and determination workloads undertaken in 1992 in support of the Laboratory Review, and the Marine Monitoring Strategy completed in May 1994, each highlighted large inter-Regional differences and the need for a thorough review of Regional monitoring activities. Further, the Laboratory Review work revealed weaknesses in the management of sampling programmes in some Regions. Most Regions found it difficult to state the size of their current workloads even in the broad categories required; some Regions do not have a database with suitable features to manage sampling programmes. It is for these reasons that the National Water Quality Monitoring Project was initiated to review this whole area and produce a consistent national monitoring programme. Improved management control would undoubtedly reduce numbers of samples and determinations significantly, leading to worthwhile savings on the present total NRA water quality monitoring costs, which are approximately £40m per year.

Water Quality monitoring, and its integration with Fisheries and Conservation monitoring is the subject of the R&D project - A2(93)2 479 'Improved Environmental Monitoring', which aims to develop more efficient approaches to the design of environmental monitoring

programmes. The project may recommend improvements to these guidelines from 1996 onwards.

## SCOPE

As we move towards the development of a national programme it is necessary to make the distinction between those activities which address national needs and those which are carried out solely for local operational purposes. Firstly, there is the monitoring that is needed for the purposes of assessing compliance with standards or specific conditions. Much of this arises from requirements of national or European legislation and the results need to be reported at a national level. This work would obviously fit within the National Programme. Part 1 of these guidelines cover national and international monitoring obligations for freshwaters, marine waters and groundwaters.

In addition, there is a general need to keep a watch on the state of the environment and report upon progress and trends over time and from place to place. For rivers, this has been done in the past through periodic surveys reported against the National Water Council (NWC) Classification Scheme. The NRA has now replaced the NWC Scheme for rivers and canals with a General Quality Assessment (GQA) Scheme for rivers. To support this, there was a need to introduce a more consistent national monitoring framework to provide a better balance in reporting upon the national picture and to ensure greater consistency in levels of service. The monitoring network required to support the GQA would logically be an integral part of the National Programme.

The definition of sampling needed to support the GQA Scheme, unlike statutory obligations, is largely at the NRA's discretion. It is considered that the best value for money can be achieved by building as far as possible on the network of sampling sites required for statutory purposes and adding further sites only where they can be demonstrated to contribute significantly to information on environmental quality. It has been possible to produce a set of guidelines to do this for rivers because the necessary statistical tools have already been developed. These guidelines are set out in Part 2. There is also a substantial historic database within Regional archives which can be drawn upon in reviewing sampling programmes. However, it has not yet been possible to produce equivalent guidelines for estuaries and coastal waters and groundwaters. These are presently under development within the Water Quality Monitoring Business Plan and will be included in future updates of this manual when this work has been completed.

The sites required for the statutory programme and the GQA system will in general, cover most of the sites where routine monitoring is required for the purposes of operational control. There are also management requirements for which sampling of a more transient nature is needed, such as investigations to support pollution incident follow up, pollution prevention work, evidence needed for negotiations with dischargers, and information required to underpin policy decisions. In these cases the sampling programme will need to be designed to address the specific question being asked. Once the question has been answered, or it is evident that the investigation has become fruitless, the sampling should be terminated. Sampling to address specific local operational needs, outside the routine monitoring programme, is collectively referred to here as Regional Operational Monitoring. Guidelines covering sampling activities falling into this category are set out in Part 3 of this document.

Regional Operational monitoring is all water quality monitoring undertaken for local Area or Regional management purposes, as opposed to statutory monitoring for national purposes, or surveillance monitoring for General Quality Assessments (GQAs) or the Baseline Coastal

**Waters Surveys.** It does not cover unplanned sampling undertaken as part of the initial investigation of pollution incidents. It is the responsibility of Area management to ensure that incidents are handled in a proper and cost effective manner. However, these guidelines do apply to the design and management of planned post pollution incident work. Part 3 sets out the approach to be taken by all NRA Regions to the management and design of Regional Operational Monitoring sampling programmes. The guidance and recommendations apply to water and sediment chemistry, biology and microbiology and all types of controlled waters including groundwaters.

The original version of these guidelines contained a section on the sampling of effluents. These guidelines belong more properly in the Discharge Consents Manual as they constitute an integral part of the compliance assessment process. They have therefore been transferred to that manual and will no longer be part of these guidelines which concentrate of the subject of environmental monitoring only.

## OBJECTIVES

The key objectives of Part 1 of this document are threefold:

- a) to identify the relevant UK and EC legislation and other national and international commitments for which monitoring requirements exist;
- b) to provide guidelines on environmental monitoring associated with these obligations; and
- c) to provide guidance on how the data arising from the various monitoring programmes should be reported.

Part 1 is therefore aimed at providing a clear definition of what are the minimum monitoring obligations of the NRA, so that the associated technical and resource requirements can be properly assessed. By defining the baseline needs, a clearer focus can then be brought upon the aims and objectives of all of the other sampling activities carried out within the NRA in relation to water quality.

The objective of Part 2 is to clearly define an approach to the design of sampling programmes for the existing, and emerging, components of the GQA Scheme, that is chemical, nutrient and biological grading of rivers and canals. The aim is to promote national consistency in approach and to ensure that monitoring activities related to GQA provide value for money by optimising the amount of useful and relevant information derived from them. The approach to sampling programme design set out in these guidelines will meet national needs for GQA purposes and some local operational requirements, particularly with respect to assessing progress with River Quality Objectives (RQOs). Sampling programmes designed according to these guidelines will also meet the monitoring needs of statutory WQOs in the future.

The overall objective of Part 3 is to clearly define an approach to the management and design of Regional Operational Monitoring programmes which will promote national consistency and cost efficiency. Specific objectives are to;

- a) identify the justifiable categories of freshwater and marine Regional Operational Monitoring.
- b) provide guidelines on the management of Regional sampling programmes which define sufficiently strict control to ensure that sampling programmes are only undertaken when justified on grounds of need, priority and cost efficiency;
- c) provide guidelines on the design of Regional sampling programmes which promote national consistency and common levels of service whilst retaining the Regional flexibility to design sampling programmes to meet Regional needs; and
- d) define the approach to be taken to a review of Regional Operational Monitoring using these guidelines.





**NRA PROGRAMME FOR THE MONITORING OF  
WATER QUALITY**

**PART 1:  
REQUIREMENTS ARISING FROM EXISTING LEGISLATION  
AND OTHER COMMITMENTS**



## **1. STATUTORY BASIS FOR NRA MONITORING**

### **1.1 Water Resources Act 1991**

The statutory basis of the NRA's monitoring programme stems from the duties and powers of the 1989 Water Act (WA '89), since consolidated into the Water Resources Act of 1991 (WRA '91). Under Schedule 10 of the WRA '91, the NRA has a duty to determine applications for consents to discharge, and may set any of a number of conditions upon such discharges. Although no specific duty is placed upon the NRA to monitor discharges in order to demonstrate compliance with the conditions of the consent, the NRA has continued past practice by doing so; it has not, however, by any means ruled out the possibility of dischargers increasingly adopting a system of self-monitoring (Ref: NRA 1990), using data gathered for the management of the effluent treatment process; this data, or the information derived from it, would be audited by the NRA. In either case, the results of analyses of effluents, and of environmental samples taken in relation to the control of pollution, have to be placed on public registers maintained by the NRA.

Such registers have also to contain details of any Water Quality Objectives (WQOs) specified under Section 83 of the WRA '91, as required under Section 190. Until recently, the only WQOs introduced on a statutory basis were those relating to various EC Directives, either in the form of specific Statutory Instruments or generally under Sections 5 and 102 of the WRA '91.

Finally, Section 84 of the WRA '91 places a duty on the NRA "to monitor the extent of pollution in controlled waters". This duty is preceded by the requirement to achieve WQOs, set by statute, by exercising its powers. Thus although extremely open-ended, the intent is clearly that of setting in place a means by which compliance with the standards, particularly specific Environmental Quality Standards (EQSs), can be demonstrated. Much also depends on the definition of 'pollution', which is not provided in the WRA '91. Usually the term is taken broadly to refer to a level of contamination which may cause hazards to human health, harm to living resources or to aquatic ecosystems, damage to amenities, or interference with other legitimate uses of water. This again implies that monitoring should be carried out in relation to standards which define the acceptable level of contamination in order to safeguard the water from adverse effects, and to protect the various uses of the water.

The NRA has issued its proposals for a scheme of national WQOs and how it might be implemented in practice (Ref: NRA 1991a) and its final recommendation based on these original proposals (Ref: NRA 1992a). However, it is for the Secretaries of State to draw up the necessary Regulations and to set individual WQOs for each stretch of water.

The Surface Waters (Rivers Ecosystem) (Classification) Regulations 1994, set out in Statutory Instrument - SI 1994/1057, came into force in May 1994. It is the Government's intention to initially select a small number of pilot river catchments, in consultation with the NRA, to test the procedures for implementing the new scheme. The monitoring requirements for assessing compliance with WQOs once they have been set are addressed in Part 2 of this manual. It is expected that the

monitoring needs for WQOs will be largely met through the network of sites already in existence for statutory and GQA monitoring purposes.

## 1.2 Environmental Protection Act 1990

The 1990 Environmental Protection Act introduced a number of major new provisions for pollution control in the UK. The central theme of Part I of the Act is that discharges from "prescribed processes" will be controlled by Her Majesty's Inspectorate of Pollution (HMIP) by applying the principles of Integrated Pollution Control (IPC).

Part I also requires that Best Available Techniques Not Entailing Excessive Cost (BATNEEC) should be employed to prevent the release of any substance prescribed for the medium to which it is released, or where that is not practicable, to minimise such a release and render it harmless; all other non-prescribed substances which are also released should be rendered harmless.

There is a phased programme for the introduction of IPC, and HMIP are gradually taking over responsibility from the NRA for the control of discharges from prescribed processes. Where HMIP is the authorising authority the NRA is no longer responsible for effluent monitoring; however the NRA will retain responsibility for the environmental monitoring of substances discharged into controlled waters from prescribed processes. The NRA and HMIP are in the process of agreeing a joint guidance note on "NRA Monitoring Responsibilities for Processes Subject to Authorisation by HMIP". This should be available by the beginning of 1995.

The prescribed substances for which releases into water are to be controlled were defined by Schedule 5 of the Environmental Protection (Prescribed Processes and Substances) Regulations (SI 472 as revised) which came into force in England and Wales on 1 April 1991. The list of prescribed substances is given in Annex 1. The Regulations do not, in themselves, define the monitoring requirements for prescribed substances in water. However, the NRA is responsible for assessing compliance with EQSs which apply to the waters receiving discharges from prescribed processes. Approximately 5,000 sites have already been identified, representing a considerable monitoring workload.

EQSs for 14 of the 23 prescribed substances have already been set, either by EC Directives for List I dangerous substances or by DoE for List II substances. EQSs for 8 of the remaining substances, dichlorvos, atrazine, simazine, trifluralin, fenitrothion, azinphos methyl, malathion and endosulfan have been proposed by DoE and circulated for comment in its consultation paper of November 1991. It is expected that the EQSs for these 8 remaining substances, once approved, will be incorporated into the amended Surface Waters (Dangerous Substances) (Classification) Regulations (see Section 2.1.3). However, the DoE has yet to confirm the final EQSs for these substances and how it intends to introduce them within the existing statutory framework for dangerous substances. No standards were proposed for polychlorinated biphenyls.

All of the 8 prescribed substances, for which EQSs have been proposed, are pesticides and some, including atrazine and simazine, are still used widely in significant quantities in some agricultural situations and in garden products. They may therefore be released into the aquatic environment from both point and diffuse

sources. This has implications for the design and implementation of appropriate monitoring programmes. The legislation to date has been aimed at the control of dangerous substances released in discharges from certain processes. Further clarification is required from DoE as to the extent to which monitoring strategies should take into account pollution arising from diffuse sources. The NRA has pointed this out in its response to the recent Government consultation document, and further guidance will be given when DoE's position on this matter has been more clearly defined.

## **2. FRESHWATERS**

This Section describes the current legislation and other non-statutory commitments for which freshwater monitoring requirements exist. It also provides details of the necessary sampling programmes and the arrangements for the reporting of data. For convenience, these details are summarised in Table 1. The anticipated numbers of samples, to be taken for each monitoring requirement, are given in Annex 15.

### **2.1 EC Directives**

#### **2.1.1 Surface Water Abstracted for Potable Supply (75/440/EEC and 79/869/EEC)**

There are two complementary EC Directives which apply to all surface water abstractions intended for public distribution as drinking water. The first, 75/440/EEC, concerns the "quality required of surface water intended for the abstraction of drinking water". It sets out a list of determinands which must be measured and gives both mandatory and guide standards for three classes of abstraction. Abstractions are classed as A1 to A3, according to the level of treatment needed to produce drinking water. The levels of treatment used to classify abstractions, and the parameters and mandatory standards are given in Annex 2. Member States were required to improve A3 abstractions over a ten year period from the adoption of the Directive. Abstractions failing to meet the standards for A3 cannot be used for drinking water.

The second Directive, 79/869/EEC, establishes the analytical methods which should be used, with minimum limits of detection, accuracy and precision, and also regulates sampling frequency. The Directive thereby ensures minimum standards common to all Member States.

The requirements of Directive 75/440/EEC were partially translated into UK legislation by the Surface Waters (Classification) Regulations 1989, Statutory Instrument (SI) 1989/1148. These Regulations came into force on 1 September 1989. However, there has never been a Direction and Notice to the NRA identifying where these standards are to be applied.

#### **Monitoring**

The NRA carries out routine monitoring in accordance with the requirements of the Directives. Guidelines on the location of sampling points were issued by the DoE (27 April 1992).

At each site the full suite of determinands set out in Annex 2 must be measured. This includes metals, pesticides, organic substances and nitrates, for which mandatory standards have been set in the Directive.

The sampling frequencies in the Directive vary between 1 and 12 times per year, according to the class of abstraction, the population served and the type of substance. Less than four samples per year is not considered to be a sensible sampling

frequency; therefore the minimum frequency is 4 times per year. Sampling frequencies are given in Annex 2.

### **Compliance Assessment**

Compliance is only assessed against the mandatory standards (I values) in the Directive, and is based on 95% of samples achieving the standards. Where the sampling frequency is less than 20 samples per year all samples must conform with the standards set in the Directive.

Derogations (waivers) can be given for some parameters where floods, natural enrichment or exceptional geographical conditions cause an exceedence of the standard. These are indicated in Annex 2. The nitrate standard cannot be waived where high levels associated with run off from farming land cause an exceedence of the standard. These are considered to be anthropogenic inputs, not natural enrichment, and are therefore not eligible for derogation.

### **Reporting**

#### **a) Timing**

Recent EC legislation (91/692/EEC), aimed at harmonising the way that Member States report to the European Commission on EC Directives requires that regular reports from Member States are submitted every 3 years. The DoE requires annual reports from the NRA which can then be amalgamated to provide the three yearly report for the Commission.

The relevant reports should be provided in the form of a computer disk using the approved format, and a covering letter, no later than 30 April. This will enable the NRA to complete a consolidated report to DoE by 31 May in line with the agreed timetable.

#### **b) Format**

The returns are made on a database in Dataease version 4.53, using a backup from a central database at Head Office. The database consists of an inventory of abstractions, a form for reporting exceedences, and a form for reporting sites with sampling shortfalls. A covering letter should accompany the returns giving any additional information, and highlighting any areas of concern.

The inventory contains information on the abstractions, including location, class, water company, population served, details of the source and sampling point, and any waivers which apply. The inventory may need updating to maintain its accuracy. Any changes should be documented in the covering letter.

All exceedences (including those with a waiver) should be entered onto the database, using the form 'Exceedences'. For each non-compliant abstraction, only those parameters exceeding the standard need to be reported. Information on the reason for the exceedence should be entered onto this form, together with details of remedial

action to be taken to ensure future compliance. Additional sampling may be required to establish the cause of non-compliance. This sampling also falls within the statutory monitoring programme.

The form 'Shortfalls' should be used to report abstractions with less than the NRA recommended sampling frequency. Within the database there is the facility to assess sampling frequencies against those stated in the Directive.

Progress reports on the upgrading of A3 abstractions would also form part of the returns. However, all the current abstractions in England and Wales are classed as A1 or A2.

### **2.1.2 Freshwater Fish (78/659/EEC)**

Directive 78/659/EEC concerns the "quality of fresh waters needing protection or improvement in order to support fish life". The Directive provides a list of determinands to be measured with associated requirements for analytical methods and minimum sampling frequencies. Two sets of standards are given which apply to designated salmonid and cyprinid fisheries.

Stretches of water were initially nominated by the former Regional Water Authorities and have been designated by Government for both salmonid and cyprinid fisheries. Approximately 20,000 kilometres of river and 1,300 hectares of still water have been designated in England and Wales.

#### **Monitoring**

Although no Regulations have been issued for the implementation of Directive 78/659/EEC, the NRA carries out the monitoring in accordance with the requirements of the Directive as a statutory requirement.

Where waters have been designated, longer lengths can be divided into stretches, provided that water quality is consistent throughout the stretch. Each stretch is allocated one sampling point, located so as to be representative of the water quality of the whole stretch. As a guideline, stretches should be under 20km in length. The Directive requires a minimum sampling frequency of once per month, but Article 7 allows this to be reduced where very high water quality can be demonstrated. Where there is no pollution or no risk of deterioration (ie. no upstream discharges) sampling can cease altogether. Unless sufficient data is available to justify a reduced sampling frequency, monthly sampling must continue.

Only determinands for which mandatory or I values are given in the Directive should be measured. These are dissolved oxygen, total ammonia, pH, zinc, and temperature at thermal discharges. The standards to be applied are shown in Annex 3.

Non-ionized ammonia is calculated from the pH, temperature and total ammonia, using the equation shown in Annex 3. Temperature should therefore be measured at all sites, although it is only assessed against the mandatory standards where there is a thermal discharge. Although the Directive contains a mandatory standard for residual chlorine, current methods of measurement do not give the required accuracy, and it has therefore been decided that this parameter should not be measured or reported until a suitable bank side test is available. Zinc standards vary depending on the hardness of the water. The hardness bandings to be used are the same as those in the Rivers Ecosystem Regulations (but not DoE Circular 7/89), and are given in Annex 3.

#### **Compliance Assessment**

Compliance is assessed against the mandatory values in the Directive. The Directive states that for pH, total ammonia, non-ionized ammonia and zinc, 95% of samples must achieve the standard. However, the Commission has agreed that where monthly



samples are taken, eleven out of the twelve samples should meet the standard to achieve compliance. For dissolved oxygen, there is an absolute minimum standard as well as a standard which 50% of samples must meet.

Derogations can be given for pH in naturally acidic areas, and zinc where natural enrichment causes exceedences. High pH due to algal growth is not eligible for a derogation, because it can be an indicator of eutrophication. The Directive allows for a relaxation of the total ammonia standard, where there are no harmful effects on the fish population. The DoE has advised that the standard can be relaxed from 1 mg/l to 3 mg/l for cyprinid waters, where the non-ionized ammonia complies and recent data showing healthy fish populations can be provided.

## **Reporting**

### **a) Timing**

The NRA is required to produce annual reports for the DoE on all sites failing to meet the requirements of the Directive. The standardised reporting directive (91/692/EEC) requires that reports consisting of annual data are submitted to the Commission every three years. Regions should make their annual returns to Head Office by 31 May. This will enable the NRA to complete a consolidated report to the DoE by 30 June, in line with the agreed timetable.

### **b) Format**

The returns should be made via a database, in Dataease version 4.53. This is supplied as a backup from a central database at Head Office. The database consists of an inventory of designated stretches, a form for reporting exceedences and a form for sites with sampling shortfalls.

The inventory consists of a list of all designated waters, and includes information relating to the stretches such as catchment, class, location and sampling point, length for rivers and surface area for still waters. Derogations are listed, along with reductions in the sampling programme due to high water quality. The inventory should be updated to maintain its accuracy, and any changes documented in a covering letter.

All sites exceeding the standards (including sites with derogations) should be reported on form 'Exceedences'. The reason for the exceedence should be entered on this form together with details of remedial action to be taken to ensure future compliance. Additional sampling may be required to establish the cause of non-compliance. This sampling also falls within the statutory monitoring programme.

The form 'Missing samples' should be used to report those sites where there was an unintentional shortfall in the sampling programme, and a reduction in sampling frequency is not justified on the grounds of high water quality. The structure of the three forms is shown in Annex 3.

c) New designations

The Directive allows for further designations at any time. To designate further stretches, a written notification should be sent to Head Office including full inventory details, and supporting water quality data.

### 2.1.3 Dangerous Substances (76/464/EEC and Daughter Directives)

EC Directive 76/464/EEC on "pollution caused by the discharge of dangerous substances into the aquatic environment" is a framework Directive with the aim of reducing the pollution of waters by seeking to eliminate discharge of the most dangerous substances in terms of persistence, toxicity and bio-accumulation (List I or Black List substances) and by reducing the input of others (List II or Grey List substances).

In order to select substances for List I status, some 4500 were initially identified by the Commission; these were then reduced to a "short list" of 129 priority candidate substances taking into account the quantities of each produced each year within the Community. Of these, 18 have been made the subject of "daughter Directives" in which environmental quality standards and limit values have been set, namely:

mercury from discharges by the chlor-alkali electrolysis industry (82/176/EEC);  
mercury from discharges other than from the chlor-alkali electrolysis industry (84/156/EEC);  
cadmium and its compounds (83/513/EEC);  
hexachlorocyclohexane (84/491/EEC);  
carbon tetrachloride, DDT and pentachlorophenol (86/280/EEC);  
aldrin, dieldrin, endrin, isodrin, hexachlorobenzene, hexachlorobutadiene and chloroform (88/347/EEC); and  
1,2 dichloroethane, trichloroethylene, perchloroethylene and trichlorobenzene (90/415/EEC).

Directive 76/464/EEC also provided a definition for substances of List II status and specified the measures to be taken by each Member State with regard to discharge control, but left the identification of List II substances and the setting of appropriate standards to individual Member States. In the UK national EQSs have been established for lead, chromium, zinc, copper, nickel, arsenic, boron, iron, pH, vanadium, triorganotins and mothproofing agents (PCSDs, Cyfluthrin, Sulcofuron and Permethrin).

#### (i) List I substances

The Surface Waters (Dangerous Substances) (Classification) Regulations 1989 (SI 1989/2286) were issued in December 1989. These established a classification system and water quality objectives for existing List I substances in UK legislation in line with the requirements of the Directives. The Regulations came into force on 1 January 1990 and defined two classifications, DS1 for inland waters and DS2 for coastal (including estuarial) waters (given in Annex 4 [1] and 4 [5]).

A Notice establishing these water quality objectives for surface waters was issued to the NRA in January 1990. At the same time a Direction was issued by DoE/VO requiring the NRA to impose consent conditions on discharges so that receiving surface waters will comply with the requirements of the

daughter Directives, and to implement monitoring procedures to demonstrate compliance.

In November 1991 the DoE issued a consultation document on EQSs for dangerous substances where it was indicated that DoE intended to extend the Regulations to include other List I and List II substances for which standards had either been set in subsequent EC Directives (eg. 90/415/EEC) (see list b in Annex 4 [3] ) or in earlier UK advice notes (eg. DoE circular 7/89) (see Appendix 2 in Annex 4 [4] ). The consultation paper also indicated a commitment to incorporate standards for the remaining UK Red List substances not already covered, within future Regulations (see list a in Annex 4 [3] ).

The intentions of the consultation document have not been fully implemented, but DoE did issue an extension to the Surface Waters (Dangerous Substances) (Classification) Regulations in February 1992 with SI 1992/337 which came into force on 20 March 1992. These Regulations set out criteria for a further classification, DS3, which applies to all relevant territorial waters, coastal waters and inland freshwaters (given in Annex 4 [2] ). DS3 sets EQSs for four List I chlorinated solvents 1,2-dichloroethane, trichloroethylene, perchloroethylene and trichlorobenzene, along with reference methods of measurement in waters, according to the requirements of EC Directive 90/415/EEC. In February 1993 a Notice and Direction were issued to the NRA by the DoE/WO to formally implement SI 1992/337. Sampling was to be carried out as from 1 January 1993.

The List I substances subject to Regulations, Directions and Notices are, therefore: mercury and its compounds; cadmium and its compounds; hexachlorocyclohexane; carbon tetrachloride, DDT and pentachlorophenol; aldrin, dieldrin, isodrin and endrin, hexachlorobenzene, hexachlorobutadiene and chloroform; and 1,2-dichloroethane, trichloroethylene, perchloroethylene and trichlorobenzene.

Effective control of the input of these List I substances requires monitoring of both effluent discharges and receiving waters. (There is a similar requirement for the control of List II substances in accordance with DoE's circular 7/89 - see section 2.1.3 ii of this report.)

The implementation, and transitional period for the introduction of Integrated Pollution Control (IPC) complicates matters somewhat. In all cases where a discharge to a controlled water is authorised either wholly or in part by HMIP, written monitoring agreements must be drawn up between the NRA and HMIP on a site-by-site basis and in a standard format (see Discharge Consents Manual: Chapter 10 - Integrated Pollution Control). The agreement must make clear the NRA's and HMIP's responsibilities for discharge and environmental monitoring. The NRA and HMIP are in the process of agreeing a joint guidance note on "NRA Monitoring Responsibilities for Processes Subject to Authorisation by HMIP". This should be available by

the beginning of 1995. NRA environmental monitoring in relation to an HMIP authorization should not differ from that in relation to an NRA consent.

### Monitoring

The NRA must monitor surface waters receiving List I substances from discharges of point sources which should, in theory, all be consented. These include all industrial plants liable to handle and discharge these substances and all significant discharges of these substances from sewage treatment works and sewers.

The sampling point should be sufficiently close to the discharge point to be representative of the aquatic environment in the area affected by the discharges. Allowance should be made for a reasonable mixing zone taking into account the prevailing hydrological and physiographic properties of the site. It has been agreed that samples should be taken below discharges at a minimum frequency of once per month.

Where new discharges of List I substances are identified, or where discharges of these substances have ceased, the NRA must notify DoE of these changes. The NRA must also identify, and where appropriate, monitor waters likely to be affected by significant diffuse sources of these substances. DoE are to be notified where such sources are believed to significantly contribute to the exceedence of an EQS.

The NRA is required to submit monitoring plans to the DoE for any new List I substance as soon as possible after the adoption of a new daughter Directive. However, the EC have recently indicated that further daughter directives will not be proposed and that in future further dangerous substances will be controlled via an amended 76/464/EEC Directive. If a discharge ceases, DoE require the NRA to continue downstream monitoring for at least two years. If the relevant substance(s) are found to be at a level lower than the limit of detection for two years then monitoring can cease.

In addition to downstream monitoring, general monitoring of background levels of List I substances is also required. The precise obligations of the different Directives vary. the cadmium and HCH daughter Directives set reference values against which monitoring at "National Network" sampling sites is to be compared. Directive 86/280/EEC however, contains a general requirement to monitor the aquatic environment affected by significant discharges. In consequence, DoE has indicated that general environmental monitoring should be undertaken for all List I substances, whether or not it is needed by the precise wording of the Directive concerned.

The extent of National Network monitoring is a matter left largely to the discretion of the NRA. However, monitoring should reflect the "ubiquity of the substance" and that it should be concentrated in those waters where the substances are thought most likely to be present, because of upstream discharges. There is also a general requirement that the NRA should monitor

for all List I substances at the tidal limits of all significant rivers in order to assist in the estimation of total loads entering the sea from rivers. (See also Sections 2.3.1 and 2.3.2).

These general requirements should be met by sampling at the network of sites covered by the existing Harmonised Monitoring Scheme, plus any other sites where elevated levels of these substances are known to occur in the environment from sources other than discharges from identified processes. Sampling at National Network sites should be carried out at a minimum frequency of four times per year; however at tidal limit sites, where monitoring under PARCOM and Annex IA of the Third North Sea Conference Declaration occurs the minimum sampling frequency will usually be twelve times per year (see Sections 2.3.1 and 2.3.2).

Further for the more persistent List I substances covered by existing Directives, there is a requirement that, in addition to compliance with the EQS in the water, the levels of these substances in sediment and/or molluscs and/or shellfish and/or fish flesh should not increase with time. This 'standstill' provision applies to mercury, cadmium, hexachlorocyclohexane, DDT, pentachlorophenol, the Drins, hexachlorobenzene, hexachlorobutadiene and trichlorobenzene. For mercury, there is also a standard for the level accumulated in fish flesh.

Monitoring must be carried out each year for the assessment of levels of these substances in sediments or biota, and the minimum frequency of sampling should be once per year. It is preferable that sediment samples should be taken at the same sites as water quality monitoring and analysis carried out on the  $<63\mu\text{m}$  fraction of the sample. To enable sensible year on year comparison, it is desirable to take such sediment samples at the same time every year.

If insufficient sediment of the required size fraction can be obtained from the river bed then samples of biota should be taken and analysed instead. However, the same substrate (sediment or biota) should be taken from one year to another to enable direct comparison of results from year to year.

Additionally, where sediment analysis has indicated that dangerous substances may be accumulating, samples of biota may be taken to investigate possible bioaccumulation. Apart from mercury, the existing dangerous substances legislation does not provide standards to be achieved in the biota.

There are still some outstanding questions over the most appropriate methods to be adopted for the purposes of a national biological sampling programme, particularly with respect to the choice of species, whether samples should be taken from natural populations or whether *in situ* bioassays should be deployed, and the analytical methods to be used. These issues are currently being addressed in the NRA's national R & D programme through project - A10(90)4 240 "Bioaccumulation of Red List Organic Compounds" which aims to produce codes of practice on the use of bioaccumulation techniques, and

D02(91)4 397 "Body Burdens in Fish" which aims to make recommendations on strategies for the monitoring of contaminants in the tissues of fish.

### **Reporting**

The NRA must submit a range of information in its List I returns to DoE. An inventory of all known discharges (including those to sewer) of List I substances must be provided. Some of this information should be obtained from Water PLCs in accordance with the Sewerage Undertakers (Information) Direction 1991. Information on relevant discharge consents, including emission standards and flows, is also required for each discharge, together with details of the monitoring points used for downstream and background monitoring in relation to each discharge. Thus the following information must be supplied annually to NRA Head Office, via the agreed DataEase database, together with explanatory notes where necessary:

- an inventory including establishments and point of discharge of List I substances, details of their locations, the receiving media and relevant downstream water sample site, sediment sample site and national network site;
- consent details of discharges to surface waters or sewers with emission standards set for each substance;
- an inventory of water sample sites and sediment sample sites, together with their locations and national grid references;
- results obtained at water sample sites and national network sites in terms of annual mean and range at water sample sites, together with the frequency of sampling and the relevant EQSs;
- where appropriate, data showing concentrations in sediments and/or molluscs and/or shellfish and/or fish, together with the frequency of sampling and the relevant EQSs;

Where sites fail to meet the conditions set out in the Regulations and the relevant Directives, this should be detailed in an accompanying report which includes possible reasons for failure and the remedial measures to be taken to ensure that EQSs are met. The provision of information on failing sites may require additional sampling. This additional sampling also falls within the statutory monitoring programme.

Further guidance on reporting of List I dangerous substances returns via the database is provided in Annex 4 [6].

### **(ii) List II Substances**

To date EQSs for List II substances have not been translated into UK legislation via Regulations, but have been set out in the DoE Circular of

March 1989 (Circular 7/89). This also sets out the monitoring requirements for both List I and List II substances.

DoE has indicated its intention to incorporate the requirements for List II substances into amended Surface Water (Dangerous Substances) (Classification) Regulations in the near future. Until this is completed, however, the provisions of Circular 7/89 still apply. The standards for the List II substances referred to in Appendix 2 of Circular 7/89 are given in Annex 4 [4].

### **Monitoring**

There are currently no strict rules for the monitoring of List II substances; the extent and frequency of sampling is a matter for the NRA's own judgement. However, the monitoring programme should be capable of demonstrating that the relevant quality objectives are being consistently achieved sufficiently close to the point of discharge as to be representative of the quality of the receiving water in the area affected by the discharge (allowing for a reasonable mixing zone).

The frequency of monitoring required will depend upon the concentration of the substance relative to the EQS and upon the variability in concentration, but the minimum sampling frequency should be monthly.

As for List I substances, monitoring downstream monitoring should continue for at least two years after the discharge ceases, and until the relevant substance(s) are found to be at a level lower than the limit of detection for a period of two years.

### **Reporting**

The NRA is required to submit to DoE information on the implementation of national programmes. The information required by Circular 7/89 is in three parts and comprises the following for each of the List II substances for which standards have been set:

- a) Lists and/or maps showing all surface waters affected by discharges of each of the substances. This information should, in addition, clearly indicate the quality standards applied in each case (or alternatively that a standstill provision has been applied where the quality standards are deemed to be either inappropriate or un-obtainable). Where possible, the location of discharges and monitoring points should be indicated either by means of maps, or within written descriptions that include OS national grid reference numbers. This information has already been supplied by most Regions - where this is so, only subsequent changes and any new discharges need to be notified with the annual returns.



- b) Annual results of monitoring is required only for those waters where the EQSs are not being achieved.
- c) Details of reasons for exceedences of EQSs and of the measures taken to enable the standards to be met, together with timetables for their implementation.

The provision of information on failing sites may require additional sampling. This additional sampling also falls within the statutory monitoring programme.

Returns to NRA Head Office must be made for all List II substances annually before the end of March. Future reporting formats are currently being considered in the light of the Standardised Reporting Directive's proposed questionnaires. Further guidance will be issued when the UK's obligations under this Directive have been formalised.

#### **2.1.4 Exchange of Information on the Quality of Surface Freshwaters (77/795/EEC and 86/574/EEC)**

EC Decision 77/795/EEC established the framework for a common procedure for the purposes of exchanging information on the quality of surface freshwater in the European Community. It was subsequently amended by Decision 86/574/EEC which added a number of extra requirements with respect to sampling and analytical procedures.

##### **Monitoring**

The parameters to be measured and the analytical details are provided in Annex 5. Samples should be taken at those sites at a minimum frequency of once per month.

##### **Reporting**

The provisions of these Decisions apply to 14 sites (shown in Annex 5) within NRA Regions. They are all sites covered by the Harmonised Monitoring Scheme. Thus, at present, there are no separate reporting arrangements for these sites because the DoE supplies the necessary data to the Commission directly from the Harmonised Monitoring archive. It is important that all Harmonised Monitoring data are supplied to DoE on at least a six monthly basis (January - June, July - December) so that Government can fulfil its reporting commitments to the Commission.

### 2.1.5 Urban Waste Water Treatment Directive (91/71/EEC)

This Directive sets out specific requirements for the consenting and monitoring of discharges from urban waste water treatment plants. It also establishes minimum levels of treatment for sewage works falling within its remit, these being 'appropriate' primary, secondary or more stringent treatment depending on the size of the discharge and 'sensitivity' of the receiving water. Environmental monitoring requirements relate principally to the determination of sensitivity.

Member States were required to establish a programme for the implementation of this Directive by 31 December 1993. Discussions are still continuing as to exactly how some of the requirements will be implemented in the UK. However decisions have been taken on the designation of Sensitive and Less Sensitive Areas. DoE/WO issued a consultation paper in March 1992 containing proposed criteria for identifying Sensitive Areas (which may be fresh or saline waters) and Less Sensitive Areas (saline waters) (Ref: DoE 1992). A second consultation paper was issued in March 1993 proposing the methodology for defining the extent of Sensitive Areas (Ref: DoE 1993). A finalised version of the criteria proposed in the earlier consultation are set out in Annex B of the March 1993 consultation paper.

Under the UK approach, waters receiving sewage discharges of >10000 pe are considered for Sensitive Area status. There are 3 types of Sensitive Area, these being:

- (a) waters which are or may become eutrophic;
- (b) waters intended for public supply abstraction with elevated nitrate concentrations; and,
- (c) waters where more stringent treatment (of discharges) is needed to fulfil other EC Directives.

For (c) the Government intends to use the other Directives as the vehicle for improvements. For (b) monitoring is covered by that undertaken for the Nitrate Directive. Monitoring for Sensitive Areas (eutrophic) is addressed below.

In May 1994, the Government announced the identification of 33 Sensitive Areas (Eutrophic) in England and Wales, requiring the introduction of phosphorus removal by 31.12.98 at some 41 STWs.

The NRA had submitted its candidates, for the first round of designations, to the DoE. These proposals were based upon best available information, rather than a pre-planned programme of data gathering in relation to eutrophication. The criteria used for identifying the waters were those defined in the DoE/MAFF/WO Consultation Paper of March 1992 (as finalised in the subsequent March 1993 consultation paper (Ref: DoE 1993)).

Final decisions on the 1994 designations were made by Ministers following lengthy consultations involving the NRA, the WSPLCs and the DoE. This process provided

the NRA with a good indication as to the level of information required to constitute a robust scientific case for designation of a water as eutrophic. Building on this experience, the Authority took the opportunity, in relation to the 1997 review, to prepare a co-ordinated programme of data/information gathering for implementation between summer 1994 and the end of 1996. This is intended to allow the DoE/Wo to consider and finalise the review of designations in 1997. Designations must be reviewed at least every four years.

The purpose of the programme is to ensure robust information for:

- (a) identifying potential candidate Sensitive Areas (Eutrophic) and also Polluted Waters (Eutrophic) under Nitrate Directive, reviewing existing designations; and,
- (b) assessing the contribution of individual qualifying STWs and their impact upon eutrophication.

A Guidance Note, outlining the future monitoring strategy, was issued to Regions in August 1994. The complete document, other than the listing of specific waters and associated STWs for assessment, is reproduced in Annex 6. The work has a "must do" status. Further guidance is to be issued in due course on (i) the assessment of discharge impact and (ii) the interpretation of river macrophyte data.

Issues relating to discharge consents and compliance will be addressed in the Discharge Consents Manual. It is anticipated that the regulations and guidelines, when issued by the DoE, will further clarify the position.

### 2.1.6 Nitrate from Agricultural Sources (91/676/EEC)

EC Directive 91/676/EEC on "the protection of waters against pollution caused by nitrates from agricultural sources" came into force on 12 December 1991. The Directive requires that each Member State identifies affected waters and designates areas of land as Vulnerable Zones according to certain criteria set out in the Directive. For freshwaters, the criteria refer to, amongst other things, those waters designated under Directive 75/440/EEC (the Surface Water Abstraction Directive), where the nitrate standard of 50 mg/l as 95 percent of samples is or could be exceeded, or where waters are either found to be "eutrophic" or in the near future may become "eutrophic" because of elevated levels of nitrogen compounds. Once vulnerable zones have been designated, Member States are required then to establish "action programmes" to reduce nitrate concentrations in waters.

#### Monitoring

"The National Rivers Authority (Nitrate Pollution) (Council Directive 91/676/EEC) Directions 1992" required the NRA to monitor nitrate concentrations in, and review the eutrophic state of, fresh surface waters, estuarial and coastal waters in accordance with article 6 of the EC Nitrate Directive. The Directive sets out a series of requirements for the monitoring of nitrate levels. Firstly, for the purposes of designating and revising the designation of Vulnerable Zones, Member States are required, within two years following notification of the Directive, to monitor the nitrate concentration in freshwaters over a period of one year. This was principally carried out at Surface Water sampling stations which have been agreed, or are likely to be included under Directive 75/440/EEC. Sampling was carried out at least monthly. Where the nitrate concentration was likely to exceed the 50mg/l level, the DoE/WO's Direction to the NRA required that a minimum of 20 samples were taken in the initial monitoring period, finishing in April 1993. These results have now been submitted to DoE, which will identify the nitrate polluted waters and designate the Vulnerable Zones using a methodology to be developed from the proposals in the March 1993 consultation paper (Ref: DoE 1993). The basic approach is to work back up a catchment, from the failing abstraction, to identify a 'passing' monitoring point. For these upstream sites, data for the 5 previous years and a 95 % level of confidence of failure will be used, as opposed to the 95 % of samples method applied at the Surface Water sampling stations.

Under the Directive the monitoring programme has to be repeated at intervals of at least 4 years, except for those sampling stations where the nitrate concentrations are consistently below 25 mg/l, and no new factor likely to increase the nitrate concentration has appeared. In these cases the monitoring programme should be repeated every 8 years. However, in order to ensure a continuity of data for trend analysis, a minimum of 12 samples per year should be taken at those surface water sites which, during the 1992 survey, failed or were close to failing the 50 mg/l standard. Because upstream sites will be used to define the extent of the vulnerable zone, above failing Surface Water sites, it is also important that nitrate data is available at these sites for subsequent reviews. Again, for these upstream sites, 5 years' data will be used.

The Government, through the release of its May 1994 Consultation Paper (Ref: MAFF 1994), has initial comments on its proposals for Vulnerable Zones in England and Wales. The zones will not be formally designated until after the completion of the consultation exercise. Once the Vulnerable Zones have been designated, action programmes should be implemented within 4 years of their establishment. Regulations will be introduced to translate the requirements of the Directive into UK law. With regard to monitoring, the regulations will cover future requirements and the NRA, DoE and MAFF will need to consider these arrangements in the light of the consultation exercise. The initial obligations were addressed by the 1992 Directions.

The Directive requires that Member States should draw up and implement suitable monitoring programmes to assess the effectiveness of the action programmes. Various working groups have now been set up by DoE to deal with the practical aspects of the implementation of this Directive. It is expected that the precise monitoring requirements will be defined as part of this process and further guidance will be given in due course.

### **Reporting**

The reporting requirements have yet to be agreed with DoE. Further guidance will follow once the regulations have been published by the DoE.

## 2.2 Harmonised Monitoring Scheme

The Harmonised Monitoring Scheme (HMS) was set up in 1974 by DoE to provide a network of sites at which river quality data could be collected and analyzed in a nationally - consistent manner. Its purposes are first, to enable estimates to be made of the loadings of materials carried down through river catchments into estuaries; and second, to allow long-term trends in river quality to be assessed. The network of sites is given in Annex 7. Most sites are situated at, or just above, the tidal limit or, in the case of major tributaries, at, or just above, the confluence. The complete list of determinands is diverse and extensive, covering some 115 different parameters. This list is provided in Annex 7. The average and instantaneous flows at each site should also be measured to allow the calculation of loads.

The objective of the Scheme at the outset was to harmonise Regional monitoring practices by providing a nationally-consistent framework for sampling and analysis. However, apart from a core set of measurements to be made at each site, the choice of which other determinands to sample at what frequencies was left for individual Water Authorities or River Purification Boards to make on the basis of local knowledge. The result was that different Water Authorities selected different determinand suites at different sites. The sites were sampled at different frequencies, in order to meet HMS accuracy targets, and the data was reported at varying intervals. Many of these differences persist amongst the NRA Regions and some may no longer be justified.

There is an outstanding need to take stock of what the HMS has achieved in the past to support decisions on how it might best serve its purpose in the future. This will involve proper statistical analysis of historic data to answer questions about appropriate sampling frequencies and analytical requirements. The list of determinands needs to be reviewed and a new minimum priority suite agreed which should be measured at all sites. The network of sites also needs to be re-examined. Where measurements are taken at Harmonised Monitoring sites to meet the requirements of other legislation (eg national network monitoring for dangerous substances and Paris Commission and Third North Sea Conference Declaration input surveys), these will also need to be taken into consideration in defining the future needs for the Scheme. This review is now under way, beginning with the statistical analysis of the HMS database

Decisions will need to be taken between DoE and the NRA as to how the Scheme might best be managed in the future. Until such an agreement is reached, however, the NRA should continue to report the data to DoE. As an interim measure, each Region should ensure that existing sampling programmes are continued so that potentially valuable time-series of data are not unnecessarily disrupted.

The data should be sent in the agreed format to the DoE on at least a six monthly basis (January - June, July - December) as soon as practicable after the end of each period. Data can still be provided quarterly if this is more convenient. The data should be sent to the Higher Scientific Officer, Environmental Protection Statistics Division, Room A105, Romney House, 43 Marsham Street, LONDON; SW1P 3PY.

## 2.3 Other International Commitments

### 2.3.1 Paris Commission Survey

The Paris Commission (PARCOM) is responsible for administering the implementation of the "Convention for the Prevention of Marine Pollution from Land-based Sources" (The Paris Convention, 1974). The Convention lists 4 different categories of pollutants according to their persistence, toxicity, and potential to bioaccumulate, and sets out the requirements for pollution reduction and elimination. At its tenth meeting of June 1988 in Lisbon, the Commission reached an agreement that the parties to the Convention should undertake a comprehensive study on riverine inputs of certain substances to the sea.

#### Monitoring

The survey is to be carried out annually and should include strategic points on river systems and discharges of the listed substances. The determinands to be measured include certain metals, PCBs, a pesticide, nutrients and other general parameters; these are given in full in Annex 8. Flows must also be measured so that loads can be estimated. Full details of the required survey methodology are set out in the Commission's survey document which is reproduced in Annex 8.

The NRA has the responsibility for conducting the PARCOM survey every year in England and Wales. It did so for the first time in 1990. All the main English and Welsh river systems should be covered, and 12 samples per year should be taken at points just above the tidal limit. These will generally be Harmonised Monitoring sites. In addition, major discharges of industrial and sewage effluent, downstream of the tidal limit sampling point, should be sampled.

Sampling under PARCOM has been rationalised on a 'by determinand' basis using data already collected for England and Wales. For each determinand, sites were ranked according to their Low Mean Annual Load. The following guidelines were used:

- a) at all sites that contribute to 95% of the total National Low Mean Annual load, monitoring should continue at a frequency of at least 12 times per year;
- b) at sites not contributing to 95% of the total National Low Mean Annual Load, but with some positive values, monitoring should continue at a lower frequency of at least 4 times per year;
- c) sites with no positive values should only be monitored occasionally, eg once per year, on a 'watching brief' basis; and
- d) the rationale must be given for any sites normally present in (a) which are absent.

The rationalisation/targeting of sampling sites should be reviewed on a periodic basis to make the best use of sampling resources.



## **Reporting**

The results should be reported according to the total annual loads of each substance entering each of the 32 ICES coastal zones around the English and Welsh coast. At present, the results should be sent before the end of March each year, to NRA Anglian Region, where the national database is held and managed. Anglian Region will then forward information to Head Office, who report the results of each annual survey to DoE.

### 2.3.2 Third North Sea Conference Declaration

In 1988 the DoE/VO issued a consultation paper entitled *Inputs of Dangerous Substances to Water: Proposals for a Unified System of Control* (Ref: DoE 1988). The paper was the UK Government's response to the Second North Sea Conference. The most dangerous substances, for which priority action was proposed, were identified on the 'Red List'. The Red List is essentially a sub-set of the original EEC Priority Candidate Black List of potential List I substances. Commitments made at the Second North Sea Conference were reiterated and extended at the Third North Sea Conference.

The final declaration of this Conference, which took place in March 1990 in The Hague, contains wide-ranging measures for the protection of the North Sea. Amongst these are a number of actions agreed by Ministers to reduce the inputs of hazardous substances into the North Sea. As a matter of principle, it was agreed that discharges of all substances that are persistent, toxic and liable to bioaccumulate should be reduced to levels that are not harmful to man or nature before the year 2,000. As an interim step, it was agreed that a reduction of 50% or more should be achieved, in the inputs of certain substances via rivers and estuaries, between 1985 and 1995. These substances are listed in Annex 1A of the Declaration which is reproduced in Annex 9. The list covers all the existing List I and Red List substances, except PCBs, as well as dioxins and most of the List II metals. This list, called the Priority Hazardous Substances List, is often referred to as the "Extended Red List". For substances that cause a major threat to the marine environment, and at least for dioxins, mercury, cadmium and lead, it was agreed that reductions between 1985 and 1995 of total inputs (via all pathways) of the order of 70% or more should be achieved, provided that the use of Best Available Technology or other low waste technology measures enables such reductions to be made. A series of measures were also agreed to prevent PCBs and hazardous PCB substitutes from entering the marine environment.

#### Monitoring

The NRA is required to carry out the necessary monitoring, except for dioxins, to enable Government to report on progress in reducing the inputs of Annex 1A substances. Annual surveys of the loads of each of the substances have to be carried out on all the major river systems entering the North Sea. As for the PARCOM survey, 12 samples per year should be taken at strategic sites just above the tidal limit on rivers. These will generally be Harmonised Monitoring sites. In addition, samples of major direct industrial discharges and sewage effluents should be taken where they occur downstream of the river tidal limit sampling points and at coastal locations. Flows should be measured at each of these sites to allow the total annual loads to be estimated.

Sampling of Annex 1A substances, already covered by Red List monitoring, has been rationalised on a 'by determinand' basis in the same way as sampling under PARCOM (see section 2.3.1). The additional Annex 1A determinands will be reviewed in the same way, when sufficient data has been collected, so that sampling can be targeted in response to the significance of inputs.

## **Reporting**

At present, data should be sent before the end of March each year to the NRA Anglian Region who manage the national database. Anglian Region will then forward this to Head Office who will report the results to DoE.

## 2.4 Other National Commitments

### 2.4.1 Environmental Change Network

The United Kingdom Environmental Change Network (ECN) was officially launched on 22 January 1992. The objectives of the network are:

- a) to establish and maintain a selected set of sites within the UK from which to obtain comparable long-term data sets by means of measurement at regular intervals of variables identified as being of major environmental importance;
- b) to provide for the integration and analysis of these data, so as to identify environmental changes, and to improve understanding of the causes of change;
- c) to make these long-term data sets available as a basis for research and prediction; and,
- d) to provide, for research purposes, a range of representative sites where there is good instrumentation and reliable environmental information.

The Network is operated by a consortium of sponsoring organisations and is managed on behalf of the consortium by the Natural Environment Research Council (NERC). The NRA is part of the consortium and has undertaken to support this initiative by providing information for several reference sites which have not been significantly affected by human activities and for which long-term time-series data already exist.

#### Monitoring

Seven primary sites and six secondary sites have been selected for data submissions from the NRA. A list of sampling sites and the determinands to be measured are reproduced in Annex 10, along with a list of the surveys to be reported, as and when they are carried out. The minimum sampling frequency for all the chemical determinands, listed under Basic and Metals, is 12 times per year at primary sites. Monitoring for most listed parameters should already be occurring at primary sites, for other reasons (eg the Harmonised Monitoring Scheme or the Freshwater Fish Directive). No additional monitoring need be carried out at secondary sites; only the listed parameters that are already being monitored, or are subsequently added, for other reasons should be reported.

Since the initial data requirement was circulated, mercury has been added to the list of determinands to be reported and Red List Organics are no longer mandatory. Red list Organics data should no longer be collected specifically for ECN requirements; however where it is collected it should be reported along with the Basic and Metals data. With regard to coliforms, whilst confirmed coliforms are the preferred option presumptive are acceptable. NB Once the choice has been made it should not change with time. Coliform analysis is not required for the River Wye site, because of the 6 hour rule. Also the previous requirement for E. Coli was an error, the parameter should be Faecal Coliforms.

## **Reporting**

Data returns should be made, on request from Bristol Head Office, at approximately six monthly intervals. The raw data should be reported in three separate files containing Basic determinands, Metals and where monitoring occurs, for Red List Organics. The reporting arrangements are under review and further guidance will be issued following discussions with other organisations involved in the ECN.

Table 1 - Summary of Freshwater Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
SI 1989/1148 Surface Water (Classification) Regulations 1989 (arising from: 75/440/EEC Surface Water Abstracted for Drinking and 79/869/EEC Methods of Measurement and Frequencies of Sampling and Analysis)	Colouration (after simple filtration), Temperature, Nitrates, Fluorides, Dissolved Iron, Copper, Zinc, Arsenic, Cadmium, Total Chromium, Lead, Selenium, Mercury, Barium, Cyanide, Sulphates, *Total Phenols (Phenol, 2 methyl phenol, 3 methyl phenol, 2 chloro phenol, 2,5 dichlorophenol, 2,4,6 trichlorophenol, 2,5 dimethyl phenol), Dissolved or Emulsified Hydrocarbons (after extraction by petroleum ether), *Polycyclic Aromatic Hydrocarbons, Total Pesticides (parathion, $\gamma$ - HCH, dieldrin), Ammonia	Designated sites	Up to 12 per year (monthly) as defined by Directive 79/869/EEC, with a minimum of 4 per year (quarterly)	Information on all sites failing to meet the standards. Database + covering letter	Annually before the end of April	EC Directive Officer at NRA Head Office	* as determined by chromatography  * The following PAHs: Benzo (a) pyrene Benzo (b) fluoranthene Benzo (ghi) perylene Benzo (k) fluoranthene Fluoranthene Indeno (1,2,3 cd) pyrene
78/659/EEC Quality of Freshwaters Needed to Support Fish Life	*Temperature, *Dissolved Oxygen, pH, Un-ionised Ammonia, Total Ammonia, Total Zinc, •Total Residual Chlorine (in situ)	Agreed sites in designated stretches	Monthly	Information on all sites failing to meet the standards. Database + covering letter	Annually before the end of March	EC Directive Officer at NRA Head Office	* Measurement required weekly upstream and downstream of a thermal discharge  * Minimum of one sample should be representative of low oxygen conditions on the day of sampling  • Until such time as accurate enough test kits become available this determinand need not be analysed
SI 1989/2286 Surface Waters (Dangerous Substances) (Classification) Regulations 1989 and the Direction to the NRA of January 1990 (incorporating the requirements of Directives 76/464/EEC, 82/176/EEC, 84/156/EEC, 83/513/EEC, 84/491/EEC, 86/280/EEC, 88/347/EEC)	At National Network sites all determinands from the list below should be monitored. At sites downstream of known discharges only determinands specific to the discharges should be monitored  Aldrin, Dieldrin, Endrin, Isodrin, *Cadmium and its Compounds, Carbon Tetrachloride, Chloroform, DDT (all isomers), para-para DDT, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclohexane ( $\alpha$ , $\beta$ and $\gamma$ ), *Mercury and its Compounds, Pentachlorophenol and its Compounds	Waters downstream of discharges; sediment and/or shellfish and/or fish in affected areas; waters at National Network sites	Monthly for water samples; Annually for •sediments/shellfish/fish; quarterly for National Network sites	Annual means and ranges for waters downstream of discharges and at National Network sites; all relevant data for sediments/shellfish/fish	Annually before the end of March	EC Directive Officer at NRA Head Office	* Total Cadmium and Mercury for inland waters  • Sediment sampling should be carried out at the same time every year
SI 1992/337 Surface Waters (Dangerous Substances) (Classification) Regulations 1992 (incorporating requirements of Directive 90/415/EEC)	1,2 Dichloroethane, Trichloroethylene, Perchloroethylene, Trichlorobenzene	*As above	As above	As above	As above	As above	* sediment and/or biota monitoring requirement only to apply to Trichlorobenzene

Table 1 - Summary of Freshwater Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
List II Substances; as set out in DoE Circular 7/89	From the list below only determinands specific to the relevant discharge (s) should be monitored:  Lead, Chromium, Zinc, Copper, Nickel, Arsenic, Iron, pH, Boron, Vanadium, Tributyltin, Triphenyltin, Mothproofing Agents (PCSDs, Cyfluthrin, Sulcofuron and Permethrin)	Waters downstream of discharges	Monthly	All relevant data for sites that have failed standards:	Annually before the end of March	EC Directive Officer at NRA Head Office	
77/795/EEC Exchange of Information on the Quality of Surface Freshwater  86/574/EEC Amendments to 77/795/EEC	Flow, Temperature, pH, Conductivity at 20°C, Chlorides, Nitrates, Ammonia, Dissolved Oxygen, BOD, COD, Total Phosphorus, Surfactants reacting to Methylene Blue, Total Cadmium, Mercury, Faecal Coliforms, Total Coliforms, Faecal Streptococci, Salmonella, Biological Quality	Harmonised Monitoring Sites	Monthly	All the data for each determinand	At least 6 Monthly	Higher Scientific Officer, Environmental Protection Statistics Division, DoE	Data reported under agreement for Harmonised Monitoring Scheme
91/71/EEC Concerning Urban Waste Water Treatment	Running waters - See sections 4 and 5 of appendix 1	See section 2 of appendix 1	See sections 4 and 5 of appendix 1	To be decided, dependant upon the requirements of DoE/NRA	Designations to be reviewed at least every 4 years. Relevant information to HO on request	EC Directives Officer at NRA Head Office	All references refer to the document reproduced in Annex 6 of this manual  Please read the sections 2 and 3 of the main document in Annex 6 of this manual
	Still waters - See sections 4 and 5 of appendix 2	See section 2 of appendix 2	See sections 4 and 5 of appendix 2				

Table 1 - Summary of Freshwater Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
Harmonised Monitoring Scheme	<p>Existing determinand suites to be maintained: full list is as follows:</p> <p>Average Flow, Instantaneous Flow, Temperature, Colour, Turbidity, pH, Conductivity, Suspended Solids, Ash (from suspended solids), Dissolved Oxygen (instantaneous), Oxygen Saturation (instantaneous), BOD (inhibited), COD, 4-hour PV, Total Dissolved Organic Carbon, Ammoniacal Nitrogen, Nitrite, Nitrate, Hardness, Un-ionised Ammonia, Chloride, Total Alkalinity, Chlorophyll a, Boron, Fluoride, Orthophosphate, Total Phosphorus, Silica, Sulphate, Calcium, Magnesium, Potassium, Sodium, *Arsenic, *Cadmium, *Total Chromium, *Copper, *Total Iron, *Lead, *Manganese, *Total Mercury, *Nickel, *Selenium, *Vanadium, *Zinc, Anionic Detergent as Manoxol OT, Non-ionic Detergent as Lissapol N, Cyanide (Total), Monohydric Phenols as Phenol, Benzo (g,h,i) perylene, Fluoranthene, Indeno (1, 2, 3-c,d) pyrene, 11,12-Benzofluoranthene, 3,4-Benzofluoranthene, 3,4-Benzopyrene, Aldrin, <math>\gamma</math>-Hexachlorocyclohexane, Heptachlor, para-para DDE, Dieldrin, para-para DDT, Total Phosphate, Faecal Coliforms, Total Coliforms, Faecal Streptococci, Salmonella, *Antimony, *Barium, *Beryllium, *Cobalt, *Molybdenum, *Tellurium, *Thallium, *Tin, *Titanium, *Uranium, *Silver, Phosphorus (elemental yellow), Total Organic Phosphorus, Total Organic Chlorine, Total Organic Silicon, Total Organic Tin, Non-persistent Oils and Hydrocarbons, Persistent Oils and Hydrocarbons, Polychlorinated Biphenyls, Chlorinated Phenols, para-para TDE, Polycyclic Aromatic Hydrocarbons, Endrin</p>	Harmonised Monitoring Sites	Existing sampling frequencies should be maintained until further notice is given	All the data for each determinand	At least 6 monthly	Higher Scientific Officer, Environmental Protection Statistics Division, DoE	<p>* For tidal limit samples determinands to be measured as both:</p> <p>a) dissolved</p> <p>b) dissolved and in suspension.</p> <p>For non-tidal limit sample just as dissolved</p> <p>* Determinands to be measured as both:</p> <p>a) dissolved</p> <p>b) dissolved and in suspension</p>
Paris Commission Inputs Survey	Mercury, Cadmium, Copper, Zinc, Lead, PCBs (the following congeners: IUPAC Nos 28, 52, 101, 118, 138, 153, 180), $\gamma$ -Hexachlorocyclohexane, Nitrate as N, Total Nitrogen (taken in UK as total inorganic N), Orthophosphate as P, Suspended Particulate Matter	Lowest freshwater influence on estuarine/coastal waters (usually Harmonised Monitoring Sites)	* At least 12 times per year	High and low mean average loads and mean flows	Annually before the end of March	Regional Marine Officer at NRA Anglian Region	* Reduced sampling frequencies for individual determinands at sites not contributing to 95% of the total National Low Mean Annual Load



Table 1 - Summary of Freshwater Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
Annex 1a of the Third North Sea Conference Declaration ( 'Extended Red List' )	Mercury, Cadmium, Copper, Zinc, Lead, Arsenic, Chromium, Nickel, Dins (Aldrin, Dieldrin, Endrin), Hexachlorocyclohexane, DDT, Pentachlorophenol, Hexachlorobenzene, Hexachlorobutadiene, Carbon Tetrachloride, Chloroform, Trifluralin, Endosulfan, Simazine, Atrazine, Tributyltin compounds, Triphenyltin compounds, Azinphos-ethyl, Azinphos-methyl, Fenitrothion, Fenthion, Malathion, Parathion, Parathion-methyl, Dichlorvos, Trichloroethylene, Tetrachloroethylene, Trichlorobenzene, 1,2-Dichloroethane, Trichloroethane	Lowest freshwater influence on estuarine/coastal waters (usually Harmonised Monitoring Sites)	* At least 12 times per year	High and low mean average loads and mean flows	Annually before the end of March	Regional Marine Officer at NRA Anglian Region	* Reduced sampling frequencies for individual determinands at sites not contributing to 95% of the total National Low Mean Annual Load
91/676/EEC Nitrate Directive	Nitrate	Designated surface water sites from Directive 75/440/EEC  Additional upstream sites, where the Surface Water site fails the 50 mg/l standard  Groundwater sources used for the abstraction of drinking water	*monthly for surface water during 1996  Routine groundwater sampling and analysis are not necessary. However the 4 yearly survey required by the Directive will need to be repeated at 4 samples per annum in 1996*	To be decided, dependent upon requirements of DoE	1993 then every 4 years before the end of March	EC Directive Officer at Head Office	* a) more frequently during flood periods b) 12 per year, <u>every year</u> if site fails or is close to failing the 50 mg/l standard  * In the year 2000 at sampling stations where all previous samples have been below 25mg/l and no new factor likely to increase the nitrate concentration has appeared

Table 1 - Summary of Freshwater Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
Environmental Change Network (ECN)	<p>Basic Determinands - pH, Turbidity, Colour, Temperature, Conductivity, Dissolved Oxygen (% sat), Dissolved Oxygen (mg/l), BOD 5 ATU, Ammoniacal Nitrogen, TON, Nitrate, Nitrite, Suspended solids, Hardness, Alkalinity, Chloride, Cyanide, Fluoride, Orthophosphate, Silicate, Sulphate, Faecal* Coliforms - Confirmed<sup>1</sup>, Total Coliforms - Confirmed<sup>1</sup></p> <p>Metals - Sodium, Potassium, Total Copper, Total Silver, Total Magnesium, Total Calcium, Total Zinc, Total Cadmium, Total Aluminium, Total Tin, Total Lead, Total Vanadium, Total Chromium, Total Manganese, Total Iron, Total Nickel, Total Mercury</p> <p>Red List organics * - Aldrin, Atrazine, Azinphos-methyl, DDT (PP'), 1,2-Dichloroethane, Dichlorvos, Dieldrin, Endosulfan, Endrin, Fenitrothion, Hexachlorobenzene, Hexachlorobutadiene, Gama HCH, Malathion, PCB (Congeners 28, 52, 101, 118, 138, 153, 180), Pentachlorophenol, Simazine, Trichlorobenzene, Trifluralin</p> <p>[ * Previous version in error parameter should be Faecal Coliforms not E. Coli ]</p>	Primary and secondary Environmental Change Network sites	<p>Monthly for all Basic and Metal determinands at primary sites.</p> <p>At secondary sites there are no additional requirements under ECN. Only data for relevant determinands that are already being monitored need be submitted</p>	All raw data in agreed format	Six monthly	Environmental Quality Technical Assistant at Head Office	<p>* Red List Organics are no longer mandatory under the ECN. Where these determinands are monitored, eg for other reasons, data should be included in the ECN returns</p> <p><sup>1</sup> Whilst confirmed is the preferred option, presumptive is acceptable. NB Once the choice has been made it should not change with time. Coliform analysis is not required for the River Wye site, because of the 6 hour rule</p>

### **3. TIDAL WATERS**

Monitoring requirements for estuaries and coastal waters arise from several EC Directives and various other international agreements. The general responsibilities of the NRA with regard to each of these is discussed in this chapter and specific monitoring details are summarised in Table 2. The anticipated numbers of samples, to be taken for each monitoring requirement, are given in Annex 15.

#### **3.1 EC Directives**

##### **3.1.1 Bathing Water Quality (76/160/EEC)**

**The requirements for monitoring, analysis and reporting were previously detailed in the NRA Policy Implementation Note SC/EC/002, "Bathing Waters - Identification, Sampling and Analysis". This PIN is however no longer applicable and the following notes replace it.**

EC Directive 76/160/EEC was adopted by the Council of the European Communities in 1975. The Directive concerns the quality of bathing waters for the purpose of protecting public health and also for reasons of amenity. Quality is to be raised over time, largely by ensuring sewage is not present or has been adequately diluted or destroyed. The NRA has been designated the competent authority by the DoE for the implementation of the Bathing Waters Directive in England and Wales. The NRA must report the results of its monitoring programme each year to the DoE. The DoE then assess compliance with the Directive and reports the results to the European Commission, which then publishes them in map and report form.

The mandatory requirements of this Directive have been transcribed into UK legislation under the provisions of the 1991 Water Resources Act by the Bathing Waters (Classification) Regulations (SI 1991/1597) which came into force on 9 August 1991; reproduced in Annex 11 [1]. The Regulations specify a single classification, BW1, which defines the determinands to be measured and the standards to be achieved. A Direction from the DoE was given to the NRA in May 1992 to implement these Regulations, together with a Notice identifying the waters to which the classification BW1 should apply and a separate Notice identifying bathing waters to which transparency and colour derogations were to apply.

The Directive defines bathing water as "fresh or sea water in which bathing is explicitly authorized or is not prohibited and is traditionally practised by a large number of bathers". So far (1994 season) DoE/WO have identified 419 coastal or estuarine sites in England and Wales as coming under the scope of the Bathing Water Quality Directive. Applications for the identification of additional bathing waters are considered on a case by case basis by the DoE after consultation and advice by the NRA, taking into account the guidance provided by the Commission in their response to a European Parliamentary Question (Annex 11 [2] ).

## **Monitoring**

The NRA is required to monitor and sample identified bathing waters during the period 1 May to 30 September (the bathing season in England and Wales being from 15 May to 30 September). Current policy is that twenty samples must be taken during that period. Samples are to be taken at predetermined sample points off the beach where the average daily density of bathers is at its highest. Samples should be taken 30 cm below the surface, except in the case of samples used for testing for mineral oils. These should be taken at the water's surface. Details of the analyses to be carried out are set out in Annex 11 [3].

The NRA has traditionally also monitored a number of recreational bathing waters in addition to identified bathing waters. As the NRA has no statutory requirement to monitor recreational waters, this practise was to cease at the end of the 1993 bathing season, unless samples were being taken for operational reasons, to monitor water quality for the future identification of the bathing water, or as part of a controlled investigation project. Two years data are required for applications for the identification of a new bathing water. Where sampling has previously been carried out at the request of the Local Council then this change in policy should have been outlined to the Council. If the Council wishes the NRA to continue monitoring recreational bathing waters, then a contract should be negotiated.

## **Reporting**

NRA Regions must submit the results of the annual bathing water quality survey to NRA Head Office before 31 October in order that these may be collated and forwarded to DoE by 7 November.

An assessment of exceedences of the mandatory coliform standards should be made. These should be reported together with details of possible causes of exceedences and measures which will be taken to ensure future compliance. The provision of such information may require additional sampling. This additional sampling also falls within the statutory monitoring programme.

Annual results should be sent in electronic format as a comma separated variable (CSV) file. The data format for reporting is reproduced in Annex 11 [3].

Article 5.2 of the Bathing Water Directive states that "deviations from the values referred to in Article 3 shall not be taken into consideration in the calculation of the percentage referred to in paragraph 1 when they are the result of floods, other natural disasters or abnormal weather conditions". This is transcribed in the Bathing Waters (Classification) Regulations 1991 SI 1597 in paragraph 2 of Schedule 1 which states "for the purposes of paragraph 1 above samples shall be disregarded if they deviate from the parametric values specified in Schedule 3 as a result of abnormal weather conditions, floods or other natural disasters."

If it is believed that a sample exceeded the mandatory coliform standards due to abnormal weather, application for a waiver for this sample should be made by a "1" in the returns format (see Annex 11 [3] ). The application for the waiver should be

supported by rainfall data and any other suitable evidence when the annual returns are made. There is no official definition of what constitutes exceptional weather and none can be given - waivers will be granted at the discretion of the EC, but DoE advise that generally a 1 in 5 year storm event is regarded as exceptional weather.

Analytical data for all samples should be included in the annual returns - exceedences relating to abnormal weather will not be included when the calculation of compliance is made. For example, if 2 of 20 samples taken over the season exceeded the mandatory faecal coliform standard and it was accepted that one exceedence was directly related to abnormal weather, only one of the 20 samples would be regarded as having failed and therefore the water would comply.

Details of identified bathing waters and their associated sampling points are held on a Dataease database at Head Office. These details do not need to be included in the data return from Regions, but if any details require updating - for example, if a new bathing water is identified, then the details should be supplied to Head Office **on paper** with the annual return. The format for updating these records is set out in Annex 11 [3]

### **Proposals for a new Bathing Water Directive**

On 16 February 1994 the European Commission approved proposals for a new Bathing Waters Directive intended to update the current Directive "in the light of scientific knowledge and technical progress". Member States have a period of time to consider the proposal before negotiations on the requirements of the proposed Directive commence.

The proposals include dropping the total coliforms parameter which is not felt to be a particularly useful indicator of sewage pollution. Salmonella and certain physico-chemical parameters which are not considered suitable measures of water quality have also been removed. The standard for enteroviruses has, however, been retained and that for faecal coliforms replaced with the more definitive *E.coli*.

The proposals also contain a mandatory standard for faecal streptococci of no more than 400 per 100 ml. This new standard would undoubtedly have implications for all Member States in terms of compliance.

It must be stressed that such amendments to the Directive are currently only a proposal and are subject to negotiations between Member States before the final text is adopted. The NRA are advising DoE on the implications of these proposals to ensure that new parameters and standards have a sound scientific basis.

### 3.1.2 Quality of Shellfish Waters (79/923/EEC)

The Shellfish Directive lays down requirements for the quality of designated waters which support shellfish (defined as bivalve and gastropod molluscs). Its purpose is to safeguard shellfish populations from the harmful consequences resulting from the discharge of polluting substances into the sea. Thus this Directive is aimed at protecting the shellfish populations themselves rather than the health of the consumers which is covered by a more recent Directive, 91/492/EEC. DoE/WO have designated 18 areas under 79/923/EEC to date.

The Annex to the Directive lists a number of parameters for which mandatory and/or guideline standards are given, together with minimum sampling frequencies. Compliance of designated shellfish waters must be demonstrated against those parameters with mandatory standards.

An advice note "Advice on the Implementation in England and Wales of the EC Directive on the Quality Required of Shellfish Waters" was issued by the DoE in November 1980. The advice note covered monitoring requirements, designations and derogations. It also gave advice on suitable water quality standards for the metal and pesticide determinands for which descriptive standards had been given in the Directive. These standards were not however, in line with those established by subsequent Dangerous Substances legislation. The NRA has pointed out these discrepancies and DoE are now reviewing these standards. Further guidance will be given when this issue has been resolved.

Until further notice the standards to be applied to the water column of designated shellfish waters are those given in Annex 12.

#### **Monitoring**

The Directive has yet to be formally translated into UK legislation through Regulations under the WRA '91. However, it is assumed that the NRA should continue to carry out the necessary monitoring in designated areas to assess compliance with its conditions. The determinands with mandatory standards listed in the Annex of the Directive are to be measured in the water column. No analysis of shellfish flesh is required.

The minimum sampling frequency is quarterly for most determinands, although some (dissolved oxygen and salinity) are required monthly, and others (organohalogenated substances and metals) have to be measured every six months (see Annex 12 for full details of sampling frequencies). However, competent authorities are allowed to reduce the frequency of sampling where it appears that the quality of the water is appreciably higher than that implied by the parametric values set (ie where no exceedences of standards have occurred in previous years). The period of sampling relative to the state of the tide and the number of samples collected should be determined on the basis of local environmental conditions. Samples over intertidal shellfish beds should be collected within one hour of high water.

Directive 91/492/EEC on the health conditions for marketing shellfish has now been adopted and translated into UK legislation via The Food Safety (Live Bivalve Molluscs) (Derogation) Regulations 1992 (SI 1992/1508). The coliform standards in 91/492/EEC effectively replace the guideline coliform standard in 79/923/EEC. As monitoring and compliance with 91/492/EEC falls under the direct responsibility of MAFF, the NRA are no longer required to monitor for coliforms in either water or shellfish flesh. The NRA will however continue to monitor the remaining water quality determinands in 79/923/EEC which have mandatory standards.

### **Reporting**

The NRA Regions should report the results annually to Head Office before the end of March so that a national report can be prepared and passed over to the DoE/WO. A report is required covering the number of samples and number of exceedences of mandatory standards at each designated shellfish water sample site and where exceedences occur, reasons for failure should be explained, together with details of action programmes to ensure future compliance. The provision of such information may require additional sampling. This additional sampling also falls within the statutory monitoring programme.

### **3.1.3 Dangerous Substances (76/464/EEC and Daughter Directives)**

#### **List I and List II Substances**

The details of the relevant EC and national legislation on dangerous substances are discussed in Section 2.1.3 of this report. Most of the provisions discussed for freshwaters also apply to tidal waters. The relevant EQSs for tidal waters are set out in the Surface Waters (Dangerous Substances) (Classification) Regulations (SI 1989/2286) in the Classification DS2 and in the Classification DS3 of SI 1992/337; both are reproduced in Annex 4. Standards for List II substances in tidal waters are given in DoE Circular 7/89 and are listed in Annex 4.

#### **Monitoring**

Monitoring should be carried out in all waters receiving identified discharges of these substances. Circular 7/89 requires that the position of the monitoring point should be sufficiently close to the discharge point to be representative of the aquatic environment in the area affected by the discharges. This is not particularly helpful in making decisions on what constitutes an acceptable effluent mixing zone; what is "representative of the aquatic environment" is very much a matter of subjective interpretation. The coastal waters aerial surveillance programme offers a very useful way forward in this debate. It will provide detailed information on the location and extent of effluent plumes through thermal and spectral imagery, thus allowing a rapid and effective means of defining the extent and movement of mixing zones.

Because the physiographic conditions and tidal regimes of estuaries and coastal waters differ widely around the coastline. Regions will need to make their own judgements on appropriate sampling point locations based upon their detailed local knowledge. In some cases, water quality models will be available to assist in assessing the extent and movement of mixing zones, and identifying sampling locations. These should be used where appropriate. Until more precise definitions and protocols have been agreed, the following tiered approach can be used as an interim measure to identify where suitable sampling points should be located. These sample points should then be used for monitoring and compliance assessment.

#### **Tier 1**

Collect water samples in the immediate vicinity of the effluent discharge at a point where the concentration is likely to be greatest. Where the EQS at this point is likely to be exceeded, or where sampling at this point is impractical, Tier 2 monitoring should be undertaken.

#### **Tier 2**

Sampling of the effluent plume should be carried out at distances of 100 m and 250 m from the point of maximum concentration. The exact sampling location will be dependent upon the tidal state and the direction of effluent movement. Where the EQS is likely to be exceeded at 250 m from the discharge, Tier 3 monitoring should be carried out.



### Tier 3

Where the EQS is exceeded at a distance greater than 250 m from the discharge point, the full extent of the area of exceedence will need to be determined by the use of predictive numerical models and/or intensive grid sampling, or any other appropriate technique (eg dye-tracing). Representative sampling sites should then be chosen for compliance monitoring taking into account the area of exceedence for particular tidal conditions.

In assessing the results of Tier 2 and Tier 3 monitoring, it should be borne in mind that the area of EQS exceedence must not interfere with any recognised uses of the receiving water. At locations where uses are confined to small areas, monitoring at distances intermediate from 0 m to 100 m and 250 m may be required to demonstrate the proportion of use-area adversely affected by the discharge(s). There is a recognised need to agree the acceptable extent of the area of exceedence and further guidance will be given when nationally consistent criteria have been agreed.

In order to demonstrate that samples are representative of waters affected by the discharge, all samples should be analyzed for salinity and a water quality parameter appropriate to the particular discharge. Samples should be collected from the surface except in circumstances where local environmental considerations indicate the need to define variations of concentration with depth.

The above approach should be viewed as the minimum to be undertaken to identify the locations of suitable sample points. More intensive surveys should be performed wherever they are warranted by local conditions. The number of samples to be taken during this initial assessment should be kept to a minimum. Once the points have been identified they should be monitored at the required frequency and only data from these points should be reported. If the sampling points need to be changed for any reason, the normal procedures for reporting changes should be followed in making the annual returns. Dependent upon the prevailing tidal regime, it may be appropriate to use two sampling points, one for the flood tide and one for the ebb tide. The two points should be reported on separately, but the numbers of samples from each can be combined to achieve the required sampling frequency. Results from no more than two sample points related to a particular discharge should be reported.

General guidance on the appropriate level of sampling are given in DoE Circular 7/89 (see Section 2.1.3) however, where possible, 12 samples per annum should be taken at the agreed sampling points. It is acknowledged that at some locations it will be impractical to sample at this frequency. Where this is the case, it is acceptable to sample at a lower frequency, but this should not fall below 4 per annum. In addition to those waters receiving discharges of dangerous substances, environmental monitoring of List I substances is also required at national network sites. These should be chosen to "generally reflect the ubiquity of the substance" (DoE Circular 7/89). It is recommended that National Network Sites should be chosen to correspond to all discharges registered with the DoE for one or more List I substance and where it is known or suspected that diffuse inputs of any List I substance will contribute to measurable concentrations in the receiving water. Where appropriate

the sites covered by the proposed UK National (Marine) Monitoring Programme (see section 3.2.1) should be used.

For those List I substances for which a 'standstill' provision applies (i.e. mercury, cadmium, hexachlorocyclohexane, DDT, pentachlorophenol, the Drins, hexachlorobenzene, hexachlorobutadiene, and trichlorobenzene) there is a requirement to monitor the levels in sediments and/or molluscs and/or shellfish and/or fish. Where possible, sediment samples should be taken at identified sites, at the same time every year and analysis should be carried out on the  $< 63\mu\text{m}$  fraction of the sample. Identification of sediment monitoring sites should be assisted by knowledge of local deposition and re-suspension characteristics; stable sedimentation regimes are required to demonstrate 'standstill' concentrations. Sediment samples should be taken at a minimum frequency of once per year.

Where conditions are inappropriate for sediment sampling, biological samples should be taken for tissue analysis where suitable species are naturally available. Where possible, suitable molluscan species should be taken for analysis, but if not available, flatfish may be used as the least preferred option. Biological samples should also be taken where there is a risk of possible adverse effects caused by bioaccumulation of dangerous substances. The guidelines set out in Section 2.1.3 should be used in making judgements on this. The techniques for bioaccumulation assessment are currently being reviewed through the NRA's R & D programme (see Section 2.1.3).

### **Reporting**

The reporting requirements are the same as those outlined for freshwaters in Section 2.1.3. All relevant data and supplementary information should be sent annually to NRA Head office in the agreed format before the end of March.

### **3.1.4 Titanium Dioxide (78/176/EEC, 82/883/EEC, 83/29/EEC and 92/112/EEC)**

These Directives concern the prevention and progressive reduction of pollution caused by waste from the titanium dioxide industry. The first two directives 78/176/EEC and 82/883/EEC set out the specific requirements for environmental monitoring in waters affected by these discharges and are set out in Annex 13. Currently, there are only three factories discharging titanium dioxide waste in the UK; one on Teeside, and two on the south bank of the Humber. The monitoring requirements therefore only affect Northumbria & Yorkshire Region and Anglian Region respectively.

A new Directive 92/112/EEC was adopted in December 1992 to replace the Directive 89/428/EEC on the harmonization of programmes for the reduction of pollution from the titanium dioxide industry, which was annulled by the European Court of Justice in 1991. Further details of the titanium dioxide Directives can be found in the NRA report "Discharges of Waste under the EC Titanium Dioxide Directives" published in March 1993 (Ref: NRA 1993b).

#### **Monitoring**

The receiving water quality should be measured at a minimum frequency of 3 times per year. Samples should be taken in the immediate vicinity of the discharge point and in a neighbouring zone deemed to be unaffected by the discharge. The Directive also requires that a biological survey is carried out and that sediment samples are taken around each discharge point once every year.

#### **Reporting**

Results of the sampling programmes should be sent annually to Head Office before the end of March.

### 3.1.5 Urban Waste Water Treatment Directive (91/271/EEC)

The basic requirements of this Directive are described in Section 2.1.5. However, there are two important aspects of Urban Waste Water Treatment Directive related to the monitoring of saline waters. These are (a) Sensitive Areas (eutrophic) (which may be fresh or saline) and (b) Less Sensitive Areas (which may only be saline).

The UK approach to identifying Sensitive Areas (eutrophic) is outlined in Section 2.1.5. For coastal waters in particular, the future strategy may include coastal zone monitoring which will involve the combined use of boats and aerial surveillance and will provide nutrient and chlorophyll data for the entire coastal strip.

It is anticipated that the NRA's role in the identification of Less Sensitive Areas (now termed High Natural Dispersion Areas (HNDAs)), and in the monitoring of the effects of discharges on such areas, will be to specify the information requirements and to audit the information provided by the dischargers. The MPMMG, at the request of the UK Environment Departments, has produced a document proposing a national strategy in relation to the "Comprehensive Studies" which will be carried out in HNDAs. The studies will be undertaken at the expense of the discharger and may involve both modelling and monitoring. The outcome will determine whether a minimum of primary (as opposed to secondary) treatment will be permitted for a given discharge. The waters and discharges, to which the initial comprehensive studies will relate, were announced by the Government on 18 May 1994. 58 HNDAs, affecting some 91 discharges, in England and Wales, were identified in the Government announcement. The UWWTD Implementation Group is considering the issue of timescales, responsibilities, sharing of expertise and reporting for the comprehensive studies. Further guidance will be issued pending the outcome of the Groups deliberations.

## **3.2 Other National and International Commitments**

### **3.2.1 UK National (Marine) Monitoring Plan**

The Ministerial Declaration of the Second International North Sea Conference held in London in 1987 contained a firm endorsement for more harmonisation of methods for monitoring, modelling and assessment of environmental conditions in the North Sea, both at national and international level. The Declaration advocated the setting up of a co-ordinated scientific programme to permit links between contaminant inputs, and their concentrations and effects, to be established with greater confidence. Consequently, as requested by the Declaration, the Oslo and Paris Commissions (OSPARCOM) and the International Council for the Exploration of the Sea (ICES), established a North Sea Task Force (NSTF) to co-ordinate this work.

One of the principal objectives of the NSTF was to prepare a Quality Status Report (QSR) of the North Sea by the end of 1993. This required co-ordinated data collection and quality assurance. In order to achieve this a Monitoring Master Plan (MMP) (Ref: NSTF 1990) was established, covering the whole North Sea area. The requirements of the NSTF MMP provided the basis for the NRA Baseline Estuary and Coastal Waters Monitoring Programme (Ref: NRA 1991b). Practical guidelines were set out in this Programme to ensure that the various monitoring obligations were met and that the requisite data were collected in a consistent manner. The NSTF ceased to exist at the end of 1993, but the harmonisation of environmental assessment will continue.

The report of the House of Lords Select Committee on Marine Science and Technology, (Ref: HMSO 1986), concluded that there was an urgent need to ensure that the overall monitoring activity of the marine environment was adequate. It recommended that the Marine Pollution Monitoring Management Group (MPMMG) should review existing activities and develop advice on what was needed to ensure that UK monitoring activity met this requirement. This review (Ref: DoE 1991a) concluded that although a great deal of estuarine monitoring was carried out around the UK, there were surprising gaps in coverage, programmes did not generally have clear quantitative objectives or sound statistical bases, and insufficient thought was given to the planning of programmes in relation to the questions that needed to be answered. The review recommended that a minimum programme should be established in all major estuaries to assess the relative extent of contamination, the current biological status, and trends in both of these. The report also recommended that, in addition, an open sea coastal programme based upon 20 - 30 reference sites should be set up to assess long-term trends in physical, biological and chemical parameters to establish the natural variability of the marine environment, thereby allowing a clearer definition of trends in contaminated areas. Both estuarine and coastal water monitoring needs could be addressed through the establishment of a consistent national monitoring programme.

In its formal response to the MPMMG review (Ref: DoE 1991b), the Government accepted the need for a minimum core programme of marine monitoring to National Standards for all main UK estuaries, and agreed that an open sea coastal programme based on up to 30 sites should be established. The Government saw the development

of a National (Marine) Monitoring Plan (NMP) as an opportunity to rationalise existing activities and to provide better co-ordination of the monitoring requirements arising from international commitments, including the Joint Monitoring Programme (JMP) of OSPARCOM and the NSTF Monitoring Master Plan. It also saw the advantages of an NMP with respect to the monitoring required for the introduction of Statutory Water Quality Objectives.

The UK NMP has now been approved by the MPMMG. The plan is reproduced in Annex 14. It sets out the network of sites, along with details of the proposed physical, chemical and biological parameters to be measured. Some of these stations are located in estuarine and coastal areas within the 3 nautical mile limit, and monitoring at these sites is therefore an NRA responsibility. The implementation of the Plan in the UK presents an opportunity for the NRA to harmonise its Regional monitoring programmes and co-ordinate its activities with other organisations. The Plan also serves to fulfil the NRA's commitments to OSPARCOM reporting.

### **Monitoring**

Samples should be taken at all sites for which the NRA is responsible. The determinands to be measured, the matrices in which they should be measured and their monitoring frequencies are set out in the UK NMP (Annex 14) and in table 2 overleaf.

### **Reporting**

Reporting arrangements have yet to be agreed. Further guidance on reporting will be issued in due course.

Table Summary of Tidal Water Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
SI 1991/1597 Bathing Waters (Classification) Regulations 1991 (arising from 76/160/EEC on Bathing Water Quality)	Total Coliforms - Confirmed, Faecal Coliforms - Confirmed, + Salmonella, + *Enteroviruses, pH, Colour, Mineral Oils, Surface Active Substances reacting with Methylene Blue, *Total Phenols (Phenol, 2 methyl phenol, 3 methyl phenol, 2 chloro phenol, 2,5 dichlorophenol, 2,4,6 trichlorophenol, 2,5 dimethyl phenol), Transparency, Faecal Streptococci*	Identified bathing waters at a point at which the daily average density of bathers is highest	Minimum of fortnightly between 1 May and 30 September (20 samples to be taken throughout season)	All the data for each determinand	Annually before end November	EC Directive officer at NRA Head Office	* Required to assess Blue Flag or Seaside Award status  + 2 samples per year.  ● Only where coliform samples failed in the previous year.  * Olfactory assessment should be made at each site visit. If phenols are suspected to be present a sample should be taken for laboratory analysis
79/923/EEC Quality Required for Shellfish Waters	a) Salinity, Dissolved Oxygen Saturation b) pH, Colouration (after filtration) Suspended Solids, Petroleum Hydrocarbons. c) Organohalogenated Substances (DDT, Lindane, Parathion and Dieldrin), Silver, Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Zinc d) Substances affecting the taste of shellfish	Designated shellfish waters	a) Monthly b) Quarterly c) Once every six months d) where presence is presumed	All the data for each determinand	Annually before the end of April	EC Directive officer at NRA Head Office	
SI 1989/2286 Surface Waters (Dangerous Substances) (Classification) Regulations 1989 and Direction to the NRA of January 1990  (Incorporating the requirements of Directives 76/464/EEC, 82/176/EEC, 84/156/EEC, 83/513/EEC, 84/491/EEC, 86/280/EEC, 88/347/EEC)	At National Network sites all determinands from the list below should be monitored. At sites downstream of known discharges only determinands specific to the discharges should be monitored.  Aldrin, Dieldrin, Endrin, Isodrin, *Cadmium and its Compounds, Carbon Tetrachloride, Chloroform, DDT (all isomers), para-para DDT, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclohexane (all isomers), *Mercury and its Compounds, Pentachlorophenol and its Compounds	Waters downstream of discharges; sediment and/or shellfish and/or fish in affected areas; waters at National Network sites	Monthly for water samples; annually for ●sediments/ shellfish/fish; quarterly for National Network sites	Annual means and ranges for waters downstream of discharges and at National Network sites; all relevant data for sediments/ shellfish/fish	Annually before the end of March	EC Directive Officer at NRA Head Office	* Dissolved Cadmium and Mercury for coastal waters  ● Sediment sampling should be carried out at the same time every year
SI 1992/337 Surface Waters (Dangerous Substances) (Classification) Regulations 1992 incorporating the requirements of Directive 90/415/EEC	1, 2 Dichloroethane, Trichloroethylene, Perchloroethylene, Trichlorobenzene	* As above	As above	As above	As above	As above	* sediment and/or biota monitoring requirements only apply to Trichlorobenzene

Table 2 - Summary of Tidal Water Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
List II Substances: as set out in DoE Circular 7/89	From the list below only determinands specific to the relevant discharge(s) should be monitored:  Lead, Chromium, Zinc, Copper, Nickel, Arsenic, Iron, pH, Boron, Vanadium, Tributyltin, Triphenyltin, Mothproofing Agents (PCSDs, Cyfluthrin, Sulcofuron and Permethrin)	Waters downstream of discharges	Monthly	All relevant data for sites that have failed standards	Annually before the end of March	EC Directive Officer at NRA Head Office	
78/176/EEC Waste from the Titanium Dioxide Industry  82/883/EEC Procedures for Surveillance and Monitoring of Environments Concerned by Waste from the Titanium Dioxide Industry	Water: Iron (total dissolved, hydrated oxides and hydroxides)  Sediment: Titanium, Iron (total, hydrated oxides and hydroxides)  Living organisms: Titanium, Chromium, Iron, Nickel, Zinc, Lead  Diversity and relative abundance of benthic fauna: presence of morbid anatomical lesions in fish	At the same location and depth and under the same conditions each time. One near the discharge and another in a neighbouring area deemed to be unaffected by the discharge	Once every 4 months for water samples; annually for sediments and biota	All relevant data	Annually before the end of March	EC Directive officer at NRA Head Office	
91/71/EEC Concerning Urban Waste Water Treatment	Tidal waters - See section 2 of appendix 3	See section 2 of appendix 3	See section 2 of appendix 3	To be decided, dependant upon the requirements of DoE/NRA	Designations to be reviewed at least every 4 years. Relevant information to HO on request	EC Directives Officer at NRA Head Office	All references refer to the document reproduced in Annex 6 of this manual  Please read the sections 2 and 3 of the main document in Annex 6 of this manual
	Coastal waters - See sections 2 and 3 of appendix 4	See sections 2 and 3 of appendix 4	See sections 2 and 3 of appendix 4				



Table - Summary of Tidal Water Quality Monitoring Requirements

Monitoring Requirement	Mandatory Determinands to be Measured	Sampling Location	Sampling Frequency	Report Format	Reporting Frequency	Reporting To	Comments
Marine Pollution Monitoring Management Group (MPMMG) - UK National Monitoring Plan	<p>Unfiltered Water: <math>\gamma</math> and <math>\alpha</math>-Hexachlorocyclohexane, *<math>\beta</math>-Hexachlorocyclohexane, *Dieldrin, *Aldrin, *Endrin, *Isodrin, Hexachlorobenzene, *Hexachlorobutadiene, Pentachlorophenol, *DDT (op DDT), *Priority Hazardous Substances (Carbon Tetrachloride, Chloroform, Trifluralin, Endosulfan, Simazine, Atrazine, Azinphos-ethyl, Azinphos-methyl, Dichlorvos, Fenitrothion, Fenthion, Malathion, Parathion, Parathion-methyl, Trichloroethylene, Tetrachloroethylene, Trichlorobenzene, 1,2-Dichloroethane, Trichloroethane) Dissolved Oxygen, Suspended Solids, Chlorophyll a, Secchi-depth, Salinity, Temperature, Oyster Embryo Bioassay</p> <p>Filtered Water Sample: Mercury, Cadmium, Copper, Lead, Nickel, Zinc, Chromium, Ammoniacal Nitrogen, Nitrate as N, Nitrite as N, Orthophosphate as P, Silicate as Si</p> <p>Total Surficial Sediment: Aluminium, Mercury, Cadmium, Copper, Lead, Nickel, Zinc, Arsenic, Chromium, Tributyl tin, • Polychlorinated Biphenyls, *Dieldrin, *Aldrin, *Endrin, Hexachlorobenzene, DDT (pp TDE, pp DDE, pp DDT), Oyster Embryo Bioassay</p> <p>Shellfish: Mercury, Cadmium, Lead, Zinc, Tributyl Tin, • Polychlorinated Biphenyls, <math>\gamma</math> and <math>\alpha</math>-Hexachlorocyclohexane, *Dieldrin, *Aldrin, *Endrin, Hexachlorobenzene, Pentachlorophenol, DDT (pp TDE, pp DDE, pp DDT), *Hexachlorobutadiene</p> <p>Fish Muscle: Mercury, Arsenic</p> <p>Fish Liver: Cadmium, Lead, • Polychlorinated Biphenyls, *Dieldrin, *Aldrin, *Endrin, DDT (pp TDE, pp DDE, pp DDT)</p>	Sites in agreed estuaries representative of the 0-10 ppt, 10-20 ppt, 20-30 ppt salinity ranges; agreed intermediate coastal water sites. To be decided for sediment, biological tissue analysis & benthos after analysis of the spatial surveys	Quarterly for water quality at estuarine sites; annually for water quality at intermediate sites; annually for sediment samples; twice per year (winter and summer) for oyster embryo bioassay at estuarine sites, once per year at intermediate sites; to be decided for sediment, biological tissue analysis & benthos after analysis of the spatial surveys	To be agreed by NRA	Annually, date to be decided	Regional Marine Officer at Anglian Region To be agreed by NRA	<p># If these determinands are detected in unacceptable concentrations in an estuary they should also be measured at the appropriate intermediate and offshore sites</p> <p>• on an individual basis congener numbers 28, 52, 101, 105, 118, 128, 138, 153, 156, 170, 180 (also Congeners 77, 126 and 169 if possible)</p> <p>• Estuarine sites only</p>



## **4. GROUNDWATER**

### **4.1 EC Directives**

#### **4.1.1 Protection of Groundwater Against Pollution (80/68/EEC)**

In contrast to the complex sets of criteria and conditions in the Directives for surface waters, the legislation for groundwaters contains few numerical standards which are required to be met. The Directive on "the Protection of Groundwater against Pollution caused by Certain Dangerous Substances", 80/68/EEC, is aimed at either preventing (for List I substances), or limiting (for List II substances), the introduction of contaminants into groundwater in order to avoid pollution. The provisions of the Directive relate to the control measures for the direct or indirect discharges themselves rather than to any particular standards to be achieved in the environment. Thus there are no specific monitoring requirements as such, although some site-specific investigative sampling may be required for the purposes of identifying the appropriate control measures and auditing their effectiveness.

The NRA has been given the task of setting up a national classification scheme, for Directive purposes, in England and Wales. The scheme will classify substances as List I, List II (or neither) on the basis of their toxicity, persistence and bioaccumulation potential. A National Advisory Group has been convened to undertake this work and to consider aspects of implementation of the Directive. It is not however anticipated, at this stage, that any additional monitoring burden will result from the introduction of the classification scheme.

#### **4.1.2 Drinking Water Quality (80/778/EEC)**

The EC Directive on the Quality of Water Intended for Human Consumption, 80/778/EEC, sets out a range of standards for the quality of water at the point of supply. Compliance monitoring is a matter for the Water Supply Companies and is not the direct concern of the NRA. However, if specific problems arising from the pollution of aquifers do occur, the NRA will investigate them and use the powers available to it to resolve them where necessary. This may involve localised investigative sampling at or around supply boreholes.

#### 4.1.3 Nitrate from Agricultural Sources (91/676/EEC)

The EC Directive on the "Protection of Waters Against Pollution Caused by Nitrates from Agricultural Sources", (see also Section 2.1.6) contains a number of provisions for groundwater. The Directive requires that Vulnerable Zones be designated for those groundwaters where the nitrate concentration either exceeds 50mg/l, or could exceed this level if the necessary preventative action is not taken. Within a two-year period following the designation of Vulnerable Zones, Member States are required to establish action programmes, including codes of good agricultural practice, to reduce nitrate levels in groundwaters.

The Directive includes several specific requirements for groundwater monitoring. Within a period of two years following notification of the Directive, the nitrate concentration in groundwaters should be measured over a period of one year "at regular intervals at sampling stations which are representative of the groundwater aquifers of Member States". The initial monitoring period has now ended. The monitoring programme should be repeated at intervals of at least four years, except for those sampling stations where the nitrate concentration in all previous samples has been below 25 mg/l and no new factor likely to increase the nitrate content has appeared, in which case the monitoring programme should be repeated only every 8 years.

The designation of Vulnerable Zones in England and Wales is currently the subject of a Government consultation exercise (launched in May 1994). In addition the Authority is formulating a national strategy on groundwater monitoring as a whole. The decisions taken on these issues will determine the nature and extent of the groundwater monitoring programme needed to be undertaken by the NRA in England and Wales in accordance with the Directive. Further guidance will be issued when the intentions of Government over the implementation of the Directive are more clearly known. However, it seems likely that Government will recommend that the NRA should, where possible, use data produced by the sampling programmes of the water supply companies, where this is compatible with Government requirements to implement the Directive.

## 4.2 Water Resources Act 1991

The Act makes certain provisions for the protection of groundwater from pollution, but is not specific about the associated monitoring requirements. As for surface waters, the key Section in the Act is S.84 which requires that the NRA should "monitor the extent of pollution in controlled waters". The standards and conditions to be met in groundwaters may be defined by the introduction of classifications (S.82) and the setting of Statutory Water Quality Objectives (S.83) for particular waters.

The Act also provides powers for certain pollution prevention measures, including the designation of Water Protection Zones (S 93) and Nitrate Sensitive Areas (S 94). These provisions are aimed at controlling pollution at source by restricting certain activities, and not achieving any specified standards in the environment. There are therefore no specific monitoring requirements associated with these provisions, although some localised investigative sampling may be needed to support decisions on the designation of areas of land and to assess the effectiveness of the control measures.

The NRA has formulated a national strategy for the protection of groundwater and the technical framework for its implementation. A policy document describing this strategy (Ref: NRA 1992b) was published in December 1992 and an R&D study has been carried out to establish a common methodology for monitoring and sampling groundwater (R&D Project 284).







# **ANNEX 1**

## **Environmental Protection Act 1990**

**Schedule 5 of the Environmental Protection (Prescribed Processes and Substances)  
Regulations (SI 1991/472)**

## **Annex 1**

### **SCHEDULE 5**

Regulation 6(2)

#### **RELEASE INTO WATER: PRESCRIBED SUBSTANCES From SI 1991/472**

Mercury and its compounds  
Cadmium and its compounds  
All isomers of Hexachlorocyclohexane  
All isomers of DDT  
Pentachlorophenol and its compounds  
Hexachlorobenzene  
Hexachlorobutadiene  
Aldrin  
Dieldrin  
Endrin  
Polychlorinated Biphenyls  
Dichlorvos  
1,2-Dichloroethane  
All isomers of Trichlorobenzene  
Atrazine  
Simazine  
Tributyltin compounds  
Triphenyltin compounds  
Trifluralin  
Fenitrothion  
Azinphos-methyl  
Malathion  
Endosulfan

## **ANNEX 2**

### **Surface Water Abstracted for Potable Supply**

**Details of classification of abstractions, derogations, mandatory standards and sampling frequencies**

## **Annex 2**

### **Directive concerning the quality required of surface water intended for the abstraction of drinking water (75/440/EEC)**

#### **ANNEX I**

#### **Definition of the standard methods of treatment for transforming surface water of categories A1, A2 and A3 into drinking water**

##### *Category A1*

Simple physical treatment and disinfection, e.g. rapid filtration and disinfection.

##### *Category A2*

Normal physical treatment, chemical treatment and disinfection, e.g. pre-chlorination, coagulation, flocculation, decantation, filtration, disinfection (final chlorination).

##### *Category A3*

Intensive physical and chemical treatment, extended treatment and disinfection e.g. chlorination to break-point, coagulation, flocculation, decantation, filtration, adsorption, (activated carbon), disinfection (ozone, final chlorination).

#### **Article 8 Derogations**

This Directive may be waived:

- (a) in the case of floods or other natural disasters;
- (b) in the case of certain parameters marked (O) in Annex II because of exceptional meteorological or geographical conditions;
- (c) where surface water undergoes natural enrichment in certain substances as a result of which it would exceed the limits laid down for categories A1, A2 and A3 in the table in Annex II;
- (d) in the case of surface water in shallow lakes or virtually stagnant surface water, for parameters marked with an asterisk in the table in Annex II, this derogation being applicable only to lakes with a depth not exceeding 20 m, with an exchange of water slower than one year, and without a discharge of waste water into the water body.

**Annex II**  
**Mandatory Standards for surface water abstractions taken from Directive 75/440/EEC**  
These are maximum values; 95% of samples must conform.

Type	Parameters		A1 I	A2 I	A3 I
i	Colouration	mg/l Pt scale	20 (O)	100 (O)	200 (O)
i	Temperature	°C	25 (O)	25 (O)	25 (O)
i	Nitrates *	mg/l NO <sub>3</sub>	50 (O)	50 (O)	50 (O)
i	Ammonia	mg/l NH <sub>4</sub>		1.5	4 (O)
ii	Sulphates	mg/l SO <sub>4</sub>	250	250 (O)	250 (O)
ii	Phenols	mg/l C <sub>6</sub> H <sub>5</sub> OH	0.001	0.005	0.1
ii	Dissolved Iron *	mg/l Fe	0.3	2	
ii	Total Copper	mg/l Cu	0.05 (O)		
ii	Total Zinc	mg/l Zn	3	5	5
iii	Total Arsenic	mg/l As	0.05	0.05	0.1
iii	Total Cadmium	mg/l Cd	0.005	0.005	0.005
iii	Total Chromium	mg/l Cr	0.05	0.05	0.05
iii	Total Lead	mg/l Pb	0.05	0.05	0.05
iii	Total Selenium	mg/l Se	0.01	0.01	0.01
iii	Total Mercury	mg/l Hg	0.001	0.001	0.001
iii	Total Barium	mg/l Ba	0.1	1	1
iii	Cyanide	mg/l CN	0.05	0.05	0.05
iii	Fluorides	mg/l F	1.5		
iii	Dissolved or emulsified		0.05	0.2	1
iii	hydrocarbons	mg/l	0.0002	0.0002	0.001
iii	Polycyclic aromatic hydrocarbons	mg/l	0.001	0.0025	0.005
iii	Total pesticides				
iii	(parathion, γ - HCH and dieldrin)	mg/l			

\* see notes on derogations (O) derogation allowed

## Phenol Analysis

The following seven phenols should be determined by chromatography and summed to give 'total phenols':

Phenol

2 methyl phenol

3 methyl phenol

2 chloro phenol

2,5 dichlorophenol

2,4,6 trichlorophenol

2,5 dimethyl phenol

## PAH analysis

The following six polyaromatic hydrocarbons should be measured and summed to give total PAH:

Benzo (a) pyrene

Benzo (b) fluoranthene

Benzo (ghi) perylene

Benzo (k) fluoranthene

Fluoranthene

Indeno (1,2,3 cd) pyrene

## Sampling frequencies

The NRA has set the minimum sampling frequency at 4 per annum. In practice this means the following minimum sampling frequencies will apply:

Abstraction type	Sampling Frequency Required
A2 population $\geq 100,000$ substance i	8
A3 population 30,000-100,000 substance i	6
A3 population $\geq 100,000$ substance i	12
All other abstractions and substances	4

## **ANNEX 3**

### **Freshwater Fisheries**

**Details of mandatory standards, compliance assessment and database structure**

## Annex 3

### Freshwater Fish Directive 78/659/EEC Mandatory Standards from Directive

Parameter	Salmonoid Imperative Standard	Cyprinid Imperative Standard	Notes
<b>Dissolved Oxygen</b> (mg/l O <sub>2</sub> )	≥ 9 ≥ 6	≥ 7 ≥ 4	50% of samples must meet this standard. Absolute minimum.
<b>pH<sup>1</sup></b>	6 - 9 (O)	6 - 9 (O)	<i>Derogation allowed in naturally acidic areas.</i>
<b>Non-ionised ammonia</b> (mg/l NH <sub>3</sub> )	≤ 0.025	≤ 0.025	Calculated from temperature, total ammonia and pH using formula below.
<b>Total ammonium<sup>2</sup></b> (mg/l NH <sub>4</sub> )	≤ 1	≤ 1	Relaxed standard of 3 mg/l can be applied where there is good evidence of healthy fish populations.
<b>Total zinc</b> (mg/l Zn)  <u>Water Hardness</u> (mg/l CaCO <sub>3</sub> ) ≤ 10 > 10 and ≤ 50 > 50 and ≤ 100 > 100	   ≤ 0.03 ≤ 0.2 ≤ 0.3 ≤ 0.5	   ≤ 0.3 ≤ 0.7 ≤ 1.0 ≤ 2.0	<i>Derogation allowed in areas of high mineralisation, natural enrichment or abandoned mines.</i>
<b>Temperature at thermal discharge</b> (°C)	≤ 1.5 ≤ 21.5 (O) ≤ 10 (O)	≤ 3 ≤ 28 (O) ≤ 10 (O)	Temperature change. Maximum absolute limit. Maximum during breeding periods if cold water needed for reproduction for certain species of fish.
<b>Total residual chlorine</b> (mg/l HOCl)	≤ 0.005	≤ 0.005	A suitable test is not yet available for this parameter.

<sup>1</sup> Artificial pH variations with respect to the unaffected values shall not exceed ±0.5 of a pH unit within the limits falling between 6.0 and 9.0 provided that these variations do not increase the harmfulness of other substances present in the water.

<sup>2</sup> In particular geographical or climatic conditions and particularly in cases of low water temperature and of reduced nitrification or where the competent authority can prove that there are no harmful consequences for the balanced development of the fish population, Member States may fix values higher than 1 mg/l.

(O) Derogations possible in accordance with Article 11.



**Sampling Frequency :** monthly (weekly for thermal discharges).

**Compliance:** 11 out of 12 samples must meet the standards for pH, non-ionized ammonia, total ammonium, and total zinc. Where sampling frequency is less than 12, all samples must meet the standard.

**Calculation of non-ionized ammonia at fish gill, to be used for Freshwater Fisheries Directive.**

The calculation uses the pH of the water, up to a maximum of 8.0. A maximum pH of 8.0 is used, because respiratory release of CO<sub>2</sub> lowers the pH at the fish gill.

$$\text{Non-ionized ammonia} = \frac{\text{Total ammonia}}{1.0 + 10^{(10.055 - (0.0324T) - \text{pH})}}$$

T = Temperature °C

Total and non-ionized ammonia are in mg/l

## Freshwater Fish Directive Database Structure

### INVENTORY

AREA \_\_\_\_\_  
CATCHMENT \_\_\_\_\_  
SUB CATCHMENT \_\_\_\_\_  
WATER \_\_\_\_\_  
STRETCH \_\_\_\_\_  
LENGTH \_\_\_\_\_  
SURFACE AREA \_\_\_\_\_  
CLASS \_\_\_\_\_  
START NGR \_\_\_\_\_  
END NGR \_\_\_\_\_  
REGION \_\_\_\_\_  
SAMPLE POINT NAME \_\_\_\_\_  
SAMPLE POINT CODE \_\_\_\_\_  
SAMPLE POINT NGR \_\_\_\_\_  
DEROGATION \_\_\_\_\_  
SAMPLING FREQUENCY \_\_\_\_\_ PER YEAR

### EXCEEDENCES

Region: \_\_\_\_\_ Sample Point Code: \_\_\_\_\_  
Failing Determinand: \_\_\_\_\_  
Reason For Failure: \_\_\_\_\_  
Derogation: \_\_\_\_\_ Reason for derogation: \_\_\_\_\_  
NRA Action Programme: \_\_\_\_\_

### MISSING SAMPLES

Region: \_\_\_\_\_ Sample Point Code: \_\_\_\_\_  
Failing Determinand: \_\_\_\_\_  
Number of Samples: \_\_\_\_\_  
Reason For Sampling Shortfall: \_\_\_\_\_  
Additional information: \_\_\_\_\_

## **ANNEX 4**

### **Dangerous Substances**

**[1] Schedule 1, classification of inland waters (DS1), of SI 1989/2286 The Surface Waters (Dangerous Substances) (Classification) Regulations 1989**

**[2] The schedule, classification of relevant territorial waters, coastal waters and inland freshwaters (DS3), of SI 1992/337 The Surface Waters (Dangerous Substances) (Classification) Regulations 1992**

**[3] Sections (a) and (b) of Annex B of the 'National Environmental Standards for Dangerous Substances in Water Joint Consultation Paper' (Nov '91)**

**[4] Appendices 1 and 2 of DoE Circular 7/89**

**[5] Schedule 2, classification of coastal waters (DS2), of SI 1989/2286 The Surface Waters (Dangerous Substances) (Classification) Regulations 1989**

**[6] Details of List I Dangerous Substances returns**

## Annex 4 [1]

### SCHEDULE 1 CLASSIFICATION OF INLAND WATERS (DS1) From SI 1989/2286

Regulation 3(1)

(1) Substance	(2) Concentration in microgrammes per litre (annual mean)
Aldrin, Dieldrin, Endrin and in Isodrin	(i) 0.03 for the four substances total
Cadmium and its compounds	(ii) 0.005 for endrin 5 (total cadmium: both soluble and insoluble forms)
Carbon tetrachloride	12
Chloroform	12
DDT (all isomers)	0.025
para-para-DDT	0.01
Hexachlorobenzene	0.03
Hexachlorobutadiene	0.1
Hexachlorocyclohexane (all isomers)	0.1
Mercury and its compounds	1 (total mercury: both soluble and insoluble forms)
Pentachlorophenol and its compounds	2

## Annex 4 [2]

From SI 1992/337

### THE SCHEDULE Regulations 2(2), 3(2) and (3).

#### CLASSIFICATION OF RELEVANT TERRITORIAL WATERS, COASTAL WATERS AND INLAND FRESHWATERS (DS3).

(1) Substance	(2) Concentration in microgrammes per litre (annual mean)	(3) Reference method of measurement
1,2-Dichloroethane	10	Gas chromatography with electron capture after extraction by means of an appropriate solvent or gas chromatography following isolation by means of the "purge and trap" process and trapping by using a cryogenically cooled capillary trap. The limit of detection is 1 µg/l. ( <i>see note</i> )
Trichloroethylene	10	Gas chromatography with electron capture detection after extraction by means of an appropriate solvent. The limit of detection is 0.1 µg/l. ( <i>see note</i> )
Perchloroethylene	10	
Trichlorobenzene	0.4 (but there must be no significant increase over time in the concentration of trichlorobenzene in sediments and/or molluscs and/or shellfish and/or fish).	Gas chromatography with electron capture after extraction by means of an appropriate solvent or, when used to determine the concentration in sediments and organisms, after appropriate preparation of the sample. The limit of determination for each isomer separately is 10 ng/l for the water environment and 1 µg/kg of dry matter for sediment and organisms. ( <i>see note</i> )

#### *Note*

The accuracy and precision of the method must be plus or minus 50% at a concentration which represents twice the value of the limit of determination.

## Annex 4 [3]

Annex B of the 'National Environmental Quality Standards for Dangerous Substances in Water Joint Consultation Paper' (Nov 91)

### PROPOSED ENVIRONMENTAL QUALITY STANDARDS TO BE ADDED TO THE DANGEROUS SUBSTANCES (SURFACE WATERS) (CLASSIFICATION) REGULATIONS 1989

(a) Substances for which EQSs are proposed in this paper

<i>Substance</i>	<i>Concentration in microgrammes per litre (annual mean)</i>		
Atrazine (14)	2	(combined atrazine and simazine)	
Azinphos-methyl (18)	0.01		
Dichlorvos (13)	(i) 0.001	in fresh waters	
	(ii) 0.04	in salt waters	
Endosulphan (20)	0.003		
Fenitrothion (17)	0.1		
Malathion (19)	(i) 0.01	in fresh waters	
	(ii) 0.02	in salt waters	
Simazine (15)	2	(combined simazine and atrazine)	
Trifluralin (16)	0.1		

(b) Substances with EQSs set in Directive 90/415/EEC

<i>Substance</i>	<i>Concentration in microgrammes per litre (annual mean)</i>
1,2-Dichloroethane (11)	10
Trichlorobenzene (12)	0.4
Trichloroethylene	10
Perchloroethylene	10

Numbers in brackets correspond to Red List substances

## Annex 4 [4]

### Appendix 1 of DoE Circular 7/89, WO Circular 16/89

#### APPENDIX 1 - ADDITIONAL NOTES ON IMPLEMENTATION FOR SPECIFIC LIST I SUBSTANCES

##### *(1a) Specific provisions relating to mercury*

##### *Directives:*

- (i) 82/176/EEC (discharges by the chlor-alkali electrolysis industry)
- (ii) 84/156/EEC (discharges by other sectors).

##### *Date of notification:*

- (i) 25 March 1982
- (ii) 12 March 1984

##### *Date of entry into force:*

- (i) 1 July 1983
- (ii) 12 March 1986

##### *Quality Objectives:* selected as appropriate from

1. 0.3 mg/kg (wet weight) in a representative sample of fish flesh.
2. 1 µg/l (annual mean) total mercury in inland surface waters.
3. 0.5 µg/l (annual mean) dissolved mercury in estuary waters.
4. 0.3 µg/l (annual mean) dissolved mercury in marine waters.

*limit values:* see appendices 3b and 3d.

*Submission of monitoring data to DoE:* Annually by 30 April for preceding calendar year.

##### *Special notes:*

- EQOs may be multiplied by 1.5 where necessary until 1 July 1989 for discharges covered by directive 84/156/EEC by prior agreement with DoE.
- A 'standstill' provision applies to concentrations in shellfish or sediments.
- MAFF will provide the necessary data for fish flesh concentrations. It may also be possible for them to supply data to demonstrate compliance with the standstill provision for shellfish through their 'mussel watch' programme; otherwise competent authorities should carry out the necessary monitoring.
- Article 3.3 of Directive 82/176/EEC requires that any authorisation to discharge from new plant should contain a reference to the standards achievable by use of the best technical means available. The DoE will need to notify the Commission if authorisation is given to a plant which does not apply such means. The Council and

the Commission have stated that the application of the best technical means available should make it possible for new plant using the recycled brine process to achieve less than 0.5 grammes of mercury discharged per tonne of installed chlorine capacity. Directive 84/156/EEC contains the standard provisions on new plant.

- With regard to "multiple" and diffuse sources, authorities are asked to consider the need for action to minimise inputs from hospitals, dental health establishments, laboratories and any other non-industrial establishment using mercury in their areas.

***(1b) Specific provisions relating to cadmium***

*Directive:* 83/513/EEC

*Date of notification:* 28 September 1983

*Date of entry into force:* 1 April 1986

*Quality objectives:*

- 5 µg/l (annual mean) total cadmium in inland surface waters
- 5 µg/l (annual mean) dissolved cadmium in estuary waters
- 2.5 µg/l (annual mean) dissolved cadmium in marine waters

*Limit values:* see appendix 3c.

*Submission of monitoring data to DoE:* Annually by 30 April for preceding calendar year.

*Special notes:*

- A 'standstill' provision applies to concentrations in sediments and/or shellfish (the latter to be determined in *mytilus edulis* if possible).
- The results of background environmental monitoring through the 'national network' referred to in Article 5 are to be compared with the following concentrations:
  - 1 µg/l (annual mean) total cadmium in inland surface waters.
  - 1 µg/l (annual mean) dissolved cadmium in estuary waters.
  - 0.5 µg/l (annual mean) dissolved cadmium in marine waters.

Any results which exceed these concentrations are to be reported by DoE to the Commission. Competent authorities should identify the reasons for such concentrations and notify these to DoE with their annual returns.

***(1c) Specific provisions relating to hexachlorocyclohexane (HCH)***

*Directive:* 84/491/EEC

*Date of notification:* 11 October 1984

*Date of entry into force:* 1 April 1986

*Quality objectives:*



0.1 µg/l total HCH (annual mean) in inland surface waters.

0.02 µg/l total HCH (annual mean) in estuary and marine waters.

*Limit values:* see appendix 3e

*Submission of monitoring data to DoE:* Annually by 30 April for preceding calendar year.

*Special notes:*

- A 'standstill' provision applies to concentrations in sediments and/or molluscs and/or shellfish and/or fish.

- The results of background environmental monitoring through the 'national network' referred to in Article 5 are to be compared with a concentration of 0.05 µg/l tot HCH. Any results which exceed this concentration are to be reported by DoE to the Commission. Competent authorities should identify the reasons for such concentrations and notify these to DoE with their annual returns.

- In some instances industrial sectors not mentioned in this directive may have discharges which may on occasion contain HCH even though the substance is not produced or used on the site. Discharges from textile or leather processing plants using raw materials from outside the UK which may be contaminated with HCH are an example. The requirements of this directive are applicable to such discharges, but in implementing them competent authorities should be aware of the special difficulties involved and the fact that the only effective way to prevent HCH entering the discharge may be to attempt to prevent the contamination at source. Where quality objectives could be threatened by such discharges it may be appropriate to fix emission standards taking into account the best technical means available to the discharger at reasonable economic cost in accordance with Annex 1 of Directive 84/491/EEC. The departments should be consulted in advance in all such cases.

- A number of instances have come to light where the use of handling of HCH at an industrial plant has been discontinued, but where, because of its extreme persistence, the substance continues to be detected in the discharge from the site in declining concentrations. Where these factors apply competent authorities may consider that to grant specific consents for HCH at existing levels of discharge would be contrary to the spirit and intent of the directive in that it would serve only to legitimise current levels of input when these are likely to decline of their own accord - and might even encourage the use of HCH to recommence. Authorities should notify the departments of any such cases and maintain periodic monitoring. Alternatively, in these cases, authorities may prefer to impose a specific consent limit at current levels, to be reviewed biennially with a view to progressive tightening of the limit as the concentration in the effluent declines.

*(1d) Specific provisions relating to carbon tetrachloride*

*Directive:* 86/280/EEC

*Date of notification:* 16 June 1986

*Date of entry into force:* 1 January 1988

*Quality objectives:* 12 µg/l (annual mean) in all waters

*Limit values:* see appendix 3f

*Submission of monitoring data to DoE:* 30 April 1989 for preceding calendar year and annually thereafter.

*Special notes:*

- There is no 'standstill' provision applying to carbon tetrachloride.
- The directive provides that, without prejudice to the general requirement to satisfy the commission, that the EQO is being met and continuously maintained, "where there is no evidence of any problem in meeting and continuously maintaining the quality objective ... a simplified monitoring procedure may be introduced". Competent authorities may wish to make use of this provision where the EQO is consistently and easily met by undertaking less frequent monitoring of waters affected by a discharge than they might do for more dangerous substances. However, they should still supply sufficient data to establish a valid annual mean concentration.

***(1e) Specific provisions relating to DDT***

*Directive:* 86/280/EEC

*Date of notification:* 16 June 1986

*Date of entry into force:* 1 January 1988

*Quality objectives:*

- 0.01 µg/l (annual mean) for the isomer para-para-DDT in all waters.
- 0.025 µg/l (annual mean) for total DDT in all waters.

*Limit values:* see appendix 3f

*Submission of monitoring data to DoE:* By 30 April 1989 for preceding calendar year and annually thereafter.

*Special notes:*

- A 'standstill' provisions applies to concentrations in the aquatic environment, sediments and/or molluscs and/or shellfish and/or fish.
- There is no authorised use of DDT in the United Kingdom under the Control of Pesticides Regulations, nor any approved products containing DDT. There has been no known production or formulation of this substance in the United Kingdom for a number of years. There should be no point source discharges of DDT. Competent authorities should, however, carry out general environmental monitoring in order to ensure that this remains the case and that the 'standstill' provision is observed in the aquatic environment. MAFF will monitor concentrations in fish flesh to check that the standstill in fish in estuarial and coastal waters is similarly observed.

- Some competent authorities have reported difficulties in achieving the required limit of detection where water samples are contaminated with other impurities. The departments are considering the implications of this. In the meantime, authorities should employ methods of measurement which enable them to obtain results as close as reasonably possible to the required limit of detection and should inform the departments where this is not achieved.

*(1f) Specific provisions relating to pentachlorophenol (PCP)*

*Directive:* 86/280/EEC

*Date of notification:* 16 June 1986

*Date of entry into force:* 1 January 1988

*Quality objective:* 2 µg/l (annual mean) in all waters

*Limit values:* see appendix 3f

*Submission of monitoring data to DoE:* By 30 April 1989 for preceding calendar year and annually thereafter.

*Special notes:*

- A 'standstill' provision applies to concentrations in sediments and/or molluscs and/or shellfish and/or fish.

*(1g) Specific provisions relating to 'the drins' (aldrin, dieldrin, endrin and isodrin)*

*Directives:* 86/280/EEC and 88/347/EEC

*Date of notification:* 16 June 1988

*Date of entry into force:* 1 January 1989

*Quality objectives:*

- From 1 January 1989

0.03 µg/l (annual mean) total drins for all waters, with a maximum of 0.005 µg/l for endrin.

- From 1 January 1994

0.01 µg/l (annual mean) aldrin for all waters.

0.01 µg/l (annual mean) dieldrin for all waters.

0.005 µg/l (annual mean) endrin for all waters.

0.005 µg/l (annual mean) isodrin for all waters.

*Limit values:* see appendix 3g

*Submission of inventory of discharges to DoE:* By 31 March 1989.

*Submission of monitoring data to DoE:* By 30 April 1990 for preceding calendar year and annually thereafter.

*Special notes:*

- A 'standstill' provision applies to concentrations in sediments and/or molluscs and/or shellfish and/or fish.
- Authorised uses of aldrin and dieldrin in the UK are strictly limited and are being phased out. All approvals for the use of products containing dieldrin will cease after 30 March 1989. The few remaining uses of aldrin in agriculture will be allowed to continue until 31 December 1992, but the sale, supply and advertisement of products containing this substance will be prohibited after 31 December 1990.
- Any possible point source discharges of these substances are likely to derive either from historic use on the site or from the processing and washing of contaminated animal skins from outside the UK. The special notes in appendix 1c on these subjects would apply here also.

***(1h) Specific provisions relating to hexachlorobenzene (HCB)***

*Directives:* 86/280/EEC and 88/347/EEC

*Date of notification:* 16 June 1988

*Date of entry into force:* 1 January 1990

*Quality objective:* 0.03 µg/l (annual mean) in all waters

*Limit values:* see appendix 3g

*Submission of inventory of discharges to DoE:* By 31 March 1990.

*Submission of monitoring data to DoE:* By 30 April 1992 for preceding calendar year and annually thereafter.

*Special notes:*

- A 'standstill' provision applies to concentrations in sediments and/or molluscs and/or shellfish and/or fish.

***(1i) Specific provisions relating to hexachlorobutadiene (HCBD)***

*Directives:* 86/280/EEC and 88/347/EEC

*Date of notification:* 16 June 1988

*Date of entry into force:* 1 January 1990

*Quality objectives:* 0.1 µg/l (annual mean) in all waters

*Limit values:* see appendix 3g

*Submission of inventory of discharges to DoE:* By 31 March 1990.

*Submission of monitoring data to DoE:* By 30 April 1991 for preceding calendar year and annual thereafter.

*Special notes:*

- A 'standstill' provision applies to concentrations in sediments and/or molluscs and/or shellfish and/or fish.

***(1J) Specific provisions relating to chloroform***

*Directives:* 86/280/EEC and 88/347/EEC

*Date of notification:* 16 June 1988

*Date of entry into force:* 1 January 1990

*Quality objective:* 12 µg/l (annual mean) for all waters

*Limit values:* see appendix 3g

*Submission of inventory of discharges to DoE:* By 31 March 1990 calendar year and annually thereafter.

*Special notes:*

- In the case of chloroform, Article 3 of directive 76/464/EEC applies only to discharges from industrial processes which may in themselves contribute significantly to the level of chloroform in the effluent. This means that competent authorities need not grant specific authorisations where chloroform is likely to be present in a discharge only or mainly as a result of background concentrations in the water supply or in water abstracted for use in the process. The provisions of the directive apply in particular to discharges containing chloroform from the following industrial processes: production of chloromethanes, production of chlorofluorocarbons, manufacture of monomer vinyl chloride using dichloroethane pyrolysis and production of bleached pulp. They also apply in plants where chloroform is used as a solvent or where cooling waters and other effluent are chlorinated.

- There is no 'standstill' provision applying to chloroform.

- The directive provides that, without prejudice to the general requirement to satisfy the Commission that the EQO is being met and continuously maintained, "where there is no evidence of any problem in meeting and continuously maintaining the quality objective ... a simplified monitoring procedure may be introduced". Competent authorities may wish to make use of this provision where the EQO is consistently and easily met by undertaking less frequent monitoring of waters affected by a discharge than they might do for more dangerous substances. However, they should still supply sufficient data to establish a valid annual mean concentration.

## Annex 4 [4]

### Appendix 2 of DoE Circular 7/89, WO Circular 16/89. National Environmental Quality Standards For List II Substances (a)

		Lead (f)	Chromium	Zinc	Copper(g)	Nickel	Arsenic
WRC Report Ref Nos.		TR208	TR207	TR209	TR210	TR211	TR212
QUALITY OBJECTIVE (e)							
<b>Fresh Water</b>							
Direct abstraction to potable supply	A1(b)	50PT	50PT	3000PT	20PT	50PT	50PT
	A2(b)	75MT	75MT	5000PT	50PT	50PT	50PT
	<i>Total hardness (as mg/l CaCO<sub>3</sub>)</i>						
Protection of sensitive aquatic life (eg salmonoid fish)(c)	0 - 50	4AD	5AD	8AT (30P)	1AD (5P)	50AD	50AD
	50 - 100	10AD	10AD	50AT (200P)	6AD (22P)	100AD	50AD
	100 - 150	10AD	20AD	75AT (300P)	10AD (40P)	150AD	50AD
	150 - 200	20AD	20AD	75AT (300P)	10AD (40P)	150AD	50AD
	200 - 250	20AD	50AD	75AT (300P)	10AD (40P)	200AD	50AD
	250 +	20AD	50AD	125AT (500P)	28AD (112P)	200AD	50AD
Protection of other aquatic life (eg cyprinid fish)	0 - 50	50AD	150AD	75AT (300P)	1AD (5P)	50AD	50AD
	50 - 100	125AD	175AD	175AT (700P)	6AD (22P)	100AD	50AD
	100 - 150	125AD	200AD	250AT (1000P)	10AD (40P)	150AD	50AD
	150 - 200	250AD	200AD	250AT (1000P)	10AD (40P)	150AD	50AD
	200 - 250	250AD	250AD	250AT (1000P)	10AD (40P)	200AD	50AD
	250 +	250AD	250AD	500AT (2000P)	28AD (112P)	200AD	50AD
<b>Salt Water</b>							
Protection of salt water life		25AD	15AD	40AD	5AD	30AD	25AD

All values are given as microgrammes per litre.

A = Annual average

P = 95 per cent of samples (d)

M = Maximum Allowable Concentration

D = Dissolved

T = Total

## National Environmental Quality Standards For List II Substances (a)

		Boron(h)	Iron (h)(i)	pH	Vanadium	
WRC Report Ref Nos.		TR256	TR258	TR259	TR253	
QUALITY OBJECTIVE (e)						
Fresh Water						
Direct abstraction to potable supply	A1(b)	1000PT	300PD	6.5 - 8.5P		
	A2(b)	1000PT	2000PD	5.5 - 9.0P		
					<i>Total hardness (as mg/l CaCo<sub>3</sub>)</i>	
Protection of sensitive aquatic life (eg salmonoid fish) (c)		2000AT	1000AD	6.0 - 9.0P	0 - 200	20AT
					200+	60AT
Protection of other aquatic life (eg cyprinid fish)		2000AT	1000AT	6.0 - 9.0P	0 - 200	20AT
					200+	60AT
Salt Water						
Protection of salt water life		7000AT	1000AT	6.0 - 8.5P(k)	100AT	

All values are given as microgrammes per litre, except pH where 95 per cent of samples must lie within the range shown.

A = Annual average

P = 95 per cent of samples (d)

M = Maximum Allowable Concentration

D = Dissolved

T = Total

## National Environmental Quality Standards For List II Substances (a)

WRC Report Ref No.		Triorganotin TR255		Compounds
QUALITY OBJECTIVE (e)		Tributyltin		Triphenyltin
Fresh Water				
Direct abstraction to potable supply	A1(b)	0.02MT		0.09MT
	A2(h)	0.02MT		0.09MT
Protection of sensitive aquatic life (eg salmonoid fish)(c)		0.02MT		0.02MT
Protection of other aquatic life (eg cyprinid fish)		0.02MT		0.02MT
Salt Water				
Protection of salt water life		0.002MT(1)		0.008MT(1)

All values are given as microgrammes per litre.

P = 95 per cent of samples (d)

M = Maximum Allowable Concentration

T = Total

## National Environmental Quality Standards For List II Substances (a)

WRC Report Ref No.		Mothproofing TR261		Agents		
		PCSD's	Cyfluthrin	Sulcofuron	Flucofuron	Permethrin
QUALITY OBJECTIVE (e)						
Fresh Water						
Direct abstraction to potable supply	A1(b)		0.001PT			0.01PT
	A2(b)		0.001PT			0.01PT
Protection of sensitive aquatic life (eg salmonoid fish)(c)		0.05PT	0.001PT	25PT	1.0PT	0.01PT
Protection of other aquatic life (eg cyprinid fish)		0.05PT	0.001PT	25PT	1.0PT	0.01PT
Salt Water						
Protection of salt water life		0.05PT	0.001PT	25PT(j)	1.0PT(j)	0.01PT(j)

All values are given as microgrammes per litre.

P = 95 per cent of samples (d)

T = Total



## Notes to Appendix 2

(a) These quality standards are set for the purpose of controlling discharges of dangerous substances under Directive 76/464/EEC. A number of other EC directives set down standards for some of the substances listed here in respect of particular users of water. For the purposes of implementing those directives certain provisions may apply (for example in relation to definitions, sampling frequency or possible derogations) which are not set out here and authorities should consult those directives separately. (See also paragraph 45 of this circular).

(b) These categories correspond to those defined in Directive 75/440/EEC. Waters in category A1 should be suitable for abstraction for drinking after simple physical treatment and disinfection; waters in category A2 for drinking after normal physical treatment, chemical treatment and disinfection.

(c) In some cases more stringent values may be appropriate locally to protect particularly sensitive flora or fauna (see appropriate WRC report).

(d) Notwithstanding the advice in paragraph 45 of this circular, where the values shown for certain substances are applied as 90 percentiles under other EC directives, authorities may apply them here also on the basis that 90 per cent of samples should comply. Otherwise 95 per cent of samples should fall within the quality standard shown.

(e) Other standards may be applicable for other particular water uses, notably irrigation of crops and livestock watering. In some cases these are identified in the appropriate WRC report and in published advice from ADAS. In other cases authorities should consult ADAS as necessary.

(f) Where breeding populations of rainbow trout are present the quality standard for lead should be 50% of that recommended for sensitive aquatic life. The standards given also assume that the lead present is almost entirely inorganic; if a significant proportion of organic lead is present, more stringent standards may be necessary.

(g) Higher concentrations of copper may be acceptable where the presence of organic matter may lead to complexation.

(h) Certain crops are particularly sensitive to these substances and may require especially stringent standards for irrigation (see appropriate WRC report).

(i) The toxicity of iron increases at pH's below 7, and authorities may need to set out more stringent quality standards, especially where pH is below 6.5.

(j) These standards may need to be reviewed when more adequate data becomes available.

(k) A more restricted range of 7.0-8.5 should be applied for the protection of shellfish.

(l) Further analytical development is likely to be needed before these standards could be verifiable in receiving waters. They can, however, be used in calculating acceptable concentrations in effluent.

## Annex 4 [5]

**SCHEDULE 2**  
**CLASSIFICATION OF COASTAL WATERS**  
**AND RELEVANT TERRITORIAL WATERS (DS2)**  
**From SI 1989/2286**

Regulation 3(2)

(1) Substance	(2) Concentration in microgrammes per litre (annual mean)
Aldrin, Dieldrin, Endrin and Isodrin	(i) 0.03 for the four substances in total
Cadmium and its compounds	(ii) 0.005 for endrin 2.5 (dissolved cadmium)
Carbon tetrachloride	12
Chloroform	12
DDT (all isomers)	0.025
para-para-DDT	0.01
Hexachlorobenzene	0.03
Hexachlorobutadiene	0.1
Hexachlorocyclohexane (all isomers)	0.02
Mercury and its compounds	0.3 (dissolved mercury)
Pentachlorophenol and its compounds	2

## **Annex 4 [6]**

### **LIST I DANGEROUS SUBSTANCES RETURNS**

#### **1.1 Introduction**

This document explains what is required in making the annual returns for List I dangerous substances. It also describes for inexperienced users of the database how information should be entered or updated on the system.

The NRA is required to make returns annually to the DoE by the end of April. To ensure that there is sufficient time for the data to be processed at Head Office, Regional returns must be received by the end of March. Most of the information is supplied to DoE on disk via a DataEase database which covers much of the information required by Circular 7/89 i.e:

- i) the points of discharge and the means of dispersal;
- ii) the area in which the quality objective is applied;
- iii) the locations of sampling points;
- iv) the frequency of sampling;
- v) the methods of sampling and measurement;
- vi) the results obtained.

Where exceedences of the Environmental Quality Standards (EQSs) in the Directives occur, detailed explanations of the probable reasons for failure and the remedial actions to ensure future compliance must be supplied in a covering report.

DoE are required to forward the database and a covering report to the European Commission by September. Each year following the UK submission to Europe, a copy of the submitted database will be sent back to NRA Head Office. The information in the database will then be divided up regionally and the previous years analytical results removed. The Regions will be sent a disk containing the information relevant to their region for updating with the next years data. This system ensures consistency - the information sent to Europe is used as the basis for the returns made in subsequent years.

#### **1.2 Structure of the List I dangerous substances database**

The database comprises seven "forms" - ecds1 to ecds7, which reflect the seven paper forms used prior to 1990:

ecds1 - SITE DETAILS

ecds2 - DISCHARGE AUTHORISATIONS

ecds3 - MONITORING SITE DETAILS

ecds4 - QUALITY STANDARDS IN WATER RESULTS

ecds5 - QUALITY STANDARDS IN SEDIMENTS/BIOTA RESULTS

ecds6 - BACKGROUND SITE DETAILS

ecds7 - QUALITY STANDARDS IN BACKGROUND WATER RESULTS

(ecds = EC dangerous substances)

The database must contain information on all authorised discharges (and discharges awaiting authorisation) of List I substances (whether from a trader directly into a controlled water, or via sewer); the details of the authorisation; the downstream monitoring points (water and sediment/biota) relating to each discharge; the analytical results obtained at these points for the relevant List I substances; the background monitoring point relating to the water to which each discharge is made; and the analytical results for **all** List I substances at this point.

### 1.3 Rationale behind database structure

The information in the seven forms is related by "fields" common to more than one form. In theory analytical results can be traced back through the forms and related to discharges - thus an exceedence of an EQS at a particular sampling point can be located and possibly attributed to a specific discharger. This is only possible in practice if the information contained in the forms is consistent.

Another important factor is the location of sampling points in relation to the discharges they are set up to monitor. The location of sampling sites must be reviewed to ensure that they are located sensibly with respect to the discharges that they are meant to reflect. If it is impossible to assign monitoring points, especially water sample sites or national network sites, then the reasons for this must be made clear in a covering letter to Head Office, otherwise the returns give the impression of discharges with no environmental monitoring - clearly contravening the requirements of the dangerous substances Directives.

The background monitoring - analysis of all List I substances (not only those authorised for discharge upstream) at national network sites - is important as environmental monitoring and to pick up general levels of List I substances in waters to which discharges are made. Exceedences of an EQS at a national network site is a matter for concern and should be investigated thoroughly.

### 1.4 Explanation of general fields

- a) For convenience forms 1 to 7 are identified by a **Form I.d** field - for ecds1 this is 1\*, for ecds2 it is 2\* etc.
- b) The **Region** field indicates which NRA Region a record is from. The region codes are listed in Appendix 1. These codes exist as choice fields - ie. nothing other than one of these codes can be entered in the Region field. The available choices are displayed across the top of the record entry screen.
- c) The List I substance which a record relates to is identified by **Substance Name** (again a choice field). The codes are listed in Appendix 2.

- d) The process from which the List I substance is discharged is identified by the **Industrial Process** (a choice field), the codes for which are listed in Appendix 3).

## 1.5 Ecds1 - SITE DETAILS

- a) This form is an inventory which must contain a record of all known discharges of List I substances - both trade discharges to sewer and STWs discharging to controlled waters. Under the present interpretation of the legislation, discharges with a "blanket consent" (an authorisation for List I substances which in reality are not actually discharged) must be included in the inventory. At present there is also no dispensation for a "de minimis" claim i.e even if the amounts contained within the discharge are very low, the inventory must still include the discharge and downstream and background monitoring must be carried out.

A discharge is identified by an **Establishment No.** which corresponds to an **Establishment name**, and **Grid Reference** of the discharge. Each discreet consented discharge from a premises must have its own identifying Establishment No and Grid Reference (although the Establishment Name can be the same), otherwise it will appear as a duplicate record.

An establishment must appear on the inventory one time for each combination of List I substance and the industrial process from which it comes. Thus an establishment with a discharge containing Cadmium from two different industrial processes and Mercury from another must have three separate records.

- b) The **Receiving medium** field indicates whether the discharge is made to a water body or to sewer. The field must contain either a STW code or F for freshwater, E for estuary, C for internal coastal waters other than estuary waters, T for territorial waters or CS for a crude sewer.

STWs receiving trade discharges of List I substances must not only appear on ecds1 as a receiving medium but must also appear on the form as an establishment, with the relevant Establishment No, Establishment Name and substances received.

- c) Each discharge must have a downstream monitoring point (**Water Sample Site**) located at the edge of the mixing zone or at a point which reflects the effect of the discharge on water quality. A discharge must also have a background monitoring site (**National Network Site**) which must be far enough downstream to reflect the overall effects on the catchment and which is usually, for freshwaters, the Harmonised Monitoring Point or the lowest point of the catchment. For estuarial or coastal waters a point should be chosen which represents local water quality but is not directly affected by the discharge. It is appreciated that access to such sites may be difficult and that sampling is likely to be less frequent than at freshwater sites.
- d) There is a "standstill" requirement in the Directives for List I substances liable to accumulation in sediments or biota. (Mercury does not have a standstill requirement but has an actual value). Thus, with the exception of CTC, CHCL3, PER, TRI or EDC, there must be monitoring of sediments or biota at an appropriate site downstream of a List I discharge (**S/B Sample Site**). This must be located just

beyond the mixing zone, or if no sediment or biota are available there, then at the nearest point downstream which will reflect the effect of the discharge. If the nearest site where sediment or biota is available is so far downstream that it will not reflect the effects of the discharge, then **NO SITE** must be entered in this field.

## 1.6 Ecds2 - DISCHARGE AUTHORISATIONS

- a) This form must contain information on the authorization of each of the discharges on the ecds1 inventory i.e all of the establishments on ecds1 must appear on ecds2 with the relevant substance(s) and authorization details.

If the authorization is one made by HMIP for a discharge of a List I substance from a prescribed process, the authorization details must still be included on this inventory of authorisations, with a suitable comment entered in the **Observations** field.

- b) The **Year of authorization** field must contain the year in which the most up to date authorization for a discharge was made i.e if a variation of a consent is made then the year of the variation must be entered. An unauthorised discharge should be indicated by 0 in the year of authorisation field and a comment made in the **Observations** field.
- c) Information on **Maximum permitted rate**, **Maximum permitted concentration** and **Maximum authorised load** must be entered if available. If this information is not available then any comments which are relevant should be made in the **Observations** field.
- d) If a consent is revoked because a discharge ceases, the discharge should remain on the inventory with a note to this effect in the **Observations** field. DoE have requested that monitoring at the downstream water sample site should continue for at least two years after a discharge ceases. If after this time the results show that the List I substance is no longer detected, then monitoring should only be carried out at a suitable background monitoring site. A note to the effect of "background monitoring only" should also be made in the **observations** field.

## 1.7 Ecds3 - MONITORING SITE DETAILS

- a) This form is an inventory of the downstream monitoring and sediment/biota sites which appear on ecds1. It must contain a record for each **Water Sample Site No** with the **Water Site Location** and a **Grid Reference**. The **Receiving water** field must contain the name of the water body on which the sampling point lies.
- b) This form must also contain all the sediment/biota sites which appear on ecds1. The **S/B site no**, **S/B site location** and **Grid Reference** must appear alongside the water sample site which they are associated with. If there is more than one S/B site associated with a water sample site then both must be recorded on this form. If no sediment site is associated with a water sample site then **NO SITE** must be entered instead of the S/B site no.

## 1.8 Ecds4 - QUALITY STANDARDS IN WATER RESULTS

- a) This form contains the analytical results obtained from sampling at downstream monitoring sites. There must be a record for each substance authorised to be discharged to the water which the sample point monitors - i.e results for all the water sample sites and the List I substances which appear on form ecds1 must appear on form ecds4.

Total HCH is interpreted to be a summation of the three isomers gamma, alpha and beta. Delta HCH should only be included in analysis where it is believed to be present. Analysis of gamma, alpha and beta isomers should strictly have been carried out for a sample to be recorded. If however, one isomer masks the presence of the others, as long as an attempt has been made to check for the others then a sample should be recorded. If analysis has not been carried out for the three required isomers for whatever reason, then please ensure that an explanation of what the results refer to is included with the returns.

The three isomers of trichlorobenzene (TCB) to be analysed are 1,2,3 TCB, 1,2,4 TCB and 1,3,5 TCB.

Total DDT is interpreted to be a summation of para-para DDT, ortho-para DDT, DDE and TDE.

- b) The relevant Environmental Quality Standard (**Rel EQS**) must be entered - the EQS is that which appears in the UK legislation which implements the Directive. The EQS value depends on the substance discharged and the type of water in which the monitoring point is located (freshwater, estuarine or coastal). List I EQSs are reproduced in Appendix 4. It is important that the EQS entered on this form is correct, as exceedences are picked up by comparison of the annual mean with the EQS.
- c) The number of samples analysed for a substance must be entered in the **No of Samples** field.
- d) The number of "less than samples" must contain the number of samples which were below the limit of detection.
- e) The annual mean is calculated as the total of the analytical values obtained divided by the total number of samples analysed. The mean must be entered in the **meanwq** field. If an analysis is below the limit of detection, the analytical value to be used in the calculation of the mean should be half of the limit of detection (a "50% value").
- f) The minimum and maximum analytical result obtained must be entered in the **Min** and **Max** fields respectively. Again, if the minimum (or maximum) result was less than the limit of detection, the 50% value should be entered. The limit of detection (min) signifier and limit of detection (max) signifier fields should therefore be left blank as all "less than values" are in effect turned into positive values using the 50% rule. **Calculation of max, min and mean is explained fully in Appendix 5.**

- g) If the mean is greater than the relevant EQS then a detailed explanation of the likely cause of the exceedence (i.e the source of the discharged substance) must be provided in a covering note, together with details of what action the NRA will take to ensure compliance in future.

#### 1.9 Ecds5 - QUALITY STANDARDS IN SEDIMENTS/SHELLFISH

- a) This form contains the analytical results obtained from sampling at sediment/biota sites downstream of discharges of List I substances. There must be a record for each Sediment site which appears on ecds1 and for each substance which this site monitors.
- b) There is no EQS field on this form but otherwise the information required is along the lines of that required for the water site analysis as on form ecds4 (section 1.8).
- c) The **Sample substance** code is comprised of two characters. The first indicates the type of substance analysed, and the second indicates the species of fish or shellfish analysed if a biota sample has been taken. The codes are listed in Appendix 7.

#### 1.10 Ecds6 - BACKGROUND SITE DETAILS

- a) This form is an inventory of the national network sites which appear on ecds1. It must contain a record for each **National Network Site** together with the **Site Description** and **Grid Reference**.
- b) The **Receiving water** field must contain the name of the water body on which the sampling point lies and the **Receiving Medium** field must contain the relevant codes as explained in section 1.5b).

#### 1.11 Ecds7 - QUALITY STANDARDS IN BACKGROUND WATER RESULTS

- a) This form contains the analytical results obtained from sampling at background monitoring sites. There must be a record for each List I substance at every national network site which appears on form ecds1.
- b) The **Reference Value** is the EQS, with the exception of Cadmium and HCH which have specified standards for background monitoring sites as listed in Appendix 6.
- c) The rest of the information required is along the lines of that required for the water site analysis as on form ecds4 (section 1.8).
- d) If the mean is greater than the Reference Value then a detailed explanation of the likely cause of the exceedence (i.e the source(s) of the substance) must be provided in a covering note, together with details of what action the NRA will take to ensure compliance in future.



## APPENDIX 1

### NRA REGION CODES

North West	01
Northumbria	02
Severn Trent	03
Yorkshire	04
Anglian	05
Thames	06
Southern	07
Wessex	08
South West	09
Welsh	10

## APPENDIX 2

### LIST I DANGEROUS SUBSTANCES CODES

Mercury - from the chlor-alkali electrolysis industry	HG-CA
Mercury - from other industries	HG-OTH
Cadmium	CADMIUM
Hexachlorocyclohexane	HCH
Carbon tetrachloride	CTC
para-para DDT	PPDDT
Total DDT	TOTDDT
Pentachlorophenol	PCP
Total "drins"	TOTDRIN
Aldrin	ALDRIN
Dieldrin	DIELDRIN
Endrin	ENDRIN
Isodrin	ISODRIN
Hexachlorobenzene	HCB
Hexachlorobutadiene	HCBD
Chloroform	CHCL3
1-2-dichloroethane	EDC
Trichloroethylene	TRI
Perchloroethylene	PER
Trichlorobenzene	TCB

# APPENDIX 3

## INDUSTRIAL PROCESS CODE NUMBERS

Substance	Industrial Process	Code
HG-OTH	Chemical industries using mercury catalysts in production of vinyl chloride and other processes	0
	Manufacture of mercury catalysts used in production of vinyl chloride	1
	Manufacture of organic and non-organic mercury compounds except for products referred to in industrial process 2 (above)	2
	Manufacture of primary batteries containing mercury	3
	Non-ferrous metal industry - mercury recovery plants, extraction and refining of non-ferrous metals	4
	Plants for the treatment of toxic wastes containing mercury	5
	Other	6
	Sewage treatment works	s
CADMIUM	Zinc mining, lead and zinc refining, cadmium metal and non-ferrous metal industry	0
	Manufacture of cadmium compounds	1
	Manufacture of pigments	2
	Manufacture of stabilisers	3
	Manufacture of primary and secondary batteries	4
	Electroplating	5
	Manufacture of phosphoric acid and/or phosphatic fertiliser from phosphatic rock	6
	Other	7
	Sewage treatment works	s
HCH	Plant for production of HCH	0
	Plant for extraction of lindane	1
	Plant where the production and extraction of lindane is carried out	2
	Other	3
	Sewage treatment works	s
CTC	Carbon tetrachloride production	0
	Production of chloromethanes by methane chlorination and from methanol	1
	Production of chlorofluorocarbons	2
	Other	3
	Sewage treatment works	s

Substance	Industrial Process	Code
DDT	Production of DDT including formulation of DDT on the same site	0
	Other	1
	Sewage treatment works	s
PCP	Production of sodium pentachlorophenate by hexachlorobenzene	0
	Other	1
	Sewage treatment works	s
DRINS	Production of aldrin and/or dieldrin and/or endrin including formulation of these substances on the same site	0
	Other	1
	Sewage treatment works	s
HCB	HCB production and processing	0
	Production of perchloroethylene (PER) and carbon tetrachloride by perchlorination	1
	Production of trichloroethylene and/or perchloroethylene by any other processes	2
	Other	3
	Sewage treatment works	s
HCBD	Production of perchloroethylene (PER) and carbon tetrachloride by perchlorination	0
	Production of trichloroethylene and/or perchloroethylene by any other process	1
	Other	2
	Sewage treatment works	s
Chloroform	Production of chloromethanes from methanol or from a combination of methanol and methane	0
	Production of chloromethanes by chlorination of methane	1
	Production of chlorofluorocarbon	2
	Other	3
	Sewage treatment works	s
1,2-dichloroethane	Production only of EDC (without processing or use on the same site)	0
	Production of EDC and processing or use at the same site (except for the use defined under code No.4 below)	1
	Processing of EDC into substances other than vinyl chloride	2
	Use of EDC for degreasing materials (away from an industrial site covered under code No.1 above)	3
	Use of EDC in the production of ion exchangers	4
	Other	5
	Sewage treatment works	s

Substance	Industrial Process	Code
Trichloroethylene	Trichloroethylene and perchloroethylene production	0
	Use of trichloroethylene for degreasing metals	1
	Other	2
	Sewage treatment works	s
Perchloroethylene	Trichloroethylene and perchloroethylene production (TRI-PER processing)	0
	Carbon tetrachloride and perchloroethylene production (TETRA-PER processes)	1
	Use of perchloroethylene for degreasing metals	2
	Chlorofluorocarbon production	3
	Other	4
	Sewage treatment works	s
Trichlorobenzene	Production of trichlorobenzene via dehydrochlorination of HCH and/or processing of trichlorobenzene	0
	Production and/or processing of chlorobenzenes via chlorination of benzene	1
	Other	2
	Sewage treatment works	s

## APPENDIX 4

### LIST I ENVIRONMENTAL QUALITY STANDARDS (EQSs) - DOWNSTREAM MONITORING

	Annual mean ( $\mu\text{g/l}$ )		
	Inland	Estuary	Marine
Mercury	1	0.3 (D)	0.3 (D)
Cadmium	5	2.5 (D)	2.5 (D)
Hexachlorocyclohexane	0.1	0.02	0.02
Carbon tetrachloride	12	12	12
para-para DDT	0.01	0.01	0.01
Total DDT	0.025	0.025	0.025
Pentachlorophenol	2	2	2
Total "drins"	0.03	0.03	0.03
Aldrin	0.01	0.01	0.01
Dieldrin	0.01	0.01	0.01
Endrin	0.005	0.005	0.005
Isodrin	0.005	0.005	0.005
Hexachlorobenzene	0.03	0.03	0.03
Hexachlorobutadiene	0.1	0.1	0.1
Chloroform	12	12	12
1-2-dichloroethane	10	10	10
Trichloroethylene	10	10	10
Perchloroethylene	10	10	10
Trichlorobenzene	0.4	0.4	0.4

Standards are for Total, unless indicated by (D) for dissolved

## APPENDIX 5

### CALCULATION OF MIN, MAX AND MEAN VALUES

#### SUBSTANCES WITH NO ISOMERS

- a) the minimum value is the minimum value recorded (even if this is a 50% value).
- b) the maximum value is the maximum value recorded (even if this is a 50% value).
- c) the annual mean is the total of all sample values (including 50% values) divided by the number of samples.

For example: 6 samples of Cadmium with values of 4, <8, 2, 3, <3 and 6.

Applying the 50% rule <8 becomes 4 and <3 becomes 1.5.

Minimum therefore is 1.5.

Maximum therefore is 6.

Annual mean therefore is  $\frac{4 + 4 + 2 + 3 + 1.5 + 6}{6}$

Limit of detection signifiers are not recorded as all samples are effectively positive values. Although DoE do not report on the "number of less than samples" it is a useful indication of the number of theoretical values being entered into the data set.

## SUBSTANCES WITH ISOMERS AND TOTAL DRINS

For a single isomer e.g paraDDT

- a) the minimum value is the minimum value recorded (even if this is a 50% value).
- b) the maximum value is the maximum value recorded (even if this is a 50% value).
- c) the annual mean is the total of all sample values (including 50% values) divided by the number of samples.

For Total of isomers, or Totdrins

For example: 6 samples analysed for all four Drins. Several analyses were lower than the limit of detection. The 50% rule must be applied so that all the results obtained are turned into positive values, as below:

Aldrin	2	3	4	1	3	7
Dieldrin	1	6	2	4	5	1
Endrin	6	5	4	3	8	1
Isodrin	10	9	8	7	6	5
Total drins	19	23	18	15	22	14

Minimum value for total drins would be 14.

Maximum value for total drins would be 23.

Annual mean for total drins would be  $\frac{19 + 23 + 18 + 15 + 22 + 14}{6}$

(Please note: The annual mean for total drins will only be equal to the sum of the annual means of the individual Drins if there is a result for each of the Drins for each sample).

Again, limit of detection signifiers should not be entered as all results are in effect positive. The number of less than samples entered for Total drins should be the number of samples where all the Drins were less than the limit of detection.



## APPENDIX 6

### LIST I RELEVANT VALUES - BACKGROUND MONITORING

	Annual mean ( $\mu\text{g/l}$ )		
	Inland	Estuary	Marine
Cadmium	1	1 (D)	0.5 (D)
Hexachlorocyclohexane	0.05	0.05	0.05

## APPENDIX 7

### SEDIMENT / BIOTA SUBSTRATE CODES

Sample substance	First character code	Second character code (for fish/shellfish species)
Sediment (dry weight)	S	
Shellfish (wet weight)	H	
Molluscs (wet weight)	M	
Fish (wet weight)	F	
Other (wet weight)	O	
Limpet	M	L
Mussel	M	M
Oyster	M	O
Cod	F	C
Dab	F	D
Flounder	F	F
Haddock	F	H
Mackerel	F	K
Plaice	F	A
Sole	F	S
Whiting	F	W
Pike	F	P
Roach	F	R
Other	F or S	X

## **ANNEX 5**

### **Exchange of Information on The Quality of Surface Freshwaters**

**[1] Annexes II and III of Council Decision 86/574/EEC, amending Decision 77/795/EEC, establishing a common procedure for the exchange of information on the quality of surface fresh water in the Community**

**[2] List of sites for which information is to be exchanged**

## Annex 5 [1]

### Annex II of Council Decision 86/574/EEC

Parameters in respect of which information is to be exchanged.

(Modes of expression and significant figures for the parametric data)

Parameter		Mode of Expression	Significant figures:	
			Before the decimal comma	After the decimal comma
Physical	Rate of flow <sup>(1)</sup> (at the time of sampling)	m <sup>3</sup> /sec	XXXX	XX
	Temperature	°C	XX	X
	pH	pH	XX	X
Chemical	Conductivity at 20°C	μS cm <sup>-1</sup>	(< 100) XX (≥ 100) XXX	
	Chlorides	Cl mg/l	(< 100) XX (≥ 100) XXX	
	Nitrates	NO <sub>3</sub> mg/l	XXX	XX
	Ammonia	NH <sub>4</sub> mg/l	XXX	XX
	Dissolved oxygen	O <sub>2</sub> mg/l	XX	X
	BOD <sub>(5)</sub>	O <sub>2</sub> mg/l	XXX	X
	COD	O <sub>2</sub> mg/l	XXX	X
	Total phosphorus	P mg/l	XX	XX
	Surfactants reacting with methylene blue	Sodium lauryl sulphate eq. mg/l	XX	XX
	Total cadmium	Cd mg/l	X	XXXX
	Mercury	Hg mg/l	X	XXXX
Microbiological	Faecal coliforms	/100 ml	XXXXXX	
	Total coliforms <sup>(2)</sup>	/100 ml	XXXXXX	
	Faecal streptococci <sup>(2)</sup>	/100 ml	XXXXXX	
	Salmonella <sup>(2)</sup>	/ 11	X	
Biological	Biological quality <sup>(2)</sup> ( <sup>3</sup> )			

<sup>(1)</sup> The date of sampling must be given

<sup>(2)</sup> The data relating to this parameter shall be exchanged when it is measured

<sup>(3)</sup> The frequency of sampling of this parameter and the mode of expression of results shall be decided on by Member States.

## Annex 5 [1]

### Annex III of Council Decision 86/574/EEC

#### Reference methods of measurement

Parameter	Mode of Expression	Reference method of measurement
Rate of flow at the time of sampling	m <sup>3</sup> /s	Flowmeter
Temperature	°C	Thermometry measured <i>in situ</i> at the time of sampling.
pH	pH	Electrometry measured <i>in situ</i> at the time of sampling without prior treatment of the sample.
Conductivity at 20°C	μS cm <sup>-1</sup>	Electrometry
Chlorides	Cl mg/l	Titration (Mohr's method) Molecular absorption spectrophotometry.
Nitrates	NO <sub>3</sub> mg/l	Molecular absorption spectrophotometry.
Ammonia	NH <sub>4</sub> mg/l	Molecular absorption spectrophotometry.
Dissolved oxygen	O <sub>2</sub> mg/l	Winkler's method Electrochemical method.
BOD <sub>5</sub>	O <sub>2</sub> mg/l	Determination of dissolved oxygen before and after 5 day incubation at 20 ± 1 °C in complete darkness. Addition of a nitrification inhibitor.
COD	O <sub>2</sub> mg/l	Potassium dichromate method.
Total phosphorus	P mg/l	Molecular absorption spectrophotometry.
Surfactants reacting with methylene blue	Sodium lauryl sulphate eq. mg/l	Molecular absorption spectrophotometry.
Total cadmium	Cd mg/l	Atomic absorption spectrophotometry.
Mercury	Hg mg/l	Flameless atomic absorption spectrophotometry.

Faecal coliforms

/100 ml

- Culture at 44°C on an appropriate specific solid medium (such as Tergitol lactose agar, Endo agar, 0.4 % Teepol broth) with or without filtration and colony count. Samples must be diluted or, where appropriate, concentrated in such a way as to contain between 10 and 100 colonies. If necessary, identification by gasification.

- Method of dilution with fermentation in liquid substrates in at least 3 tubes in three dilutions. Subculturing of the positive tubes on confirmation medium. Count according to MPN (most probable number). Incubation temperature:  $44 \pm 0.5$  °C.

Parameter	Mode of expression	Reference method of measurement
Total coliform	/100 ml	<p>- Culture at 37°C on an appropriate specific solid medium (such as Tergitol lactose agar, Endo agar, 0.4 % Teepol broth) with or without filtration and colony count. Samples must be diluted or, where appropriate, concentrated in such a way as to contain between 10 and 100 colonies. If necessary, identification by gasification.</p> <p>- Method of dilution with fermentation in liquid substrates in at least 3 tubes in three dilutions. Subculturing of the positive tubes on confirmation medium. Count according to MPN (most probable number). Incubation temperature: <math>37 \pm 1</math> °C.</p>
Faecal streptococci	/100 ml	<p>- Culture at 37°C on an appropriate solid medium (such as sodium azide) with or without filtration and colony count.</p> <p>- Method of dilution in sodium azide broth (Litsky). Count according to MPN (most probable number).</p>
Salmonella	/1 L	Concentration by filtration (on membrane or appropriate filter). Inoculation into pre-enrichment medium, Enrichment and transfer into isolating gelose - identification.
Biological quality		Pending community wide harmonisation. Member States will use their respective methods.

## Annex 5 [2]

### List of Sites for Which information is to be Exchanged

#### Harmonised Monitoring Sampling Points - Appendix 1 COMMISSION OF EUROPEAN COMMUNITIES

Exchange of information on the Quality of Surface Fresh Water in the Community.  
EEC directive 77/795

Exchange of Information Code	Harmonised Monitoring Station Code	River	Location:	
			Name	NGR
U1	02 020	N. Tyne	Chollerford	NY 919706
U2	02 021	S. Tyne	Warden Bridge	NY 910660
U3	02 923	Tyne	Wylam Bridge	NZ 119645
U4	02 026	Derwent	Derwenthaugh	NZ 187607
U5	09 001	Axe	Whitford Bridge	SY 262953
U6	09 025	Fal	Tregony G.S	SW 921447
U7	09 026	Carnon	Devoran Bridge	SW 791394
U8	01 023*	Lune	Denny Bridge	SD 504647
	01 011	Lune	Forge Weir	SD 514648
U9	01 010	Wyre	St Michaels Weir	SD 462411
U10	01 008	Ribble	Samlesbury	SD 590305
U11	06 010	Thames	Teddington Weir	TQ 171714
U12	03 013	Tame	Cherwynd	SK 187138
U13	03 007	Trent	Nottingham	SK 581383
U14	03 008	Trent	Yoxall	SK 131177
U15	12 002	Spey	Fochabers	NJ 341596
U16	14 008	Almond	Craigiehall	NT 165752
U17	17 005	Leven	Renton Footbridge	NS 389783

\* Station 01 023 used from January 1981; prior to this the River Lune station was at Forge Weir.



## **ANNEX 6**

### **Urban Waste Water Treatment**

**Guidance note on information gathering for future designation reviews for Sensitive Areas (eutrophic) and "Polluted Waters" (eutrophic). August 1994**



**URBAN WASTE WATER TREATMENT & NITRATE DIRECTIVES**

**Sensitive Areas (eutrophic) and "Polluted Waters" (eutrophic)**

**Guidance Note on Information Gathering for Future Designation Reviews**

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**[ The above annex is not included in this manual ]**

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## 1. INTRODUCTION.

1.1 The intention of this document is to provide guidance for Regions on data/information gathering requirements in the run up (1994-96) to the first review (1997) of waters identified (i.e. designated) under those provisions of the Urban Waste Water Treatment (UWWT) and Nitrate Directives concerning eutrophication. The document outlines the recommendations of a national working group, convened to consider this matter, and addresses three issues:

- (i) The gathering of evidence to support the identification of a water as being, or at risk of shortly becoming, eutrophic.
- (ii) The identification of categories of waters to which the monitoring strategy should be applied.
- (iii) The question of monitoring to assist in deciding whether nutrient removal at individual qualifying STWs will have an effect upon the level of eutrophication.

The identification, under the two Directives, of waters for reasons other than eutrophication (eg elevated nitrates in ground and surface waters used for drinking water abstraction) is an issue which lies outside the scope of this document.

### 1.2 Directive provisions.

The provisions of the two Directives, as interpreted in the UK, for waters suffering, or at risk, from eutrophication, may be summarised as follows.

#### i. UWWT Directive (91/271/EEC).

Waters identified as eutrophic, or at risk of shortly becoming so, and receiving "qualifying" (> 10,000 pe) STW discharges (either directly or into the upstream catchment), shall be designated as Sensitive Areas (eutrophic) [SAs(E)] by 31.12.93. The STWs will need P and/or N removal (as appropriate) to Directive standards by 31.12.98 unless it can be demonstrated that such removal, for a particular STW, will have no effect upon the level of eutrophication.

#### ii. Nitrates Directive (91/676/EEC).

Waters which are eutrophic due to nitrates from agricultural sources, or at risk of shortly becoming so unless protective action is taken, must be identified as "polluted waters" (eutrophic) [PWs(E)] and areas of land draining to those waters, and which contribute to their nitrogen pollution, must be designated as Vulnerable Zones by 19.12.93. Restrictions on agricultural activities will be imposed within the Vulnerable Zones (by 1999).

### iii. Review of designations (both Directives).

Sensitive Areas, Polluted Waters and Vulnerable Zones must be reviewed at least every four years. The DoE intends that the first review will take place in 1997, for which the NRA (or its successor) will be expected to provide the bulk of the required data/information.

With regard to implications for STWs, nutrient removal for qualifying STWs implicated in reviews of Sensitive Areas must be installed within 7 years of a review ie 2004 in relation to the 1997 round. The proviso regarding non-effectiveness of P/N reduction (see 1.2(i)) applies equally here.

### 1.3 Experience from the 1993 round of designations.

The NRA submitted its candidates, for the first round of designations (1993) under both Directives, to the DoE. The proposals were based upon best available information, rather than a pre-planned programme of data gathering in relation to eutrophication. The criteria for identifying the waters were defined in the DoE/MAFF/Wo Consultation Paper of March 1992 (DoE 1992<sup>1</sup>) (as finalised in the subsequent March 1993 paper (DoE 1993<sup>2</sup>)). The information was submitted using the DoE proforma. Final decisions on the designations were made by Ministers following lengthy consultations involving the NRA, the WSPLCs and the DoE. These provided the NRA with a good indication as to the level of information required to constitute a robust scientific case for designation of a water as eutrophic. Building on this experience, the Authority has an opportunity, in relation to the 1997 review, to prepare and implement a coordinated programme of data/information gathering for implementation between summer 1994 and the end of 1996 (thereby ensuring that the data will encompass three summers). This will allow the DoE/Wo to consider and finalise the review of designations in 1997.

- 1.4 A consistent and considered national approach, to the collection and presentation of the evidence to (a) support designation candidates and (b) assess the contribution of individual STWs, is highly desirable. It will assist the NRA Regions in deciding what monitoring is appropriate under the eutrophication provisions of the two Directives. It should ensure that relevant and adequate information is available in 1997, for the NRA national panel (hoop one) and the DoE/Wo (hoop two) to assess the designation candidates, and reduce the potential for WSPLCs to question the strength of evidence.

### 1.5 Impact of STWs.

The tripartite DoE/NRA/WSPLC consultations also involved consideration of the impact of individual qualifying STWs. The UWWT Directive (Annex II) includes a caveat to the effect that discharges are exempted from the need for nutrient removal if it is shown that such treatment will have no effect on the level of eutrophication. It has proved difficult to make this judgement at many sites and R & D in this area is desirable.

R & D needs are to be considered by the national working group. However, it is necessary now to incorporate, within the overall strategy, guidance on data gathering to assist in making decisions on STWs in the 1997 review.

#### 1.6 Waters to be targeted.

This document also provides guidance on where to target the data/information gathering. Identifying now the waters to be targeted is necessary to ensure that (a) sufficient data may be collected prior to the 1997 review and (b) DoE and other interested parties are aware of potential future designations for costing purposes.

## 2. GENERAL APPROACH.

### 2.1 Evidence to support the identification of waters.

2.1.1 The evidence put forward in support of a given candidate water should reflect the provisions of the Directives (91/271/EEC<sup>3</sup> and 91/676/EEC<sup>4</sup>) and the DoE Consultation Papers<sup>1,2</sup>. This Guidance Note should be referred to in conjunction with those documents. To constitute a robust case the evidence must comprise all the following elements.

- (a) **General information** about the nature of the proposed area/waters.
- (b) **Chemical** data/information (which must include data for the limiting nutrient).
- (c) **Biological** data/information.
- (d) A demonstration that an "**undesirable disturbance**" (see UWWT/Nitrate Directive definitions of eutrophication) is occurring (to the quality of the water and the balance of organisms) or may soon occur. This can most readily be demonstrated through information about adverse effects upon the uses of the waters, but also/alternatively by changes in the ecology. The adverse impact must be attributable to eutrophication (and not, for example, to organic pollution).

**Proposed specific data/information requirements for each of the different categories of waters (still freshwaters, running freshwaters, estuaries and coastal waters), expanding upon the finalised criteria in Annex B of the March 1993 Consultation Paper<sup>2</sup>, are laid out in the Appendices to this document. These guidelines also incorporate advice on data gathering to assist in assessing the impact of STWs (see 2.3).**

2.1.2 Although it is necessary to make a robust case, it is not essential to collect data/ information for every one of the identification criteria listed in the DoE Consultation Paper. Every proposal will be assessed on its merits, as to whether the overall balance of evidence, bearing in mind 2.1.1 above, constitutes a case for designation.

### 2.1.3 Waters at risk of shortly becoming eutrophic.

The main thrust of this paper is in relation to sites considered to be suffering from the symptoms of eutrophication now. However, there will be some waters, of a more oligotrophic nature, which presently exhibit only the initial symptoms of enrichment, but which may warrant protection for the very reason that they are truly sensitive to, and would rapidly suffer as a result of, accelerated nutrient enrichment. The Directives allow for the designation of such waters and the issue of evidence to support designation must therefore be considered. SSSIs and other high conservation status sites, whose plant/animal communities may be damaged, are the most likely candidates. There will be relatively few such sites under UWWTD since P-controlled (inland) oligotrophic waters tend not to receive qualifying STW discharges. Saline water sites (eg SSSIs or IAWs) will also need to be considered although the assessment of subtle effects in such waters is particularly difficult (with present knowledge) and there would appear to be little scope for designations in this context.

It is proposed that Regions should put forward such cases on the basis of the particular sensitivities of the individual site, consulting as necessary with the relevant conservation body (English Nature or CCW). The task of identifying these waters may overlap with the consideration of SWQO Special Ecosystem proposals.

## 2.2 Waters to which the monitoring strategy is to be applied.

- 2.2.1 It is necessary to identify now the principal waters to which future monitoring for UWWTD/NO<sub>3</sub> Directives eutrophication purposes should be applied. This is because the NRA Regions need to begin data/information gathering in 1994 to ensure a good data set by the end of 1996. In addition, the DoE, MAFF and the WSPLCs need to know where potential future work and money may need to be targeted under the two Directives. The conservation bodies (EN,CCW) are also keen to know where future work will be targeted and to assist the NRA, where appropriate, in making its case.

### 2.2.2 Basic principles - UWWTD.

Under this Directive, P-controlled or N-controlled waters may be considered for SA(E) status, but only where there is a direct and/or an upstream qualifying STW.

### 2.2.3 Basic principles - Nitrates Directive.

Under this Directive, the constraint of including only waters receiving qualifying STW discharges does not apply. Any waters (normally saline ones), not necessarily receiving discharges, where nitrogen (from agriculture) is the causal nutrient, may be considered for potential identification as PWs(E).

#### 2.2.4 Categories of waters.

- i. Sites identified as SAs(E) in the first round of designations (announced by the Government on 18/5/94).
  - *we must continue to monitor these so that the designations may be reviewed in 1997 and the impact of P removal (where it is provided) can be assessed.*
- ii. Sites proposed by the NRA as candidates for identification as SAs(E) in the first round, but which the DoE declined to designate, on the grounds of insufficient evidence.
  - *these will need to be monitored over the next three years (1994-96 inclusive) so that robust information is available to the NRA in deciding which sites to propose for identification in the 1997 review.*
- iii. Sites initially proposed by the NRA as candidates for identification as SAs(E) or PWs(E) in the first round, but subsequently withdrawn by the Authority on the grounds of insufficient evidence.
  - *as for ii.*
- iv. Sites proposed by the NRA Regions as candidates for identification as SAs(E) or PWs(E) in the first round, but rejected by the NRA National Panel on the grounds of insufficient evidence.
  - *as for ii.*
- v. Sites not proposed as SA(E) or PW(E) candidates for the first round (since insufficient evidence was available to make an assessment), but warranting investigation for the 1997 review.
  - *as for ii. Regions have recently submitted their proposed sites.*
- vi. Sites which the Regions consider may be at risk from shortly becoming eutrophic but for which sufficient evidence was not available to put forward a case for designation in the first (1993) round.
  - *see 2.1.3.*

**The specific waters falling within the above categories, with the exception of "vi" above, are shown in the Annex to this Guidance Note which includes an identifier (ID "i" to ID "v") relating to the categories above. The information gathering exercise, described in this Note, is applicable to all the listed waters.**

#### 2.2.5 Approaches for fresh and saline waters.

Under the approach laid out in this section and the Appendices, the bulk of the effort, in the run up to the 1997 review, will be targeted to inland (fresh) water situations. This is because, in UK waters, problems associated with eutrophication have manifested themselves primarily in fresh rather than saline water environments.



In addition, the UWWTD will bring significant improvements to treatment levels for many discharges to saline waters with consequent improved water quality. To undertake a major monitoring exercise in waters where the quality regime will be changing and where clearly recognised problems are few, cannot be justified. The relatively small number of estuaries (and almost no coastal waters) suggested by Regions for the proposed future monitoring is considered to be adequate.

- 2.2.6 Strong consideration should be given to raw water reservoirs which suffer from problems due to blue-green algae or other problem algal blooms (providing they receive qualifying discharges either directly or within the upstream catchment).

2.3 Assessing the impact of qualifying STWs on identified/potential SAs(E).

2.3.1 Techniques.

Predictive techniques (principally water quality models) are needed which will enable decisions to be made as to whether the UWWTD Annex II caveat is applicable i.e. whether a given qualifying discharge can be exempted from the need for nutrient removal on the grounds that the treatment would have no effect upon the level of eutrophication. For the first round of designations, some relatively simple modelling was undertaken but, in many instances, this did not lead to a clear case for or against nutrient removal.

Techniques are required which will allow determination of:

- (a) the relative contributions of nutrient from various sources (i.e. based upon internal and external loadings), nutrient fate/transport within the water environment and;
- (b) the effects of control measures such as nutrient removal, on nutrient concentrations in receiving waters and their influence on the manifestation of eutrophic effects such as algal proliferation or changes to the macrophyte community.

The former will assist in identifying the key sources for control. For the latter it would be ideal if limiting concentrations for the relevant nutrient could be defined (below which problems would not occur). However, this would seem to be an unrealistic hope, certainly in the case of running freshwaters, estuaries and coastal waters, since there are numerous other factors affecting primary production. For rivers, simple comparisons (eg of macrophyte species and % cover) upstream and downstream of STWs, will continue to be useful in demonstrating discharge impact.

A review of model availability and of current R&D, in relation to eutrophication and discharge impact, for the four categories of waters, is to be undertaken and R&D needs can then be established with respect to the shortfall. **It is intended that supplementary advice on the modelling aspects of this exercise will be issued in due course.** This will address model availability, data needs and potential use of per capita flow and nutrient figures.

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Initial indications, with regard to model availability, are as follows.

i. Still Freshwaters.

A model (Protec II) has been developed which appears to suit our purposes.

ii. Rivers.

The bulk of the discharge assessment work will fall in this category. It seems likely that models which allow determination of the impact of nutrient removal upon the biology (algae or macrophytes) of the receiving waters will not be available (for the 1997 review). Models which determine the impact of treatment upon nutrient concentrations in receiving waters may be the best tools available. Such models require river quality and flow plus effluent quality and flow information.

With these it is possible to model the existing situation, based upon real or estimated flow and quality for all significant inputs affecting the SA(E) and then remodel, setting some or all of the qualifying STWs to the concentration or % reduction standards specified in the Directive. This would predict the effects of nutrient removal treatment, at particular STWs, on resultant nutrient concentrations in the receiving waters.

iii. Estuaries and coastal waters.

The situation is broadly similar to that for rivers, however there are water quality models which allow determination of chlorophyll-*a* concentrations in estuaries and enclosed coastal waters (bays). These principally use information on nutrient loadings. Such models have yet to be developed for many individual UK estuaries and to date have not been widely used for modelling chlorophyll. The CSTT report includes a section on predicting the trophic state of saline waters, which may be helpful in undertaking assessments.

There will be a need to quantify nutrient (nitrogen) loads to estuaries and coastal waters for both UWWT and Nitrate Directives, to assess the relative contributions from agriculture and STWs. Current WRC/SNIFFER projects<sup>8</sup> on eutrophication risk assessment should provide assistance in this area though further R&D may need to be considered.

2.3.2 Information gathering requirements.

To a large extent, the level of information required for the modelling will be case specific. Initial modelling runs can be undertaken using estimated (or assumed) figures for effluent nutrient concentrations and flow. Receiving water quality data will be generated from the NRA's monitoring to determine whether the waters themselves are eutrophic.

The initial modelling may suffice for some discharges where treatment will clearly have an insignificant effect upon resultant receiving water nutrient concentrations. It will also permit identification of cases where the model is sensitive to effluent quality and where actual effluent data will thus be needed for a robust assessment.

It is necessary to consider now what data collection is required to satisfy (a) future modelling needs and (b) other (less sophisticated) assessments of discharge impact. The following approach is therefore recommended.

(i) Receiving water quality and flow data.

Water quality data, for the relevant indicator parameters, will be generated through NRA monitoring to determine whether the waters themselves are eutrophic. River flow data will also be required. **Guidance on basic monitoring in this context is incorporated within the Appendices. It is anticipated that these data will broadly satisfy model requirements though Regions should extend the monitored parameters as required where specific model needs are known.** The data generated for rivers will also permit less complex assessments of discharge impact, eg upstream/downstream comparisons, which can be equally useful in demonstrating whether a deterioration (in terms of eutrophication) is occurring.

(ii) Effluent nutrient quality and flow details.

These are required to allow an assessment of the relative P or N contribution from qualifying STWs in comparison to other sources including other discharges (trade or sewage) and the river load itself.

Some 350 STWs (nationally) will need to be assessed for the 1997 review. For STW flow, estimates based upon population or consented dry weather flow should suffice. Where actual effluent nutrient concentrations are required, it is likely that, for discharges to P-controlled waters, both total P and ortho-P (in the effluent) will be required, and for discharges to N-controlled waters, both total N and TON, to quantify both the potentially and readily available nutrient inputs. A minimum monthly frequency is recommended. However, as discussed above, actual effluent quality data may not be required in all cases. In addition, on the basis that these discharge impact assessments are for the potential benefit of WSPLCs (being used in deciding whether the requirement for nutrient removal can be waived), the NRA intends to pursue, through the forum of the UWWTD Implementation Group, the possibility of sharing the financial and/or monitoring burden between NRA and WSPLCs. The need to put in place effluent monitoring is less urgent than receiving water monitoring. One or two years effluent data (1995 and/or 1996) should suffice. **Therefore, until the precise arrangements are resolved, Regions need not put in place additional data collection for nutrients or flow in STW effluents. However, Regions should bear in mind the need to complete the major discharge assessment exercise by the end of 1996 and should therefore begin now to consider model and effluent data requirements. As mentioned in 2.3.1, further advice will be issued in due course.**

### 3. COLLECTING THE DATA/INFORMATION.

- 3.1 Existing chemical and biological monitoring programmes will need to be reviewed in relation to the requirements laid out in Section 2 and the Appendices. Regions should ideally undertake the review with a view to implementing the programme of data/ information gathering from Summer 1994. This monitoring may prove to be a long term commitment, since the Directive requirement to review areas/zones every four years is a permanent obligation. The level of monitoring will be reviewed periodically.
- 3.2 In carrying out the review, Regions should maximise the use of data from their routine monitoring programmes, in order to minimise any extra monitoring burden. Additional monitoring needs should be addressed where possible by supplementing the currently-monitored determinands on the existing sampling routes/points. Creation (or resurrection) of extra sampling points should be minimised although some additional monitoring effort will almost certainly be involved and the DoE has stressed that the monitoring arrangements must be sufficiently robust for decisions on eutrophic status to be taken in 1997.

The Appendices attempt to strike a balance, within the overall exercise, between the twin purposes of (a) monitoring to support the designation of waters as eutrophic (or at risk) and (b) monitoring to assist in assessing the impact of individual qualifying discharges. Regional staff, in reviewing their monitoring programmes, should undertake the task with these twin aims clearly in mind.

#### 3.3 Overlap with other monitoring initiatives.

There are a number of other monitoring initiatives currently being developed/ introduced which involve (sometimes amongst other things) nutrients and related parameters. Examples for inland waters are the various components of the GQA scheme, the SWQO Special Ecosystem proposals<sup>5</sup>, Blue-Green Algae Action Plans<sup>6</sup> and the Lake Classification proposals<sup>7</sup>. In saline waters, examples include the JONUS, LOIS and (soon) SONUS studies. In developing this guidance note it is only possible to highlight the issue of overlap. It falls to Regions to rationalise the various requirements within their monitoring programmes.

#### 3.4 Relative Regional priorities.

The importance of eutrophication as a water quality issue varies considerably from Region to Region. Within the procedures for proposing (a) waters for designation and (b) particular STWs for nutrient removal, there is a degree of flexibility for Regions to reflect the relative priority afforded to eutrophication. Whilst any water which clearly meets the criteria should be put forward as a designation candidate, as required by the Directive, the initial selection of candidates in 1997 will essentially lie with Regions. Furthermore, Regions should bear in mind that, where nutrient removal at a particular STW will have no effect on eutrophication, it is possible to designate the water but not require removal at the works.

- 3.5 This monitoring programme and the complementary R&D work will be reviewed as the work progresses. Once the information has been collected it will be vetted, as in the recent exercise, by the NRA National Panel. The panel will assess and compare each SA(E) and PW(E) proposal and draw up a unified list for submission to the DoE as the Authority's designation candidates for the second round. The proposals will be submitted on a revised version of the DoE proforma (see 4). It is anticipated that completion of proformas and assessment by the NRA Panel will begin in early 1997.

#### 4. AMENDMENTS TO THE PROFORMA.

The Appendices to this paper set out the suggested range of data/information required to constitute a robust submission for a proposed eutrophic water/area. The DoE proforma document is the main vehicle by which the NRA's proposals are presented to the Department. The current format of the document would benefit from amendment so that it will more closely reflect the characteristics of the information we will be gathering (see Appendices). Changes to the format will need to be agreed with the DoE. The working group will (in due course) consider the necessary amendments and these can then be pursued with the Department.

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#### REFERENCES

- <sup>1</sup> DoE, Welsh Office, MAFF (March 1992) - Consultation Paper on Criteria and Procedures for Identifying Sensitive Areas and Less Sensitive Areas (UWWTD) and "Polluted Waters" (Nitrates Directive) in England and Wales.
- <sup>2</sup> DoE, Welsh Office, MAFF (March 1993) - Consultation Paper on Methodology for Identifying Sensitive Areas (UWWTD) and Designating Vulnerable Zones (Nitrates Directive) in England and Wales.
- <sup>3</sup> Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC).
- <sup>4</sup> Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC).
- <sup>5</sup> Statutory Water Quality Objectives: Proposed Special Ecosystem Classification for Rivers. Environmental Quality Section, NRA Bristol Office.
- <sup>6</sup> Guidelines for the Development and Implementation of Action Plans to Combat and Review the Incidence of Blue-Green Algal Blooms. Toxic Algae Task Group.
- <sup>7</sup> NRA R & D Project 286. Lakes - Classification & Monitoring; a strategy for the classification of lakes. Draft R & D Note 286/5/A. (Final report expected soon.)
- <sup>\*</sup> WRc/SNIFFER projects on eutrophication risk assessment (lakes, rivers and tidal waters). Report SR3707, Eutrophication of Tidal Waters: Classification & Screening Tools, 1994 .  
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## APPENDIX ONE.

### EC UWWT & NO<sub>3</sub> DIRECTIVES INFORMATION/DATA IN RELATION TO EUTROPHICATION

#### Running Freshwaters.

This Appendix must be read in conjunction with Sections 2 & 3 of the Guidance Note.

The following points indicate the level of information which will be required at the 1997 review and must therefore be gathered in the period 1994-96.

#### 1. *General description.*

An outline of the nature of the proposed candidate water will be required (at the time the proforma is completed), including the following points:

- the length of the stretch in km, NGRs/names of start/finish points, and indicating whether the proposed stretch is in the upper/middle/lower reaches.
- local hydrogeology; state whether it is a chalk stream, a clay catchment, an acidic upland stream etc.
- flow regime and depth; state whether it is deep and sluggish, canalised, fast flowing and shallow, etc. Include an estimate of summer retention time, indicating whether the 5 day algal multiplication period may be exceeded.
- comments on whether any significant changes to the nature of the watercourse and the quality regime occur along the proposed stretch. Indicate where and why such changes occur.
- a brief summary of the uses of the watercourse including any conservation status. This should accord with uses identified under the Catchment Management Plan (CMP) (if such a plan has been produced). (See also 6.)
- a MAP showing the stretch, the location of qualifying and other discharges, chemical and biological monitoring points, and other relevant points eg abstractions to water treatment works/reservoirs.

#### 2. *Location of monitoring points.*

Data should be collected at a sufficient number of points along the proposed stretch, to adequately represent the whole length and, particularly for modelling purposes, to demonstrate the impact of major discharges (including trade effluents) to that system. Data for a monitoring point (or points) upstream of the proposed eutrophic stretch should also be provided, to demonstrate a contrast. Chemical and biological points should coincide where possible (this being essential for D.O and chlorophyll-*a* points), but need not if biological relevance would be compromised.

A1.1

For chemical sites, the general approach should be as for the GQA scheme, having one point between each major discharge and further points to demonstrate the effects of important tributaries or other significant influences on quality through the stretch. The need to derive nutrient load assessments from the data collected should influence the choice of sites.

For biological sites, the choice of monitoring points for phytoplankton (chlorophyll) should allow for algal doubling times downstream of discharges, and for macrophytes should be aimed at best demonstrating differences (ie change in percentage cover) upstream and downstream of qualifying discharges (see also 5).

3. *Time period for data sets.*

Data should be derived from a time period long enough to avoid distortion due to particularly wet or dry years. A minimum of two years data, but preferably a period covering three summers, is recommended.

4. *Chemical parameters.*

A brief description of the parameters considered to be relevant (and less relevant) will be required.

With regard to sampling frequencies, at least 30 samples should be collected over the whole monitoring period. This broadly equates to a monthly frequency.

Data for the following parameters should be collected, if considered relevant, the nutrient data being obligatory:

- (i) Orthophosphate - mean, max, standard deviation, no. of samples.

It is recognised that the loading of phosphorus is determined by total P. However, in most river systems ortho-P will be a good estimate of total P. In terms of identifying problem/priority sites ortho-P is fully adequate and it is also the form specified, for running freshwaters, in the DoE consultation paper.

- (ii) D.O. %SAT - min, max, and no. of samples from spot sampling.  
(Daytime/nighttime summer values?).

- data from AWQM stations are desirable, to show day/night variations particularly in the summer months.

For each of the above (other than AWQM data), the number of results breaching the DoE criteria (P.30 of Annex B of the 1993 Consultation Paper) will be required.

Graphical and schematic presentations (see attached examples) will be required, since these are a considerable help to those assessing the proposals.

A1.2

## 5. *Biological evidence.*

- (i) A brief description of the parameters considered to be relevant (and less relevant) will be required. For instance, in the headwaters, macrophyte % cover will normally be an important indicator and planktonic algae (indicated by chlorophyll-*a* data) will be almost absent (due to the flow regime). In deep slow flowing waters, planktonic algae (and hence chlorophyll-*a*) will usually be good indicators and macrophyte cover may be sparse due to the effect of depth on light penetration.

- (ii) Macrophytes (including macrophytic algae).

Macrophyte surveys should be targeted to demonstrate a change in percentage cover and species diversity U/S and D/S of a STW discharging into a proposed SA(E). High % cover measurements for species indicative of eutrophic conditions, together with low species diversity, may be taken to indicate a eutrophic situation.

A two-tiered survey approach is recommended. At sites where the impact of a discharge has not been identified or if the trophic status is uncertain a general assessment of the area should be made, involving walking the river bank and noting the dominant macrophyte species present. This "look-see" technique should be used to target the sites which require further investigation. Where there is a visible change in the macrophyte community structure U/S and D/S of a discharge, this should be assessed by more intensive surveys, to determine the percentage cover of each species present.

The timing of surveys will vary between the Regions because of local factors affecting macrophyte growth. Surveys should not take place following river dredging or weed cutting. A minimum of two full surveys should take place in any one of the three years up to the next round of designations in 1997, together with one survey in each of the other two years. Therefore a minimum of four surveys should be carried out at each site over the next three years.

A suggested macrophyte methodology, "Standard Methodologies - Assessment of Freshwater Riverine Environments Using Macrophytes" National Rivers Authority, is appended to this report.

- N.B. Advice as to which species of macrophytes are indicative of eutrophication in different parts of England and Wales is currently being sought and will be issued as a supplement to this guidance note. This will affect the interpretation of the data. It need not delay the instigation of the monitoring.

- (iii) Chlorophyll-*a*
  - mean, max, standard deviation, no. of samples.
  - Summer statistics (period May to Sept inclusive) as well as annual statistics would be useful.

Sampling frequency should be as for the chemical parameters ie monthly. Locations should be those where algal blooms are anticipated to occur and should coincide with those for DO % Saturation.

### A1.3



- (iv) For fauna (invertebrates and fish), supporting information should be presented if this is considered to assist in demonstrating effects of eutrophication. No additional data collection should be initiated for the purposes of this exercise.
- (v) The above will need to be backed up by statements about effects upon river biology eg changes to diversity, abundance, community structure etc. Significant algal blooms (particularly blue-greens) and their persistence should be investigated and documented, as should any extreme events eg fish kills due to DO depletion.
- (vi) Photographic evidence will be valuable in demonstrating algal/macrophyte cover and particularly in contrasting sites upstream and downstream of STWs.

Graphical and schematic presentations (see attached examples), will be required, since these are a considerable help to those assessing the proposals.

#### 6. *Demonstration of an undesirable disturbance.*

For a water to qualify as eutrophic, as defined in the Directive, it is necessary to demonstrate that an "undesirable disturbance" is occurring to the balance of organisms and the quality of water. In Section 5 (Biological Evidence) the need to document the ecological effects of eutrophication ie upon diversity, abundance and community structure is stressed. This information is extremely valuable in demonstrating an "undesirable disturbance". Similarly, for the Chemical Parameters (Section 4), low dissolved oxygen levels would be a relevant indicator.

In addition, statements regarding any adverse effects upon the recognised river uses of the stretch eg abstractions, fisheries, amenity etc, attributable to eutrophication problems, should be compiled. These should accord with the content of any CMP for the catchment. Details of relevant complaints (including the reasons for them) from water companies, industry, anglers and angling associations, canoeists, conservation bodies, members of the public etc, are useful in this regard and should therefore be recorded. The need to undertake weed clearance to avoid flooding or permit navigation is another factor worthy of mention in this context.

Any conservation status (eg SSSI) should be highlighted, particularly if that status is considered to be dependant upon the trophic state of the water and/or suffering due to accelerated nutrient inputs and/or if the stretch may fall within the Special Ecosystem Use-Class of the SWQO system. Regions are encouraged to liaise with English Nature/CCW in assessing effects upon sites of conservation interest eg SSSI rivers, in order best to maximise the available information regarding these sites.

In order to constitute an undesirable disturbance, it is not necessary for there to be adverse effects in terms of all the factors (chemistry, biology, river uses and conservation status). Weight of evidence in each case will be assessed on its merits.

#### 7. *River flow data.*

These should be collected at relevant gauging stations to permit determination of loadings. Where there is no gauging station at a point of interest, then flow will need to be estimated, or spot flow measurements taken.

A1.4

## APPENDIX TWO.

### EC UWWT & NO<sub>3</sub> DIRECTIVES INFORMATION/DATA IN RELATION TO EUTROPHICATION

#### Still Freshwaters.

This Appendix must be read in conjunction with Sections 2 & 3 of the Guidance Note.

The following points indicate the level of information which will be required at the 1997 review and must therefore be gathered in the period 1994-96.

#### 1. *General description.*

An outline of the nature of the proposed candidate water and its catchment will be required, including the following points:

- the extent of the proposed area/water.
- for lakes, comments on the natural trophic status and major influences upon this.
- depth and whether stratification occurs.
- for raw water reservoirs, a brief description of the water supply scheme, indicating the main raw water inputs to the reservoir, the main influences on trophic status, and also comments upon whether phosphorus reduction measures (eg ferric dosing), or other methods of alleviating the effects of eutrophication (eg destratification), have been implemented.
- whether the water body has been identified for development of a Blue-Green Algae Action Plan.
- an estimate of retention time.
- a brief indication of the uses of the water body including any conservation status. This should accord with uses identified under the Catchment Management Plan (CMP) (if such a plan has been produced).
- a MAP showing the proposed SA/PW, the location of qualifying and other discharges, chemical and biological monitoring points, and other relevant points eg abstractions to water treatment works.

#### 2. *Location of monitoring points.*

Data should be collected for sufficient points within the proposed SA/PW to adequately represent the whole water body and assess the effects of major inputs. The quality of water at abstraction points (to WTW) is also normally of interest. Sampling from boats should be minimised, eg if suitable jetties or other structures are present.

A2.1

### 3. *Time period for data sets.*

Data should be derived from a time period long enough to avoid distortion due to particularly wet or dry years. A minimum of two years data, but preferably a period covering three summers, is recommended.

### 4. *Chemical parameters.*

Data for the following parameters should be collected:

- (i) Total phosphorus - mean, max, standard deviation, no. of samples.

At least 30 samples should be collected over the whole monitoring period. This broadly equates to a monthly frequency.

- (ii) Dissolved Oxygen.

For water bodies which stratify, data from the epilimnion and hypolimnion, to demonstrate the extent of surface supersaturation and deep-water oxygen depletion, are desirable. Two sets of data per summer should suffice for establishing whether stratification occurs.

- (iii) Water clarity

Secchi disc transparency - mean, max, min, no of samples, should be gathered where feasible, ideally at monthly sampling frequency. Extra monitoring effort should be minimised eg Water Companies may be a useful source of data.

For each of the above (other than DO), the number of results breaching the DoE criteria (P.29 of Annex B of the 1993 Consultation Paper) will be required.

Graphical and schematic presentations (see attached examples) will be required, since these are a considerable help to those assessing the proposals.

### 5. *Biological evidence.*

- (i) General. A description of the parameters considered to be relevant (and less relevant) will be required. The dominant algal species and the changing assemblages from spring through to autumn are normally an important indicator of trophic status. A summary will be required regarding biological effects attributable to eutrophication eg changes in algal (or macrophyte) diversity, abundance, species composition etc.

The occurrence of algal blooms, in particular, should be documented including their type(s) (especially blue-greens) and whether they are sustained. If the water body is identified for development of Blue-Green Algae Action Plan, in accordance with the Toxic Algal Task Group's guidelines<sup>6</sup>, then details of the reasons for identification (the derivation of the priority score) should be provided.

Any extreme events such as fish kills due to DO depletion should also be recorded. Effects upon macrophytes, invertebrates and fish species should be noted if it is considered that these assist in demonstrating the effects of eutrophication.

- (ii) Chlorophyll-*a* - mean, max, no. of samples.

A monthly sampling frequency is recommended. Individual measurements from the summer months are useful, to assist in demonstrating whether algal blooms are sustained.

- (iii) Photographic evidence should be gathered if this will assist in demonstrating an "undesirable disturbance" eg blue-green algal scums.

Graphical and schematic presentations (see attached examples) will be required, since these are a considerable help to those assessing the proposals.

#### 6. *Demonstration of an undesirable disturbance.*

For a water body to qualify as eutrophic, as defined in the Directive, it is necessary to demonstrate that an "undesirable disturbance" is occurring to the balance of organisms and the quality of water. In Section 5 (Biological Evidence) the need to document the ecological effects of eutrophication ie upon diversity, abundance and community structure is stressed, as is the need to highlight blue-green algal problems. Such information is extremely valuable in demonstrating an "undesirable disturbance".

In addition, statements regarding any adverse effects upon the recognised uses of the water body eg water supply abstractions, fisheries, amenity etc, attributable to eutrophication problems, should be compiled. These should accord with the content of any CMP for the catchment. Details of relevant complaints (including the reasons for them) from water companies, industry, angling associations, windsurfers/yachtsmen, canoeists, conservation bodies, members of the public etc, are useful in this regard and should therefore be recorded. Details of closures or restrictions on amenity usage due to blue-green algae are a good example of relevant information in this respect and should therefore be documented.

Any conservation status (eg SSSI) should be highlighted, particularly if that status is considered to be dependant upon the trophic state of the water body and/or suffering due to accelerated nutrient inputs. Regions are encouraged to liaise with English Nature/CCW in assessing effects upon sites of conservation interest eg SSSI lakes, in order best to maximise the available information regarding these sites.

In order to constitute an undesirable disturbance, it is not necessary for there to be adverse effects in terms of all the factors (chemistry, biology, water uses and conservation status). The weight of evidence in each case will be assessed on its merits.

### A2.3

### APPENDIX THREE.

#### EC UWWT & NO<sub>3</sub> DIRECTIVES INFORMATION/DATA IN RELATION TO EUTROPHICATION

##### Coastal Waters.

This Appendix must be read in conjunction with Sections 2 & 3 of the Guidance Note.

1. *Comments on the proposed strategy for coastal waters.*

A minimum additional effort strategy is proposed for coastal waters. This reflects the premise that eutrophication is not a problem in UK coastal waters, that major investment on sewage treatment is to be undertaken, and that considerable national/international R&D (JONUS, LOIS, SONUS) is already in hand for those particular waters where additional work appears warranted. Very few coastal waters have been proposed by Regions for monitoring in relation to the 1997 review.

2. *Location of monitoring points and parameters of interest.*

- 2.1 It is recommended that a primarily observational approach is adopted, with the aim of establishing the occurrence of exceptional nuisance algal blooms, the duration of blooms, excessive macro-algal growths, or other evidence of undesirable disturbances.
- 2.2 This should be undertaken at existing monitoring points, notably those for bathing waters and shellfish waters. All EC bathing waters are monitored weekly, May to September inclusive, as part of the National Marine Algal Bloom Monitoring Programme. On occasions where algal blooms are seen to be present, samples should be taken for cell counts and chlorophyll-*a* concentration (the parameters with numeric indicator values in the DoE consultation paper). Monthly summer sampling for these parameters is recommended for sites where regular "significant blooms" occur and consideration should be given to remote sensing surveys, from aircraft, at such sites to determine spatial distribution of blooms and evidence of impact. "Significant blooms" have been defined in the National Marine Algal Bloom Monitoring Programme as blooms causing significant accumulations of algal material on beaches and which have led, or may lead, to public concern or complaints.
- 2.3 All reports of undesirable disturbances attributable to algal blooms should be investigated and records collated. This will include disturbance such as excessive scum and foam on water and on beaches, and benthic invertebrate, shellfish, and fish mortalities not associated with organic pollution. Historic data/records should also be presented where supportive.

A3.1

- 2.4 Shorelines should be examined in summer (June - August) to establish the presence of excessive growth of macro-algae (*Enteromorpha* and *Ulva*) in areas where there are known problems. Excessive growth would be areas of greater than 10 hectares in which the average algal cover exceeds 25%. In such areas quantitative information on % cover should be collected for three summers.
- 2.5 Winter nutrients should be determined on three occasions between December and February each year to determine the degree of hypernitrification, at those coastal sites identified under this monitoring exercise. Analyse for TON and  $\text{NH}_3$ , to establish levels of dissolved available inorganic nitrogen, and for  $\text{NO}_2$ .
- 2.6 Data collected for other purposes, which may assist in the assessment of eutrophication, should be collated for use in this exercise.

3. *General description.*

For sites where evidence is considered sufficient to put the waters forward as a designation candidate, an outline of the nature of the proposed eutrophic water should be given, including the following points:

- the extent of the area/water and a brief description of the oceanography.
- comments on whether any significant changes to the quality regime of the waters occur within the proposed stretch of coastline. Indicate where and why such changes occur.
- a map showing the SA[E]/PW[E], the location of qualifying (and other significant) discharges (if applicable), chemical and biological monitoring points, and any other relevant features.
- details of any significant designations or interests in relation to other environmental initiatives eg SSSI, Important Area of Marine Wildlife, proposed SAC under Habitats and Species Directive, PARCOM site etc.

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## APPENDIX FOUR.

### EC UWWT & NO<sub>3</sub> DIRECTIVES INFORMATION/DATA IN RELATION TO EUTROPHICATION

#### Estuaries.

This Appendix must be read in conjunction with Sections 2 & 3 of the Guidance Note.

1. *Comments on the proposed strategy for estuarine waters.*

There are some 178 estuaries in England and Wales. Many of these have little potential for eutrophication problems to manifest themselves. Sites considered to be low risk in this respect are those with flushing times of less than 1-2 weeks (since algal populations do not have time to develop), and those where the suspended solids content is high (and light penetration is therefore poor). Regions have in fact proposed some 45 estuaries for assessment in the run up to the 1997 review.

A minimum additional effort strategy is generally proposed for these estuaries. This reflects the premise that eutrophication of estuaries is not a significant problem in the UK, that major investment on sewage treatment is to be undertaken, and that considerable national/international R&D (JONUS, LOIS, SONUS) is already in hand for many of the principal waters where additional investigation appears warranted. However, estuaries are of a more individual nature than coastal waters, being heavily influenced by local factors. The level of resources employed should therefore reflect Regional priorities, with more effort being targeted to the obvious cases such as sites identified as problem or potential problem areas under PARCOM.

Two alternative approaches are recommended, basic screening studies or purposeful monitoring. The choice should lie with Regions and reflect the balance of evidence of undesirable disturbances. There is no simple trigger parameter by which the choice of approach can be made since the factors influencing primary production in estuaries are numerous and complex.

Where existing evidence or levels of monitoring are sparse or inconclusive then the screening studies should be adopted as the first stage, moving on to purposeful monitoring where warranted (see below). For PARCOM sites, or other estuaries where further investigation is considered warranted, then the purposeful monitoring approach should be adopted from the start. It is recommended that to warrant undertaking the purposeful monitoring, the estuary should be suffering from clearly recognised problems attributable to eutrophication. Examples include algal blooms of a particularly unusual scale or large blooms persisting from spring through to autumn, deterioration of shellfisheries, widespread public complaints about scums on water and beaches, or excessive growths of macro-algae.

A4.1

## 2. *Basic screening studies.*

- 2.1 These involve a primarily observational approach, with the aim of establishing the occurrence of exceptional nuisance algal blooms, the duration of blooms, excessive macro-algal growths, or other evidence of undesirable disturbances. This should be carried out at existing monitoring points. Where estuaries contain EC bathing waters, the approach outlined in 2.2 of Appendix Three should be followed.
- 2.2 All reports of undesirable disturbances attributable to algal blooms should be investigated and records collated. This will include disturbance such as excessive scum and foam on water and on beaches, and benthic invertebrate, shellfish, and fish mortalities not associated with organic pollution.
- 2.3 Shorelines should be examined in summer (June - August) to establish the presence of excessive growth of macro-algae (*Enteromorpha* and *Ulva*) in areas where there are known problems. Excessive growth would be areas of greater than 10 hectares (and greater than 25% of the available intertidal area) in which the average algal cover exceeds 25%.
- 2.4 Analysis for chlorophyll-*a* concentration should be undertaken on samples taken for other purposes where it is believed that such data may be relevant.

## 3. *Purposeful monitoring.*

### 3.1 **Estuaries where phytoplankton growth is significant.**

Where the observational approach and/or historic monitoring indicate a clear problem with undesirable disturbances, the aim of the exercise must then be to confirm whether the estuary is suffering from eutrophication and to determine whether agriculture and/or qualifying STWs inputs are important influences on trophic status.

Given the individual nature of estuaries it is not considered feasible to lay down precise monitoring requirements which will be suitable to each case. The design of an appropriate monitoring regime must therefore be, to a great extent, a Regional matter and should be greatly influenced by the requirements of the specific model which will be needed to assess nutrient (ie nitrogen) loadings and the effects of control measures (actual or potential) upon the biological disturbances. Full scale water quality models are likely to be required for the affected estuaries.

The monitoring exercise is likely to require boat-based surveys, though in some estuaries it may be practical to sample from jetties, bridges, headlands, marinas etc.

Consideration should also be given to the use of remote sensing surveys from aircraft to determine spatial distribution of blooms and evidence of impact.

Winter nutrient data will almost certainly be required, eg three occasions between December and February each year to determine the degree of hypernitrification, analysing for TON and  $\text{NH}_3$ , to establish levels of dissolved available inorganic nitrogen, and for  $\text{NO}_2$ . In addition, summer nutrients, chlorophyll-*a* and cell counts (the latter two having numeric threshold values in the DoE Consultation Paper) are likely to be required.

A4.2



All reports of undesirable disturbances attributable to algal blooms should continue to be investigated and records collated. This will include disturbance such as excessive scum and foam on water and on beaches, and benthic invertebrate, shellfish, and fish mortalities not associated with organic pollution. Where estuaries contain EC bathing waters, the approach outlined in 2.2 of Appendix Three should be followed.

### 3.2 Estuaries where macro-algal growth is significant.

Shorelines should continue to be examined in summer (June - August) to establish the presence of excessive growth of macro-algae (*Enteromorpha* and *Ulva*) in areas where there are known problems. Excessive growth would be areas of greater than 10 hectares (and greater than 25% of the available intertidal area) in which the average algal cover exceeds 25%. In such areas photographic evidence and quantitative information on % cover should be collected for three summers. Infra-red false colour aerial surveys may be useful in this context.

Winter nutrients should be determined on three occasions between December and February each year to determine the degree of hypernutrification. Analyse for TON and  $\text{NH}_3$ , to establish levels of dissolved available inorganic nitrogen, and for  $\text{NO}_2$ .

All reports of undesirable disturbances attributable to eutrophication should continue to be investigated and records collated. This will include disturbance such as excessive scum and foam on water and on beaches, and benthic invertebrate, shellfish, and fish mortalities not associated with organic pollution.

Appropriate nutrient budget models will need to be developed for these estuaries.

### 4. *General description.*

For sites where evidence is considered sufficient to put the waters forward as a designation candidate, an outline of the nature of the proposed eutrophic water should be given, including the following points:

- the extent of the area/water.
- comments on whether any significant changes to the quality regime of the waters occur within the estuary. Indicate where and why such changes occur.
- a map showing the SA[E]/PW[E], the location of qualifying (and other significant) discharges (if applicable), chemical and biological monitoring points, and any other relevant features.
- details of any significant designations or interests in relation to other environmental initiatives eg SSSI, Important Area of Marine Wildlife, proposed SAC under Habitats and Species Directive, PARCOM site etc.

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A4.3

## **ANNEX 7**

### **Harmonised Monitoring Scheme**

#### **Harmonised Monitoring Network and list of determinands**

## Harmonised Monitoring Sites in the United Kingdom

KILOMETRES

## Harmonised Monitoring Sampling and Gauging Points

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>NORTH WEST</b>						
<b>(Code 01)</b>						
Eastern	001	Mersey	Filxton	SJ 742938	Ashton Weir	SJ 772936
	003	Irwell	Salford	SJ 823990	Adelphi Weir	SJ 824987
	004	Tame	Tame Street, Portwood	SJ 900913	Portwood	SJ 906918
Western	005 L	Weaver	Frodsham	SJ 530785	Ashbrook	SJ 670633
	002 L	Mersey	Above Howley Weir	SJ 616880	Howley Weir	SJ 616880
	006 L	Alt	Above Hightown	SD 292051	Sefton	SD 359012
	015 L	Douglas	Wanes Blades Bridge	SD 476126	Wanes Blades Bridge	SD 476126
Northern	007	Ribble	Milton	SD 716388	Henthorn Weir	SD 721391
	008 L	Ribble	Samlesbury	SD 590305	Samlesbury Weir	SD 589304
	009	Calder	Whalley	SD 729361	Whalley Weir	SD 730360
	010	Wyre	St Michaels	SD 462411	St Michels	SD 465411
	011*LR	Lune	Forge Weir	SD 514648	Caton Weir	SD 529653
	023 L	Lune	Denny Bridge	SD 504647	Caton Weir	SD 529653
	012 L	Kent	Sedgwick Weir	SD 509875	Sedgwick Weir	SD 508874
	013 L	Bela	Milnthorpe	SD 489813	Beetham Weir	SD 496806
	014 L	Leven	Low Wood Bridge Haverthwaite	SD 346837	Newby Bridge Weir	SD 366863
	016 L	Darwen	Walton Green	SD 557279	Walton-le-Dale	SD 557279
	017	Eden	Temple Sowerby	NY 604281	Temple Sowerby	NY 604283
	018	Eamont	Udford	NY 575304	Udford	NY 575305
	019 L	Eden	Beaumont	NY 351593	Sheepmount	NY 390571
	020 L	Esk	Burnfoot	NY 364665	Netherby	NY 390718
	022 L	Derwent	Seaton Road Bridge Workington	NY008291	Camerton	NY 037305
	021 L	Lyne	Lyne Foot	NY 36562	No gauging facilities	-

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>NORTHUMBRIAN</b>						
<b>(Code 02)</b>						
Northumberland and Tyne	001	Tweed	Norham Bridge	NT 890473	Norham	NT 898477
	009 L	Coquet	Warkworth	NU 238060	Morwick	NU 234044
	012 L	Wansbeck	Sheepwash Dam	NZ 256858	Mitford	NZ 181857
	015*	Blyth	Bedington Bridge	NZ 267815	Hartford	NZ 242800
	020	North Tyne	Chollerford	NY 919706	Reaverhill	NY 906732
	021	South Tyne	Warden Bridge	NY 910660	Haydon Bridge	NY 856647
	923 L	Tyne	Wylam	NZ 119645	Bywell	NZ 038617
	026 L	Derwent	Above Derwenthaugh	NZ 187607	Rowlands Gill	NZ 168581
Wear	044 L	Wear	Lamb Bridge	NZ 284525	Chester-le-Street	NZ 283512
	G12	(Reservoir)	Tunstall Reservoir	NZ 067407	-	-
Tees	058	Tees	Broken Scar	NZ 259137	Broken Scar	NZ 359137
	061 L	Tees	Low Worsall	NZ 391102	Low Moor	NZ 364105

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>SEVERN TRENT</b>						
(Code 03)						
Upper Severn	752	Severn	Shelton	SJ 467138	Montford, River Severn	SJ 411145
	019	Tern	Atcham	SJ 553093	Yeaston, River Perry Walcot	SJ 434193 SJ 592123
Lower Severn	227 L	Severn	Haw Bridge	SO 845278	Haw Bridge	SO 845278
	012	Stour	Stourport	SO 814709	Kidderminster, River Stour	SO 828769
			Foothridge		Kidderminster, Sewage Works	SO 825738
	029	Teme	Powick	SO 836525	Knightstord	SO 735557
	416	Avon	Evesham Road Bridge	SP 034431	Plus 2 tributaries Evesham	SP 034431
Lower Trent	006 L	Trent	Dunham	SK 820745	North Muskham	SK 801601
	007	Trent	Nottingham	SK 581383	Colwick	SK 620399
	009 L	Idle	Bawtry	SK 656927	Mattersey Blythe	SK 690895 SK 610870
Soar	010	Soar	Redhill Lock	SK 493303	Zouch	SK 498240
Upper Trent	008	Trent	Yoxall	SK 131177	Yoxall	SK 131177
	014	Sowe	Milford	SJ 975215	Milford	SJ 975215
Tame	013	Tame	Chetwynd	SK 187138	Elford	SK 173105
Derwent	011	Derwent	Wilne	SK 452315	Church Wilne	SK 447315
	015	Dove	Monks Bridge	SK 268270	Marston-on-Dove	SK 235288

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>YORKSHIRE</b>						
<b>(Code 04)</b>						
North and East	001 L	Hull	Hemphome Lock	TA 080500	Hempholme	TA 080498
	002 + R	Ouse	Skelton	SE 560551	Skelton	SE 568554
	015	Ouse	Nether Poppleton	SE 560551	Skelton	SE 568554
	003 L	Ouse	Naburn Weir	SE 594445	Computed flow	-
	012 L	Esk	Ruswarp	NZ 887091	Sleights Weir	NZ 865081
	013 L	Wharfe	Tadcaster Weir	SE 485437	Flint Mill	SE 422473
Central	004 L	Aire	Beal Weir	SE 534255	Beal	SE 534255
	005	Aire	Fleet Weir	SE 381285	Computed flow	-
	006	Calder	Methley	SE 409258	Newlands	SE 365220
Southern	007 L	Don	Doncaster, North Bridge	SE 568038	Doncaster	SE 569040
	008	Don	Halfpenny Bridge	SK 400914	Hadfields	SK 390910
	009	Dearne	Pastures Bridge	SE 498008	Adwick	SE 477020
	010	Rother	Canklow	SK 425905	Woodhouse Mill	SK 432857
	011 * R	Derwent	Elvington	SE 704475	Stamford Bridge	SE 714557
	014 L	Derwent	Loftsme Bridge	SE 707302	Stamford Bridge	SE 714557
	G14	(Borehole)	Austerfield	SK 662963	-	-
			Borehole			

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority Division	Station Code	River	Sampling Location		Flow Gauging Location	
			Name	NGR	Name	NGR
ANGLIAN (Code 05) Oundle	500*LR	Welland	Peakirk	TF 208093	Tallington Kings Street	TF 095078 TF 109106
	502 L	Welland	Crowland	TF 229107	Tallington Kings Street	TF 095078 TF 109106
	501	Welland	Tinwell	TF 017060	Barrowdown Foster Bridge	SP 948999 SK 961030
	511	Nene	Wansford	TL 082996	Orton	TL 166972
	510 L	Nene	'Dog-in-a- Doublet' Sluice	TL 272994	Orton, less exported water into Kings Dyke at Stanground	TL 166972
	G11	(Reservoir)	Rutland Water	SK 905083	-	-
	Cambridge 626	Bedford Ouse	Earlth	TL 394748	Offord and Brampton	TL 216669
	603*	Bedford Ouse	Thornborough	SP 739356	Thornborough	SP 736353
	651 L	Ely Ouse	Denver Sluice	TF 598009	Denver Sluice	TF 588009
	634*	Cam	Dimmocks Cote	TL 537723	Botisham Lock	TL 508657
Norwich	646*	Little Ouse	Brandon Creek	TL 608918	Abbey Heath	TL 851844
	683 L	Middle Level Main Drain	Mullicourt Priory Sluice	TF 531029	Computed flow	-
	714 L	Wensum	Sweet Brier Road	TG 206096	Costessy Mill	TG 177127
	722 L	Bure	Horstead Mill	TG 267198	Horstead Mill	TG 267198
	Colchester 810 L	Stour	Langham	TM 026345	Langham	TM 020344
	811	Stour	Wixoe	TL 709431	Kedlington & Stumer	TL 696441 TL 708450
	812*	Stour	Cattawade Intake (Essex Water Co)	TM 101331	Computed flow	-
	820 L	Colne	East Mills	TM 007254	Lexden	TL 962261
	830	Blackwater	Langford	TL 836092	Appleford & Guithaven	TL 854158 TL 818147
	840 L	Chelmer	Langford	TL 835086	Crahbs Bridge Rushes Lock	TL 786107 TL 794090
Colchester	841*	Can	Beaches Mill	TL 690072	Beaches Mill	TL 690072
	842*	Chelmer	Springfield Mill	TL 713071	Springfield Mill	TL 713071
	850*	Mardyke	A13 Road Bridge	TQ 556790	Stifford	TQ 595804

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below



## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>THAMES</b>						
(Code 06)						
South and West	001	Thames	Farmoor Intake	SP 439064	Eynsham	SP 445087
	002	Cherwell	Marston Road, Oxford	SP 527067	Enslow	SP 482183
	003	Thame	Dorchester Bridge	SU 579939	Shabbington	SP 670055
	004	Kenner	100m above Thames	SU 731738	Theale	SU 649708
	005	Loddon	A4 Roadbridge, Twyford	SU 779766	Sheepbridge, River Loddon	SU 720652
					Swallowfield, River Blackwater	SU 731648
	009	Mole	Confluence with Thames	TQ 154683	No gauging facilities	-
East and North	006	Thames	NSWC Intake, Egham	TQ 023718	Teddington	TQ 170713
	007	Colne	Confluence with Thames	TQ 033716	Denham	TQ 052864
	008	Wey	Confluence with Thames	TQ 070653	No gauging facilities	-
	010 L	Thames	Teddington Weir	TQ 171714	Teddington Weir	TQ 170713
	101	Lee	Waterhall	TL 299099	Waterhall	TL 299099
	102	Lee	Ware Lock	TL 351143	Waterhall - River	TL 299099
	103*	Lee	Kings Weir	TL 373051	Lee, Panshanger	
					Fieldes Weir - R Lee & R Stort	TL 390092
					Rye Meads Sewage Works	TL 393098
	104	Lee	Lea Valley Road	TQ 375949	Fieldes Weir - R Lee & R Stort	TL 390092
					Rye Meads Sewage Works	TL 393098
					Waltham Abbey, Cobbins Brook	TL 387999
	105L	Lee	Carpenters Road	TQ 377845	Chalk Bridge, R Lee	TQ 356913
					New Cut	
					Edmonton, Pymmes Brook	TQ 340925
					Edmonton, Salmon Brook	TQ 353932
					Edmonton, Intercepting Drain	TQ 354932
					Deephams Sewage Works	TQ 357932
	106L	Roding	Woodford Bridge	TQ 418916	Redbridge	TQ 415884

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
SOUTHERN (Code 07)						
Kent	004 L	Rother	Blackwall Bridge	TQ 885258	No gauging facilities	-
	001 L	Medway	Upstream of Allington Sluices	TQ 750582	Teston	TQ 708530
	003 L	Great Stour	Bretts Bailey Bridge	TR 187603	Horton	TR 117555
	002*	Eden	Penhurst Gauging Station	TQ 521438	Penhurst	TQ 521438
Sussex	006 L	Ouse	Barcombe Mills	TQ 433148	Barcombe Mills	TQ 433148
	008 L	Arun	Pallingham Gauging Station	TQ 044222	Pallingham	TQ 047229
	007 L	Rother	Hardham Gauging Station	TQ 033178	Hardham	TQ 034178
	005 L	Cuckmere	Shermans Bridge	TQ 532051	Shermans Bridge	TQ 533051
Hampshire	G13	(Borehole)	Patcham Boreholes	TQ 294091	-	-
	010*LR	Itchen	The White Swan	SU 449156	Highbridge Allbrook	SU 467214
	013 L	Itchen	Gatersmill	SU 434156	Highbridge Allbrook	SU 467214
	009*LR	Test	Longbridge	SU 355179	Broadlands	SU 354189
	012 L	Test	Testwood	SU 353153	Longbridge	SU 355178
	011	Blackwater	Nutsey Bridge, Testwood	SU352151	Ower	SU 328174

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>WESSEX</b> (Code 08)						
Avon and Dorset	100 L	Avon	Knapp Mill Pipe Bridge	SZ 154940	Knapp Mill	SZ 089964
	200 L	Stour	Bridge at Hurn Court School	SZ 122955	Throop Ensbury	SZ 089964
	400 L	Frome	Holme Bridge	SY 891866	East Stoke Mill	SY 866867
	300 L	Piddle	Baggs Mill Bridge	SY 913876	Baggs Mill	SY 913876
Somerset	426 L	Parrett	Langport, Westover	ST 416266	Ashford Mill	ST 359188
					Chiselborough	ST 461145
					Pen Mill	ST 573162
	326 L	Tone	Knapp Bridge	ST 302260	Bishops Hull	ST 206253
					Bishops Hull	ST 205251
Bristol and Avon	004 L	Avon	Keynsham	ST 662689	Bathford	ST 787670
					Compton Dando	ST 648648
					Bitton	ST 681699
	001	Avon	Great Somerfords	ST 975829	Great Somerfords	ST 966832
	003	Milford Brook	Milford	ST 764611	Monkton Combe	ST 746711
	002	Somerset Frome	Tellisford	ST 805565	Tellisford	ST 805565

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>SOUTH WEST</b> (Code 09)						
Exe	001 L	Axe	Whitford Road Bridge	SY 262953	Whitford	SY 262953
	002 L	Otter	Dotton Footbridge	SY 087886	Dotton Footbridge	SY 087886
	003 L	Exe	Trews Weir	SX 925915	Thorverton	SS 936016
					Woodmill	ST 021058
					Cowley	SX 901967
	036	Exe	Thorverton Rd Br	SS 936016	Thorverton	SS 936016
	005*	Exe	Pixton	SS 935260	Pixton	SS 935260
	004*	Culm	Stoke Canon	SX 939976	No gauging facilities	-
	006+	Barle	Brushford	SS 927258	Brushford	SS 927258
	007*	Creedy	Oakford Farm	SX 901976	Oakford	SS 901967
Dart	008 L	Teign	Preston Footbridge	SX 885746	Preston Footbridge	SX 885746
	009+	Teign	Clifford	SX 781899	Clifford	SX 781899
	010*	Bovey	Twinyeo Farm	SX 845761	No gauging facilities	-
	011 L	Dart	Totnes Weir	SX 801613	Austins Bridge	SS 750660
	012+	West Dart	Huccaby	SX 662731	Dunnabridge	SX 643742
	013 L	Avon	Hatch	SX 714473	Loddiswell	SX 719476
	041+	Avon	Loddiswell New Bridge	SX 719477	-	-
Taw	028 L	Torridge	Beam Footbridge	SS 474209	Torrington	SS 500185
	029*	Torridge	Sheepwash	SS 491057	Sheepwash	SS 491057
	030 L	Taw	Chapelton	SS 582261	Umberleigh	SS 608237
	031*S	Taw	Taw Bridge	SS 673065	Taw Bridge	SS 673068
	032+	Little Dart	Dart Bridge	SS 669137	Dart Bridge	SS 669137
	033+	Mole	Head Barton	SS 668183	Woodleigh	SS 660211
	034+	Bray	Meethe Barton	SS 675230	Clapworthy Mills	SS 675241
	035 L	Yeo	Riversmead	SS 595357	Riversmead	SS 595357
	039+	Torridge	Beam Quarry	SS 471209	-	-
	040*	Torridge	Rothern Old Bridge	SS 479197	-	-
Tam	014 L	Plym	Plymbridge	SX 524587	Carn Wood	SX 521612
	015 L	Tavy	Denham Bridge	SX 477679	Lopwell	SX 474650
	016*	Walkham	Grenofen Bridge	SX 490710	Horrabridge	SX 503704
	017 L	Tamar	Gunnislake	SX 433723	Gunnislake	SX 426725
			Newbridge			
	018*	Lyd	Lifton Bridge	SX 389848	Lifton Park	SX 388842
	019*	Thrushel	Tinhay	SX 395855	Tinhay	SX 398856
	020*	Tamar	Boyton Bridge	SX 328923	Boyton	SX 328923
	021*	Ottery	Werrington Park	SX 344868	Warrington Park	SX 336866
	022*R	Inny	Innyfoot	SX 379779	Bealsmill	SX 359771
Fowey	038*	Inny	Bealsmill	SX 359771	Bealsmill	SX 359771
	023 L	Lynher	Notter Bridge	SX 385609	Pillaton Mill	SX 368624
	024 L	Fowey	Respryn Bridge	SX 099635	Restormel	SX 108613
	027 L	Camel	Polbrock Bridge	SX 014695	Denby	SX 017682
	042+	Fowey	Restormel Gauging Station	SX 097625	-	-
Fal	025 L	Fal	Tregony Gauging Station	SW 921447	Tregony	SW 921447
	026 L	Carnon	Devoran Bridge	SW 791394	No gauging facilities	-
	037 L	Red	Gwithian Towans	SW 585422	Computed flow	-

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

S = Sampling point station 031 started up again in 1986

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## Harmonised Monitoring Sampling and Gauging Points - Continued

Authority	Station Code	River	Sampling Location		Flow Gauging Location	
Division			Name	NGR	Name	NGR
<b>WELSH</b>						
(Code 10)						
South Eastern	038	Elan	Glyn Foothbridge	SN 965656	Elan Village	SN 934653
	036	Wye	Bridge Sollars Bridge	SO 413425	Belmont, Hereford	SO 485388
	037L	Wye	Redbrook Railway Bridge	SO 536098	Redbrook	SO 528110
	033 L	Usk	Chain Bridge	SO 345056	Chainbridge	SO 345056
	034 L	Afon Lwyd	Ponthir weir	ST 330924	Ponthir	ST 330924
	035 L	Ebbw Fawr	Rhiwderin	ST 259889	Rhiwderin	ST 259889
	013 L	Rhymney	Llanrhyney	ST 214807	Llanedeyrn	ST 225822
	012 L	Taff	Blackweir	ST 171781	Pontypridd	ST 079897
	011 L	Ely	St Fagans	ST 119769	St Fagans	ST 121770
	009 L	Ogmore	Dipping Bridge	SS 891784	Dipping Bridge	SS 891784
	010 L	Neath	Aberdulais	SS 773990	Aberdulais	SS 773992
	024 L	Tawe	Morrison Road Bridge	SS 674979	Ynystanglws	SS 685998
	025 L	Loughor	Ynys Llwehwr	SN 618089	Ynys Llwehwr	SN 618089
South Western	026 L	Towy (or Tywi)	Nantgaredig Road Bridge	SN 491204	Ty Castell	SN 491204
	027 L	Taf	Clog-y-Fran Bridge	SN 238161	Clog-y-Fran	SN 238161
	028 L	Eastern Cleddau	Canaston Bridge	SN 070153	Canaston Bridge	SN 070153
	029*LR	Western Claddau	Mart Foothbridge	SM 953159	Prendergast Mill	SM 954177
	039 L	Western Claddau	Prendergast Mill	SM 954177	Prendergast Mill	SM 954177
	030 L	Teifi	Llechryd Bridge	SN 217436	Glan Teifi	SN 244416
	032 L	Rheidol	Penybont Bridge	SN 594803	Llanbadarn Fawr	SN 601804
	040 L	Gwili	Abergwili Rd Br	SN 434210	Glan Gwili	SN 431220
	031*LR	Ystwyth	Lanfarin Bridge	SN 590778	Pont Llolwyn	SN 591773
	041 L	Ystwyth	Rhydyfelin	SN 588788	Pont Llolwyn	SN 591773
	017 L	Dovey (or Dyfi)	Pont-ar-Ddyfi	SH 744019	Near Dovey Bridge	SH 748019
	015 L	Dysynni	Pont-y-Garth	SH 636071	Pont-y-Garth	SH 634068
	018 L	Wnion	Pont Fawr, Dolgellau	SH 729180	Dolgellau	SH 730179
Northern	019 L	Mawddach	Ganllwyd	SH 729234	Ganllwyd	SH 728233
	014 L	Dwryyd	Maentwrog Bridge	SH 666407	Maentwrog	SH 670415
	020 L	Glaslyn	Pont Croesor	SH 593413	Beddgelert	SH 592478
	021 L	Dwyfawr	Dolbenmaen Road Bridge	SH 507430	Dolbenmaen	SH 487400
	016 L	Gwyrfai	Bontnewydd Bridge	SH 483598	Bontnewydd	SH 484599
	022 L	Ogwen	Felin Cochwillan	SH 601699	Felin Cochwillan (est)	SH 601699
	023 L	Conwy	Cym Llanerch	SH 801595	Cwm Llanerch	SH 802528
	001	Dee	Llandderfell	SH 982366	Bala	SH 942357
	002	Dee	Overton	SJ 354427	Manley Hall	SJ 348415
	003 L	Dee	Iron Bridge	SJ 418601	Farnon to Chester Weir	SJ 412544
	004	Alwen	Glan Alwen Fords	SJ 058428	Druid	SJ 042436
	005	Clywedog	Pickhill Bridge	SJ 396482	Pickhill	SJ 396482
	006	Alyn	Ithel's Bridge	SJ 390562	Pont-y-Capel	SJ 336541
	007 L	Clwyd	Pont Dafydd, St Asaph	SJ 044748	Pont-y-Cambwll	SJ 069709
	008 L	Elwy	Gipsy Lane	SJ 032760	Pont-y-Gwyddel	SH 952718

\* Discontinued

+ Withdrawn

L = Lowest sampling point

R = This sampling location is replaced by the one on the line immediately below

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## Annex 7

### Harmonised Monitoring of River WaterQuality

### Results Form DOE 40000A

#### Identifying Data (see Guidance Notes)

Water Authority Code

Sampling Point Code

Date of Sample (dd/mm/yy)

Time of Sample (nearest hour)

1	A	*				
2			*			
3				*		
4						*
5			*			
6	1	*				

#### Determinands

#### Units

Average Flow

Cumecs

Instantaneous Flow

Cumecs

Temperature

°C

Colour

Hazen Units

Turbidity

FTU

pH

pH units

Conductivity

µs/cm

Suspended Solids

mg/l

Ash (from Suspended Solids)

mg/l

Dissolved Oxygen (instantaneous)

mg/l O

Dissolved Oxygen (minimum)

mg/l O

Oxygen Saturation (instantaneous)

%

Oxygen Saturation (minimum)

%

BOD

mg/l O

BOD (inhibited)

mg/l O

Chemical Oxygen Demand

mg/l O

4-hour PV

mg/l O

Total Dissolved Organic Carbon

mg/l O

Ammoniacal Nitrogen

mg/l N

Nitrite

mg/l N

Nitrate

mg/l N

Hardness

mg/l CaCO<sub>3</sub>

Ammonia (free)

mg/l NH<sub>3</sub>

7			*			*
8			*			*
9		*	*			
1	0		*		*	
1	1				*	
1	2		*	*		
1	3					*
1	4			*		*
1	5			*		*
1	6		*		*	
1	7				*	
1	8		*		*	
1	9				*	
2	0		*		*	
2	1		*		*	
2	2		*		*	
2	3		*		*	
2	4		*		*	
2	5					*
2	6					*
2	7				*	
2	8				*	*
2	9		*			*
n/l						

Page 1

**Determinands (continued)**
**Units**

Chloride	mg/l Cl
Total Alkalinity	mg/l CaCO <sub>3</sub>
Chlorophyll $\alpha$	$\mu$ g/l
Boron	mg/l B
Fluoride	mg/l F
Orthophosphate	mg/l P
Total Phosphorus	mg/l P
Silica	mg/l SiO <sub>2</sub>
Sulphate	mg/l SO <sub>4</sub>
Calcium	mg/l Ca
Magnesium	mg/l Mg
Potassium	mg/l K
Sodium	mg/l Na
<b>Dissolved:</b>	
Arsenic	mg/l As
Cadmium	$\mu$ g/l Cd
Total Chromium	mg/l Cr
Copper	mg/l Cu
Total Iron	mg/l Fe
Lead	mg/l Pb
Manganese	mg/l Mn
Total Mercury	$\mu$ g/l Hg
Nickel	mg/l Ni
Selenium	mg/l Se
Vanadium	mg/l V
Zinc	mg/l Zn

6	2	*
---	---	---

7						*	*
8				*		*	
9				*		*	
1	0			*			*
1	1			*		*	
1	2			*			*
1	3			*			*
1	4			*			*
1	5			*			*
1	6			*		*	
1	7			*			*
1	8			*			*
1	9			*		*	

2	0			*			*
2	1			*			*
2	2			*		*	
2	3			*		*	
2	4			*		*	
2	5			*		*	
2	6			*		*	
2	7			*		*	
2	8			*		*	
2	9			*		*	
3	0			*		*	
3	1			*		*	
n/l							

Determinands (continued)

Units

6	3	*
---	---	---

Dissolved & in suspension

(Tidal limit samples only)

Arsenic	mg/l As
Cadmium	µg/l Cd
Total Chromium	mg/l Cr
Copper	mg/l Cu
Total Iron	mg/l Fe
Lead	mg/l Pb
Manganese	mg/l Mn
Total Mercury	µg/l Hg
Nickel	mg/l Ni
Selenium	mg/l Se
Vanadium	mg/l V
Zinc	mg/l Zn

	7					*
	8					*
	9					*
1	0					*
1	1					*
1	2					*
1	3					*
1	4					*
1	5					*
1	6					*
1	7					*
1	8					*

Anionic Detergent as Manoxol OT	mg/l
Nonionic Detergent as Lissapol N	mg/l
Cyanide (Total)	mg/l
Monohydric Phenols as Phenol	mg/l

1	9					*
2	0					*
2	1					*
2	2					*
n/l						



**Determinands (continued)**
**Units**

Benzo (g,h,i) perylene	ng/l
Fluoranthene	ng/l
Indeno (1,2,3-c, d) pyrene	ng/l
11, 12 Benzofluoranthene	ng/l
3, 4 Benzofluoranthene	ng/l
3,4 Benzopyrene	ng/l
Aldrin	ng/l
$\gamma$ BHC	ng/l
Heptachlor	ng/l
pp DDE	ng/l
Dieldrin	ng/l
pp DDT	ng/l

6	4	*
---	---	---

7						*
8						*
9						*
1	0					*
1	1					*
1	2					*
1	3					*
1	4					*
1	5					*
1	6					*
1	7					*
1	8					*

Total Phosphate mg/l P

1	9					*
---	---	--	--	--	--	---

**Micro Biological**

Faecal Coliforms	No/100 ml
Total Coliforms	No/100 ml
Faecal Streptococci	No/100 ml
Salmonella	No/l

2	0						*
2	1						*
2	2						*
2	3						*
n/l							

# Determinands (continued)

Units

## Dissolved

Antimony	$\mu\text{g/l Sb}$
Barium	$\mu\text{g/l Ba}$
Beryllium	$\mu\text{g/l Be}$
Cobalt	$\mu\text{g/l Co}$
Molybdenum	$\mu\text{g/l Mo}$
Tellurium	$\mu\text{g/l Te}$
Thallium	$\mu\text{g/l Tl}$
Tin	$\mu\text{g/l Sn}$
Titanium	$\mu\text{g/l Ti}$
Uranium	$\mu\text{g/l U}$
Silver	$\mu\text{g/l Ag}$

## Dissolved and in Suspension

Antimony	$\mu\text{g/l Sb}$
Barium	$\mu\text{g/l Ba}$
Beryllium	$\mu\text{g/l Be}$
Cobalt	$\mu\text{g/l Co}$
Molybdenum	$\mu\text{g/l Mo}$
Tellurium	$\mu\text{g/l Te}$
Thallium	$\mu\text{g/l Tl}$
Tin	$\mu\text{g/l Sn}$

6	5	*
---	---	---

	7							*
	8							*
	9							*
1	0							*
1	1							*
1	2							*
1	3							*
1	4							*
1	5							*
1	6							*
1	7							*

1	8							*
1	9							*
2	0							*
2	1							*
2	2							*
2	3							*
2	4							*
2	5							*
n/l								

Determinands (continued)	Units
Dissolved and in suspension	
Titanium	µg/l Ti
Uranium	µg/l U
Silver	µg/l Ag

6	6	*
---	---	---

7								*
8								*
9								*

Phosphorus (elemental yellow)	µg/l P
Total Organic Phosphorus	µg/l P
Total Organic Chlorine	µg/l Cl
Total Organic Silicon	µg/l Si
Total Organic Tin	µg/l Sn
Non-persistent Oil and Hydrocarbons	µg/l
Persistent Oil and Hydrocarbons	µg/l
Polychlorinated biphenyls	µg/l
Chlorinated phenols	µg/l
pp TDE	µg/l
PAH	µg/l
Endrin	µg/l

1	0							*
1	1							*
1	2							*
1	3							*
1	4							*
1	5							*
1	6							*
1	7							*
1	8							*
1	9							*
2	0							*
2	1							*
2	2							*
2	3							*
2	4							*
2	5							*
n/l								

## **ANNEX 8**

### **Paris Commission Survey**

**Convention for The Prevention of Marine Pollution From Land Based Sources - Tenth Meeting of The Paris Commission**

## **Annex 8**

### **CONVENTION FOR THE PREVENTION OF MARINE POLLUTION FROM LAND-BASED SOURCES TENTH MEETING OF THE PARIS COMMISSION**

**LISBON: 15 - 17 JUNE 1988**

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#### **PRINCIPLES OF THE COMPREHENSIVE STUDY OF RIVERINE INPUTS**

##### **1. OBJECTIVES OF THE COMPREHENSIVE STUDY**

- 1.1 To assess, as accurately as possible, all river borne and direct inputs of selected pollutants to Convention waters on an annual basis. Inputs from lakes, polders and storm overflows are to be included where information is available.
- 1.2 To report these data annually to the Paris Commission and review them periodically with a view to determining temporal trends.
- 1.3 For each country, to aim to monitor on a regular basis 90% of the inputs of each selected pollutant.

##### **2. PARAMETERS TO BE MONITORED**

- 2.1 The following parameters will be monitored on a mandatory basis:

Mercury (Hg)  
Cadmium (Cd)  
Copper (Cu)  
Zinc (Zn)  
Lead (Pb)  
PCBs\* (the following congeners: IUPAC Nos 28, 52, 101, 118, 153, 138, 180)  
Gamma-HCH (Lindane)  
Nitrates expressed as N  
Orthophosphates expressed as P  
Total N  
Total P  
Suspended particulate matter (SPM)  
Salinity (in saline waters)

### **3. TIMETABLE**

- 3.1 The comprehensive study of riverine inputs will commence with measurements carried out in 1990. The results will be reported to the Secretariat by 30 June 1991 and will be reviewed by the Ad Hoc Working Group on Input Data in the autumn of 1991.
- 3.2 The major load bearing rivers (to be identified by each Contracting Party) will be monitored every year in accordance with the objectives of the comprehensive study as set out in paragraph 1.3. The inputs from minor river systems (accounting for approximately 10% of the total pollution load from each country) will be assessed by each Contracting Party using "best estimates" of concentrations and river flows, and also reported to the Secretariat on an annual basis. Actual measurements (flows and concentrations) will be carried out on the minor river systems at an appropriate frequency to be determined by each contracting Party in the light of its knowledge of the river system concerned.

### **4. REPORTING FORMAT**

- 4.1 The format for reporting results under the comprehensive study is attached (Appendix I). The reports should be submitted using the paper reporting format but the Secretariat will consider the feasibility of accepting computer generated data (the Secretariat's computer system can accept data in Lotus 1-2-3 or ASCII format on 5.25" floppy disks). The reporting format requires Contracting Parties to describe the methodology used in assessing the input load from each source category.

### **5. RIVER SYSTEMS INCLUDED IN THE COMPREHENSIVE STUDY**

- 5.1 A list of the river systems which will be monitored by Contracting Parties is at Annex 10.

### **6. METHODOLOGY FOR ASSESSING RIVERINE INPUTS**

#### **6.1 Objective**

- 6.1.1 To obtain as precise an estimate as possible of the input load in terms of tonnes per annum.

#### **6.2 Sampling strategy**

- 6.2.1 The sampling regime should be designed on the basis of historical records. It should aim to cover the whole flow cycle but should concentrate on periods of expected high river flow. Past experience has shown that there is a positive correlation between periods of high river flow and high input load, especially for heavy metals, suspended solids and nitrates.
- 6.2.2 Most monitoring effort should be directed towards those rivers with the highest input load.

### 6.3 Sampling frequency

- 6.3.1 For the major load bearing rivers (as referred to in para 3.2), there should be a minimum of 12 data sets, collected within a 12 months' time span, in order to estimate the annual input load. The data sets need not be collected at regular monthly intervals but can be collected at a frequency which appropriately reflects the expected river flow pattern.
- 6.3.2 The sampling frequency may be increased beyond the minimum 12 data sets for those rivers carrying the heaviest contaminant loads. With such rivers, it should not be necessary to take samples more than once per week.
- 6.3.3 For "unpolluted" rivers, defined as those rivers where, on the basis of past knowledge, the concentration levels are at or below the limit of detection for the specified parameters, the requirement of 12 data sets may be too stringent. In such cases, the Contracting Party should ensure that sufficient samples are taken to obtain a "best estimate" of the pollution load.
- 6.3.4 It follows that for some rivers it may be necessary to monitor certain parameters at the "standard" frequency of 12 data sets per annum where concentration levels are significantly above the detection limit, but to monitor other parameters at a reduced frequency.
- 6.3.5 All rivers with a significant contaminant load should be gauged for river flow on a routine basis.

### 6.4 Site selection (see also section 6.6)

- 6.4.1 The measurement site should be in a region of unidirectional freshwater flow.
- 6.4.2 The site should be an area where the water is well mixed (such as at or immediately downstream of a weir) and hence of uniform quality, otherwise it will be necessary to establish the relationship between the concentration at the sampling Point and other points in the cross section weighting each point by the volume of water per unit time represented by that point.

### 6.5 Estimation of annual load

- 6.5.1 The load of a specific substance transported by a river should be estimated by taking the product of the mean flow weighted concentration and the total flow, expressed in the following formula:

$$\frac{Q_r \sum_{i=1}^n (C_i Q_i)}{\sum_{i=1}^n (Q_i)}$$

Where  $C_i$  is the concentration measured in sample  $i$ ;  
 $Q_i$  is the corresponding flow for sample  $i$ ;  
 $Q_r$  is the mean flow rate for each sampling period; and  
 $n$  is the number of samples taken in the sampling period.

- 6.5.2 In those cases where insufficient information is available to use the above formula, the pollutant load should be estimated by taking the average of the product of flow and concentration for a series of measurements, as expressed in the following formula:

$$\frac{\sum_{i=1}^n (C_i Q_i)}{n}$$

- 6.5.3 For small rivers, which will not be monitored to obtain 12 data sets per annum, the best available estimates of flow and flow-weighted concentrations should be used to estimate contaminant loads. Tributaries which discharge directly into the saline estuaries of major river systems may fall into this category:-

## 6.6 Measurements in tidal areas

- 6.6.1 Some Contracting Parties may consider that, given the circumstances of their particular river system, it may be preferable to take measurements in the tidal area rather than upstream of any tidal influence as advocated in para. 6.4.1. The rationale for this decision may be because such a measurement campaign may be considered as providing the best estimate of:

1. the influence of point source discharges;
2. the discharge from diffuse sources between the sampling area and the tidal limit;
3. removal of sediments to landfill.

- 6.6.2 Measurements in the tidal area may need to be supplemented by measurements of inputs from the point sources downstream of the sampling area.

- 6.6.3 If the assessment of annual input loads is based on measurements made in the saline regions of an estuary, the assessment should be corroborated by the results of mass balances.

## 7. **METHODOLOGY FOR ASSESSING DIRECT DISCHARGES**

### 7.1 Sewage effluents

- 7.1.1 Where possible the annual load should be estimated as the product of annual flow and flow weighted concentration. In some cases the only flow data available will be dry weather flows. These should be multiplied by 1.7 to give average flow data. Where there are flow data but no quality data, the following example of typical quality data may be used to estimate loads.



	BOD mgO/l	SPM mg/l	Total N mgN/l	Total P mgP/l
crude sewage	350	350	55	15
partially treated sewage	100	100	40	10
treated sewage	20	30	30	7
treated sewage with nutrient removal	15	10	8 - 10	0.5 - 1

- 7.1.2 Where only population data is available for crude (untreated) sewage discharges, the following derived per capita loads based on the above quality data and a flow of 180 l/person/day may be used for nutrients:

BOD	0.063	KgO/person/day
SPM	0.063	Kg/person/day
Total N	0.009	KgN/person/day
Total P	0.0027	KgP/person/day

If more specific data are available from knowledge of local conditions, these may be preferable to the example given above.

- 7.1.3 For metals in sewage discharges the loads should be calculated from monitoring and flow measurements wherever possible. Where such information is not available, it will be necessary to estimate the metal inputs. In countries where the consents for discharges from sewage works are set as maxima, estimates based on the consent conditions may be calculated as follows:-

$0.5 \times \text{maximum flow permitted} \times 0.5 \times \text{maximum permitted concentration}.$

## 7.2 Industrial effluents

- 7.2.1 Where direct measurements of industrial effluents are not available, the same formula as proposed for assessing metal loads from sewage discharges may be used (para 7.1.3) in the absence of a more appropriate formula.

## 7.3 Stormwater overflows

- 7.3.1 Whenever possible, Contracting Parties should make estimates of the pollution load in stormwater discharges. Where estimates are provided, a description of the methodology used should be given.

## 8. LIMITS OF DETECTION

- 8.1 Because the concentrations of contaminants are likely to be significantly higher in river or estuarine waters than in open ocean waters, it is not necessary to employ unduly sophisticated methods of analysis. It is necessary to choose a method which will give at least 70% of positive samples (ie above the detection limit). The following are the recommended detection limits (ie. it is not necessary to choose a more sensitive method):

Hg and Cd	: 10 ng/l
Zn	: 0.5 µg/l
Cu and Pb	: 0.1 µg/l
gamma-HCH	: 1 ng/l
PCBs (for each selected congener)	: 1 ng/l

- 8.2 In all cases, the total concentration should be determined.\*\*
- 8.3 In those cases where the results recorded are less than the limits of detection, two load estimates should be supplied, one assuming that the true concentration is zero and the other assuming that the true concentration is the limit of detection. This will provide maximum and minimum concentrations within which the true estimate will fall. When used to estimate inputs these data will then provide upper and lower bounds for the estimate.

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\* To be determined on a voluntary basis, pending further discussion at the Sixteenth Meeting of TWG.

\*\* For the determination of mercury, reference should be made to document TWG 15/10/2, which explains the German experience using different extradition procedures.

## **ANNEX 9**

### **Third North Sea Conference Declaration**

**Annex 1a of the Final Declaration of the Third International Conference on the Protection of the North Sea**

## Annex 9

### Annex 1A of the Final Declaration of the Third International Conference on the Protection of the North Sea

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#### LIST OF PRIORITY HAZARDOUS SUBSTANCES

##### Substance

1. Mercury
2. Cadmium
3. Copper
4. Zinc
5. Lead
6. Arsenic
7. Chromium
8. Nickel
9. Drins
10. HCH
11. DDT
12. Pentachlorophenol
13. Hexachlorobenzene
14. Hexachlorobutadiene
15. Carbon Tetrachloride
16. Chloroform
17. Trifluralin
18. Endosulfan
19. Simazine
20. Atrazine
21. Tributyltin compounds
22. Triphenyltin compounds
23. Azinphos-ethyl
24. Azinphos-methyl
25. Fenitrothion
26. Fenthion
27. Malathion
28. Parathion
29. Parathion-methyl
30. Dichlorvos
31. Trichloroethylene
32. Tetrachloroethylene
33. Trichlorobenzene
34. 1,2-Dichloroethane
35. Trichloroethane
36. Dioxins

## **ANNEX 10**

### **Environmental Change Network**

**List of sampling sites, chemical determinands to be measured, and survey results to be reported**

## Annex 10

### **Environmental Change Network List of sampling sites, chemical determinands to be measured, and survey results to be reported**

#### Primary Sites

Cringle Beck at Thunder Bridge	Anglian
River Coquet at Warkworth	Northumbria/Yorkshire
River Eden at Temple Sowerby	North West
River Lathkill at Alport	Severn Trent
River Exe at Thorveton	South Western
River Esk at Ruswarp	Northumbria/Yorkshire
River Wye at Redbrook	Welsh

#### Secondary site

Bradgate Brook at Newton Linford	Severn Trent
River Frome at Holme Bridge	South Western
*River Bure at Horstead Mill	Anglian
*Wroxham Broad	Anglian
*Upton Broad	Anglian
*Hickling Broad	Anglian

#### Survey results to be reported

Invertebrate Survey  
Macrophyte Survey  
Fish Survey  
Flow Gauging (annual average)  
Flow interpolation (Q95T)

\* sites, identified under the standing water component of the ECN programme, which will be used to interpret the quality of the Broads

## Data Requirements for Environmental Change Network Reporting

No	Determinand	Units	No	Determinand	Units
Basic			30	Zinc - Total	µg/l Zn
1	pH	pH units	31	Cadmium - Total	µg/l Cd
2	Turbidity	FTU	32	Aluminium - Total	µg/l Al
3	Colour Filtered (0.45µm membrane)	Hazen	33	Tin - Total	µg/l Sn
4	Temperature	Celsius	34	Lead - Total	µg/l Pb
5	Conductivity at 25°C	µS/cm	35	Vanadium - Total	µg/l V
6	Dissolved Oxygen	% saturation	36	Chromium - Total	µg/l Cr
7	Dissolved Oxygen	mg/l O	37	Manganese - Total	µg/l Mn
8	BOD 5 ATU Total	mg/l O	38	Iron - Total	µg/l Fe
9	Ammoniacal Nitrogen	mg/l N	39	Nickel - Total	µg/l Ni
10	Nitrogen TON	mg/l N	40	Mercury - Total	µg/l Hg
11	Nitrate	mg/l N	Red List organics (No longer mandatory)		
12	Nitrite	mg/l N	41	Aldrin	µg/l
13	Suspended solids (105°C)	mg/l	42	Atrazine	µg/l
14	Hardness Total as CaCO <sub>3</sub>	mg/l CaCO <sub>3</sub>	43	Azinphos-methyl	µg/l
15	Alkalinity Total as CaCO <sub>3</sub> at pH =4.5	mg/l CaCO <sub>3</sub>	44	DDT (PP')	µg/l
16	Chloride	mg/l Cl	45	1,2-Dichloroethane	µg/l
17	Cyanide	mg/l CN	46	Dichlorvos	µg/l
18	Fluoride	mg/l F	47	Dieldrin	µg/l
19	Phosphate Ortho	mg/l P	48	Endosulfan (total of A+B)	µg/l
20	Silicate Reactive Dissolved	mg/l SiO <sub>2</sub>	49	Endrin	µg/l
21	Sulphate	mg/l SO <sub>4</sub>	50	Fenitrothion	µg/l
22	Faecal Coliforms Confirmed*	per 100ml	51	Hexachlorobenzene	µg/l
23	Total Coliforms Confirmed*	per 100ml	52	Hexachlorobutadiene	µg/l
Metals			53	Gamma HCH	µg/l
24	Sodium	µg/l Na	54	Malathion	µg/l
25	Potassium	µg/l K	55	PCB Total of Congeners 28, 52, 101, 118, 138, 153, 180	µg/l
26	Copper - Total	µg/l Cu	56	Pentachlorophenol	µg/l
27	Silver - Total	µg/l Ag	57	Simazine	µg/l
28	Magnesium - Total	µg/l Mg	58	Trichlorobenzene (total of 3 isomers 1,3,5+1,2,3+1,2,4)	µg/l
29	Calcium - Total	µg/l Ca	59	Trifluralin	µg/l

NB Red List Organics are no longer mandatory determinands under the ECN

Whilst confirmed is the preferred option, presumptive is acceptable. NB Once the choice has been made it should not change with time. Coliform analysis not required for the River Wye and the River Eden sites (because of the 6 hour rule). Previous version in error parameter 22 should be Faecal Coliforms not E. Coli.

## **ANNEX 11**

### **Bathing Water Quality**

- [1] Schedules 1, 2 and 3, of SI 1991/1597, The Bathing Waters (Classification) Regulations 1991**
- [2] Quotation from Official Journal of European Community 10 September 1985**
- [3] Details of analytical requirements and reporting formats**



## **Annex 11 [1]**

**From SI 1991/1597**

### **SCHEDULE 1      Regulation 2(3)**

#### **CRITERIA FOR THE CLASSIFICATION BW1**

1. Subject to the following provisions of this Schedule, the criteria for the classification BW1 are that

- (a) at least 95 per cent of the samples of the waters taken and tested in accordance with Schedule 2 must conform to the parametric values specified in Schedule 3;
- (b) no sample of the waters taken in accordance with Schedule 2 which when tested for compliance with the phenols parameter by the absorption method or with the transparency parameter fails to comply shall have a value which deviates from the relevant parametric value for that parameter specified in Schedule 3 by more than 50 percent;
- (c) consecutive samples of the waters taken in accordance with Schedule 2 at statistically suitable intervals shall not when tested deviate from the relevant parametric values specified in Schedule 3.

2. For the purposes of paragraph 1 above samples shall be disregarded if they deviate from the parametric values specified in Schedule 3 as a result of abnormal weather conditions, floods or other natural disasters.

3. (1) Subject to sub-paragraph (2), where in the case of particular waters to which the classification BW1 applies -

- (a) any requirements relating to any parameter for pH, colour or transparency cannot be complied with as a result of exceptional weather or geographical conditions; or
- (b) any requirements relating to any parameter cannot be complied with as a result of the waters having undergone a process of natural enrichment from soil without human intervention,

the Secretary of State may by notice served on the National Rivers Authority modify or display that requirement in relation to those waters.

(2) The Secretary of State shall not exercise his powers under this paragraph so as to permit a risk to public health.

## **SCHEDULE 2      Regulation 2(3)**

### **SAMPLING REQUIREMENTS**

1. Samples must be taken in accordance with the requirements of Schedule 3 in any year throughout the period beginning on 1st May and ending on 30th September.
2. Additional samples must be taken during that period if there are grounds to suspect that the quality of the waters is deteriorating for any reason or is likely to deteriorate as a result of any discharge.
3. All samples must be taken at the same point at the place in the particular waters where the daily average density of bathers is at its highest, and preferably 30 centimetres below the surface, except in the case of samples for testing for mineral oils, which must be taken at surface level.
4. The methods of analysis and inspection specified in Schedule 3, or methods which are at least as reliable, must be used for determining whether the parametric values specified in that Schedule are met

### **Notes to Schedule 3**

1. Samples may be taken at intervals of four weeks where samples taken in previous years show that the waters are of appreciably higher standard than required for classification in question and the quality of the waters has not subsequently deteriorated and is unlikely to do so.
2. Samples must be taken in relation to this parameter when there are grounds for suspecting that there has been a deterioration in the quality of the waters or the substance is likely to be present in the waters.

### SCHEDULE 3 Regulation 2(3)

#### QUALITY AND ADDITIONAL SAMPLING REQUIREMENTS

Parameter	Parametric value	Minimum sampling frequency	Methods of analysis and inspection
<b>Microbiological</b>			
Total coliforms	10 000/100ml	Fortnightly (see note 1)	Fermentation in multiple tubes. Sub-culturing of the positive tubes on a confirmation medium.
Faecal coliforms	2 000/100ml	Fortnightly (see note 1)	Either counting according to MPN (most probable number) or membrane filtration, culturing on an appropriate medium, sub-culturing and identification of the suspect colonies.  The incubation temperature is variable according to whether total of faecal coliforms are being investigated.
Salmonella	Absent in 1 litre	(see note 2)	Membrane filtration, culturing on an appropriate medium, sub-culturing and identification of suspect colonies.
Enteroviruses	No plague forming units in 10 litres	(see note 2)	Concentration (by filtration, flocculation or centrifuging) and confirmation.
<b>Physio-chemical</b>			
pH	6 to 9	(see note 2)	Electrometry with calibration at pH 7 and 9.
Colour	No abnormal change in colour	Fortnightly (see note 1)	Visual inspection or photometry with standards on the platinum-cobalt scale.
Mineral oils	No film visible on the surface of the water and no odour	Fortnightly (see note 1)	Visual and olfactory inspection
Surface-active substances reacting with methylene blue	No lasting foam	Fortnightly (see note 1)	Visual inspection
Phenols (phenol indices)	No specific odour	Fortnightly (see note 1)	Olfactory inspection
	≤0.05 mg/litre (C <sub>6</sub> H <sub>5</sub> OH)	(see note 2)	Absorption spectrophotometry 4-aminoantipyrine (4 AAP) method.
Transparency	1 metre	Fortnightly (see note 1)	Secchi's disc.

## Annex 11 [2]

QUOTATION FROM OFFICIAL JOURNAL OF EUROPEAN COMMUNITY 10  
SEPTEMBER 1985

Question No 59 by Mr Prag (H-388/85)

Subject: Pollution of bathing water at beaches in the Member States

Further to my Written Question No 835/85<sup>(1)</sup> and answer No QXWO835/84EN given by Mr Narjes on behalf of the Commission (26 November 1984), I understand that the one Member State which has notified only a small number of bathing areas for monitoring under the terms of Directive No 76/160/EEC in respect of the quality of bathing water is the UK. I understand that the Department of the Environment reduced the number of beaches at which the bathing water was to be monitored from more than 600 to only 27 by declaring that the Directive need apply only to beaches where more than 500 people bathe at once.

Does the Commission agree that, as large numbers of holiday-makers prefer to bathe in water where fewer than 500 others bathe, this loophole is nonsensical, and that it is equally offensive to bathe in water containing totally untreated sewage regardless of whether there are 499 or more other people bathing in the same polluted water? Will the Commission now inform me of the results of its evaluation of the results of applying the Directive in question, and will it also inform of the action it intends to take in order to ensure that the aims of its Directive are fully achieved?

Answer

The Commission is aware that the interpretation of the notion in Article 1 paragraph 2 second alternative of Directive 76/160/EEC, which qualifies a water as bathing water in which bathing is not prohibited and is traditionally practised by a large number of bathers' is not easily practicable. The Commission believes that in order to interpret this notion, the requirement of a specific number of bathers can only be one criterion among others. Indeed the number of bathers varies according to the season, school holidays, working days and so on. Thus the number of bathers counted on a specific day cannot in itself determine the bathing water quality for a specific water. Rather some objective criteria will also have to be taken into account. Such objective criteria are amongst others:

- (1) facilities of access to the beach
- (2) sanitary equipment
- (3) facilities for changing
- (4) parking space for cars
- (5) life guards on the beach

(6) first aid service

(7) kiosks and shops (mobile shops)

(8) availability of water sport facilities (boats, surfing, swimming lessons)

Indeed, such measures of infrastructure demonstrate action of local, regional or national administrations in order to promote bathing. Therefore the presence of such measure of infrastructure proves that the authorities felt induced by the great number of bathers to provide for measures to ensure safe bathing, safe access to the beach and to the waters and amenities to further increase the number of bathers.

Furthermore, it is not known why persons who are on a beach abstain from bathing; they might do so in some cases also because the water is too polluted. For these reasons the Commission is of the opinion that all circumstances regarding the individual water have to be taken into consideration when assessing whether a specific water qualifies as bathing water under the second alternative of Directive 76/160/EEC Article 1 paragraph 2.

The Commission is actively pursuing the action which it has started against two member countries by virtue of individual complaints. The Commission hopes that the discussions which were started with the member countries concerned will soon lead to satisfying results as regards the application of Directive 76/160/EEC.

## **Annex 11 [3]**

### **Details of Analyses**

#### Total coliforms and faecal coliforms

Twenty samples per season per site should be analysed for total and faecal coliforms using the methods set out in the NRA *Manual of Standard Methods for Microbiological Analysis* (Ref: NRA - R&D 1992). All coliform counts should be confirmed.

#### Faecal streptococci

Twenty samples per season per site should be analysed for faecal streptococci using the methods set out in the NRA manual (Ref: NRA - R&D 1992). As faecal streptococci are currently not used by DoE in the assessment of compliance, counts should be presumptive.

#### Salmonella

Two samples per season per site should be analysed for presence or absence of salmonella using the methods set out in the NRA manual (Ref: NRA - R&D 1992).

#### Enterovirus

Two samples per season are required at sites which during the previous bathing season were non-compliant with the coliform standards. Sampling at sites other than these must currently be considered non-statutory monitoring. Samples should be analysed using the methods set out in the NRA manual (Ref: NRA - R&D 1992) to obtain a count in plaque forming units per 10 litres.

#### pH

A minimum of one on-site measurement per season should be made at each site.

#### Colour

Visual assessment should be made at each site visit, even where a waiver applies. Only abnormal changes in colour believed to be due to discharges should be reported as positive results in the data returns.

#### Mineral oils

Visual assessment should be made at each site visit. If an oil film is visible a sample should be taken at the water's surface for laboratory analysis. Only results greater than 0.3 mg/l should be reported as positive in the data returns.

### Surface Active Substances

Visual assessment should be made at each site visit. If **lasting** foam is seen and believed to be from a discharge, not from algal blooms or other natural phenomena, a sample should be taken for laboratory analysis. Only results greater than 0.3 mg/l lauryl sulphate from the Methylene Blue test should be reported as positive in the data returns.

### Phenols

Olfactory assessment should be made at each site visit. If phenols are suspected to be present a sample should be taken for laboratory analysis. The following seven phenols should be determined by chromatography and summed to give 'total phenols': Phenol; 2 methyl phenol; 3 methyl phenol; 2 chloro phenol; 2,5 dichlorophenol; 2,4,6 trichlorophenol; and, 2,5 dimethyl phenol. Only results greater than 0.05 mg/l of total phenols as  $C_6H_5OH$  should be reported as positive in the data returns.

### Transparency

Visual assessment should be made at each site visit, even where a waiver applies. Results can be reported as either > 1.0, < 1.0, or a more accurate estimate, as long as compliance against the minimum requirement of 1.0 metre transparency can be assessed.

### Other substances

As there are no mandatory requirements for other parameters (dissolved oxygen, floating materials, ammonia, kjeldahl nitrogen, pesticides, heavy metals, cyanides, nitrates and phosphates), these should only be analysed and results reported if they are believed to be present due to a pollution incident.

## Data Format for reporting

Annual results should be sent in electronic format as a comma separated variable (CSV) file, with one record (all details for one sample) per line. There should therefore be at least twenty lines of data per sample point. Parameters should be included in the order given below:

Parameter	Details required
Sampling point code	DoE code eg. 03600
Date of sample	eg. 150594
Time of sample	eg. 0930
Indicator for total coliforms	> or < if appropriate
Total coliform count	up to 6 figures, no commas for thousands
Indicator for faecal coliforms	> or < if appropriate
Faecal coliform count	up to 6 figures, no commas for thousands
Indicator for faecal streptococci	> or < if appropriate
Faecal streptococci count	up to 6 figures, no commas for thousands
Indicator for pH	> or < if appropriate
pH measurement	to one decimal place eg. 6.8 and with trailing zeros eg. 7.0 if appropriate
Indicator for transparency	> or < if appropriate
Transparency measurement	to one decimal place eg. 1.5 and with trailing zeros eg. 1.0 if appropriate
Salmonella presence/absence	1 if present, 0 if absent
Indicator for enterovirus	> or < if appropriate
Enterovirus count	up to 3 figures
Colour abnormal/normal	1 if abnormal due to discharge, 0 if normal
Mineral oils	1 if present and confirmed by lab, 0 if absent
Surface active substances	1 if present and confirmed by lab, 0 if absent
Phenols	1 if present and confirmed by lab, 0 if absent
Abnormal weather	1 if applicable, blank if not

## Format, of paper record, for updating details of identified bathing waters

Parameter	Details required
County	Name of County
District	Name of District Council
Bathing water name	Suggested name
Latitude	eg. N 554524
Longitude	eg. W 015914
Transparency waiver	Indicate if required
Colour waiver	Indicate if required
Sampling point grid reference	eg. NU00805150
Comments	Any other relevant information



## **ANNEX 12**

### **Quality of Shellfish Waters**

#### **Environmental Quality Standards and Minimum Sampling Frequencies for Shellfish Waters**

## Annex 12

### Environmental Quality Standards and Minimum Sampling Frequencies for Shellfish Waters

Parameter	Minimum Sampling Frequency per annum	Mandatory Standard
pH	4	7 - 9
Temperature	4	No mandatory standard
Colour	4	Derivation from "normal" must not be > 10 mg Pt/l
Suspended solids	4	Derivation from "normal" must not be > 30 %
Salinity	12	≤ 40 ‰ Derivation from "normal" must not be > 40 %
Dissolved oxygen	12	> 70 % (average value) Not < 40 % unless no adverse effects
Hydrocarbons	4	No visible film. No adverse effects
Lindane	2	100
Dieldrin	2	100
DDT	2	33
Parathion	2	100
Silver	2	10
Arsenic	2	3000
Cadmium	2	330
Chromium	2	1000
Copper	2	10
Mercury	2	1
Nickel	2	100
Lead	2	100
Zinc	2	40

#### Notes

- i) Standards for dissolved metals and organohalogenated substances are given in µg/l.
- ii) 100% of samples must meet the above standards.
- iii) Reduced sampling frequency may be applied where water quality has been demonstrated to consistently exceed the required standards and it is believed no deterioration of water quality can have occurred.

## **ANNEX 13**

### **Titanium Dioxide**

**Annex II of Council Directive 82/883/EEC, on procedures for the surveillance and monitoring of environments concerned by waste from the titanium dioxide industry**

# Annex 13

## Annex II of Council Directive 82/883/EEC

### METHOD OF WASTE DISPOSAL: DISCHARGE INTO OR IMMERSION IN SALT WATER (estuarine, coastal, open sea)

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Water column  Non-filtered sea water <sup>(1)</sup>	Temperature (°C)		3	Thermometry. Measurement is to be carried out on the spot at the time of sampling.
	Salinity (‰)		3	Conductimetry.
	pH (pH unit)		3	Electrometry. Measurement is to be carried out on the spot at the time of sampling.
	Dissolved O <sub>2</sub> (mg/O <sub>2</sub> dissolved/l)		3	- Winkler method. - Electrochemical method.
	Turbidity (mg solids/l)  or  suspended matter (mg/l)		3	For turbidity: turbidimetry. For suspended matter: gravimetry.  - Weighing after filtration through 0.45 µm pore size membrane filter and drying at 105°C.  - Weighing after centrifugation (minimum time five minutes, average acceleration 2800 to 3200 g) and drying at 105°C.
	Fe (dissolved and in suspension) (mg/l)		3	After the sample has been appropriately prepared, determination by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.
		Cr, total Cd, total Hg (mg/l)	3	- Atomic absorption spectrophotometry. - Molecular absorption spectrophotometry.
	Ti (mg/l)	V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry. - Polarography.

<sup>(1)</sup> Member States may choose whether to analyse non-filtered or filtered water for substances under 'Parameters'.

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Sea water filtered through 0.45 $\mu$ m pore size membrane filter <sup>(1)</sup>	Dissolved Fe (mg/l)		3	Determination by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.
		Cr, Cd, Hg (mg/l)	3	- Atomic absorption spectrophotometry. - Molecular absorption spectrophotometry.
		Ti, V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry. - Polarography.
Suspended solids remaining in 0.45 $\mu$ m pore size membrane filter	Total Fe (mg/l)	Cr, Cd, Hg (mg/l)	3	- Atomic absorption spectrophotometry. - Molecular absorption spectrophotometry.
		Ti, V, Mn, Ni, Zn (mg/l)	3	Atomic absorption spectrophotometry.
		Cu, Pb (mg/l)	3	- Atomic absorption spectrophotometry. - Polarography.
	Hydrated oxides and hydroxides of iron (mg Fe/l)		3	Extraction of the sample under appropriate acid conditions; measurement by atomic absorption spectrophotometry or by molecular absorption spectrophotometry.  The same method of acid extraction must be used for all samples coming from the same site.

<sup>(1)</sup> Member States may choose whether to analyse non-filtered or filtered water for substances under 'Parameters'.

Components	Parameters to be determined		Minimum annual sampling and analysis frequency	Reference method of measurement
	mandatorily	optionally		
Sediments  In the top layer of sediment as near the surface as possible	Total Ti, Fe (mg/kg dry matter)	V, Cr, Mn, Ni, Cu, Zn, Cd, Hg, Pb (mg/kg dry matter)	1	Identical methods to those for measurements in the water column.  After appropriate preparation of the sample (wet or dry mineralization and purification). The quantities of metals must be measured for a specific range of particle sizes.
	Hydrated oxides and hydroxides of iron (mg Fe/kg)		1	Identical methods to those for measurements in the water column.
Living organisms  Species representative of the site: benthic fish and invertebrates or other appropriate species <sup>(1)</sup>	Ti, Cr, Fe, Ni, Zn, Pb (mg/kg wet and dry weight)	V, Mn, Cu, Cd, Hg (mg/kg wet and dry weight)	1	Atomic absorption spectrophotometry after appropriate preparation of the composite sample of ground flesh (wet or dry mineralization and purification).  - For fish, the metals must be measured in muscle or other appropriate tissue; the sample must consist of at least 10 specimens.  - For molluscs and crustaceans, the metals must be measured in the flesh. The sample must consist of at least 50 specimens.
Benthic fauna	Diversity and relative abundance		1	Qualitative and quantitative classification of representative species, indicating the specimen count per species, density, dominance.
Planktonic fauna		Diversity and relative abundance	1	Qualitative and quantitative, classification of representative species, indicating the specimen count per species, density, dominance.
Flora		Diversity and relative abundance	1	Qualitative and quantitative, classification of representative species, indicating the specimen count per species, density, dominance.
Fish in particular	Presence of morbid anatomical lesions in fish		1	Visual inspection of samples of the representative species taken for chemical analysis.

<sup>(1)</sup> Species representative of the site of discharge in particular in terms of their sensitivity to bioaccumulation, eg *Mytilus edulis*, crangon crangon, founder, plaice, cod, mackerel, red mullet, herring, sole (or other appropriate benthic species).

## **ANNEX 14**

### **MPMMG National (Marine) Monitoring Plan**

**MPMMG UK National (Marine) Monitoring Plan (March 1994)**

# ***Marine Pollution Monitoring Management Group***

## ***Monitoring Coordination SubGroup***



# **UK NATIONAL MONITORING PLAN**



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**HMIP**  
March 1994

## **MPMMG**

# **UK National Monitoring Plan (NMP)**

### **1. Introduction**

In 1987/88 the Marine Pollution Monitoring Management Group (MPMMG) reviewed the monitoring carried out in UK estuaries and coastal waters [1] and concluded that there would be considerable merit in the regular sampling of a network of coastal monitoring stations. These stations should include some that are not expected to be significantly contaminated. Similarly the North Sea Task Force, meeting in 1989, concluded that, for the whole North Sea, monitoring was too concentrated in inshore areas covered by the Joint Monitoring Group of the Oslo and Paris Commissions (JMG) and that data were lacking in offshore areas. Both groups recommended that a series of offshore sites could serve as reference stations producing data for comparison with more heavily contaminated sites around the coast and in estuaries. They would also provide data on the natural variability of the marine environment which could then be used to filter out short term changes at the more heavily contaminated sites, thereby allowing a clearer definition of contamination trends in affected areas.

In its formal response to the MPMMG review [2], the Government accepted the need for a minimum core programme of marine monitoring to national standards for all UK waters. It was agreed that there should be a network of sampling sites around the UK coast comprising estuarine, intermediate and offshore localities. There should be at least one estuarine and one intermediate site in each National Rivers Authority Region or River Purification Board area as appropriate. Responsibility for monitoring biological, physical and chemical determinands at these stations would fall to the National Rivers Authority (NRA) or the River Purification Board (RPB) concerned or to MAFF, SOAFD or DANI/DOE Northern Ireland, depending on the location of the stations: some stations might be monitored jointly by two or more agencies, thus establishing a firm link between the estuarine, inshore and offshore monitoring programmes in the UK and the laboratories assessing them.

This programme is not intended as a substitute for more intensive sampling programmes already underway to assess sources and, where appropriate, control measures taken in some estuaries. The national programme defined in this document is a subset of local monitoring and is primarily aimed at producing a coordinated and reliable data set on nationally significant contaminants in inshore and coastal waters. It provides a framework for assessing the need for and the effects of national measures and provides a focus for improving standards in all marine contaminant monitoring.

## **2. General Objectives**

The general objectives of the National Monitoring Plan, which will start in 1993/4, are:

a) To establish as precisely as practicable the spatial distribution of contaminants in different areas of UK waters and to define their current biological status, thus identifying any areas of specific concern, eg areas where the levels of one or more contaminants might affect biological processes or make fish and shellfish unfit for consumption. [see Appendix 4]

b) To detect with appropriate accuracy trends in both contaminant concentrations and biological well-being in those areas identified as being of concern [see Appendix 5].

c) To measure long-term natural trends in physical, biological and chemical parameters at selected areas.

## **3. Strategy**

To achieve these objectives, it is necessary to establish a central computerised database for important contaminants in biota, sediment and water, and for biological effects, in the UK marine environment. This database must permit comparison of environmental levels between sites, over time and with criteria relating to human and environmental health. It should be able to provide an indication of inputs, eg by allowing comparisons of normalised sediment data, and be able to identify the effects of changes in inputs, eg as a result of Government policy to reduce inputs.

The strategy proposed, therefore, is to conduct a basic annual programme monitoring contaminants in water and an initial spatial study of sediments and biota, including a review of existing information collected to NMP standards. These studies will establish the concentrations of contaminants and biological effects at each site in order to identify areas of concern and to estimate the inherent variability in data collected at the sites. In the light of the results of the spatial study, particular determinands of concern will be included in future annual programmes, along with methods of sampling, etc.

The requirements for the initial spatial study are set out in Appendix 4 and for the water monitoring programme in Appendix 5.

In the areas identified as being of concern, it will be necessary to establish the variability inherent in any entry into the database, including both the actual variability in levels of contaminants or biological effects with repeated sampling at and around sampling sites and that introduced by the extraction and analysis of the sample. This information is essential in judging the significance of differences in reported levels at different sites or over time.

This study may therefore involve a large amount of sampling at and around the site. It may be, however, that at many sites sufficient data already exist to define many of the spatial distributions of contaminants and biological effects, to identify areas of concern and to estimate variability.

For benthos monitoring, there may be difficulties in interpreting spatial trends along transects from inshore to offshore (see section 4), since the natural habitat variability may be so great that it masks any anthropogenic effects. The spatial study will nevertheless assist in the design of the annual monitoring programme for benthic macrofauna.

In addition, the assessment of long-term trends needs knowledge of other relevant sources of variation, eg deposition and mixing rates for sediments. It may also be necessary to establish relationships among the variables measured, because contaminant concentrations may be intercorrelated.

In the light of the results of the initial spatial study, it will be possible to develop an ongoing programme to establish reliable trends for selected contaminants and biological effects at any site in response to potential influences on the quality of the aquatic environment. The requirements for the annual monitoring programme, which at present applies to water sampling, are set out in Appendix 5. This will be developed after consideration of the results of the spatial survey.

#### **4. Network of Monitoring Sites**

Figure 1 shows the approximate locations of intermediate and offshore sites in the UK National Monitoring Plan. These are listed, together with the estuarine sites and the organisations responsible for monitoring, in Appendix 1.

Three principles were adopted in choosing the network of monitoring sites:

- a) the inshore sites correspond as far as possible to present JMG sites;
- b) where practical there is a salinity gradient in the sites from major estuaries, through the interface between the estuarine plume and open sea water (called intermediate sites) and out to the offshore sites;
- c) the offshore sites in the North Sea and English Channel correspond to the North Sea Task Force stations.

Particular considerations in the choice of the three fixed sampling sites per estuary are that they should be approximately representative of salinity regimes 0-10, 10-20 and 20-30 at high water within the confines of the estuary under normal flow conditions. The sites are chosen to provide a good geographical coverage of the estuary and to equate, in general terms, to the upper, middle and lower reaches. It may be necessary to go outside these salinity bands in some instances in order to achieve appropriate coverage of specific estuaries. Sites are located within the main channel for water quality monitoring. It may be necessary to go outside the main channel for biological and sediment sampling in order to obtain a representative sample, because of local factors such as dredging operations or to avoid the mixing zone of a known input, and also for reasons of practicality and ease of access.

The estuarine sites will be monitored by NRA, RPB's or DOE(NI) as appropriate. The responsibilities for sampling and analysis of intermediate sites are as agreed between NRA, RPB's, DOE(NI) and the Fisheries Departments on a local basis, whilst the offshore sites are the sole responsibility of the Government Departments.

Once a sampling site has been chosen and, if necessary, adjusted as a result of the initial spatial survey, all future sampling should be as near as possible at the same sampling location. In the case of estuarial sites, it should be under the same tidal conditions (see Section 7.1); the salinity should be measured at the time of sampling.

## **5. Variables to be Measured at Each Station**

### **5.1 Physical and chemical determinands**

All determinands should initially be reported upon at all categories of sites as indicated in Table 1, where the matrix is available. If any determinands are analysed in a matrix not specified in Table 1, eg for local or international purposes, it would be helpful if the results of those analyses are also reported to the NMP. Appendix 2 gives a list of references providing an initial source of information on specific methodologies for analysing many of the determinands. The National Marine AQC Coordinating Committee (NMAQC) will prepare a list of the ranges of detection to be met within the NMP, and update this Appendix as necessary. NMAQC will also advise on the procedures to be adopted or discarded according to the results of ongoing rounds of proficiency testing and method development. The list of determinands to be reported at any site may be amended as a result of the initial study.

**Sediments:** All sediment analyses must be accompanied by an estimation of organic carbon content and particle size analysis and, for metals, must approximate as closely as possible to an estimation of total elemental concentration. Concentrations reported must relate to dry weight. Where coal or other special factors are likely to be present the results should be so qualified.

### **5.2 Biological effects monitoring**

#### **5.2.1 Benthic Macrofauna**

Samples should be recovered from estuarine, intermediate and offshore sites. Sampling methods and timing, ie February - May, should follow the guidance in the literature [3,4,7,8]. Where possible, sampling sites should be chosen to be representative of stable depositional substrates (silt/clay), although it is recognised that this will not be achievable at all locations.

#### **5.2.2 Oyster embryo bioassay**

Wherever possible the bioassay should be performed by the Fisheries Departments, although samples may be collected by the appropriate agency using methods defined by the Fisheries Departments. On water samples, the bioassay will follow the guidelines specified by ICES (TIMES No. 11) [9]. For the bioassay of sediments, the current use of an elutriate and the oyster embryo bioassay will be replaced by a whole-sediment bioassay as soon as an appropriate test is developed and tested.

The information required with relation to each sample is shown in the Data Reporting Format (Appendix 3), which is essentially that used by ICES [5]. MPMMG will advise on the data required for benthos and on the supporting chemical analysis required for the various biological effects techniques.

### **5.3 Biological Effects - Monitoring by Government Departments**

#### **5.3.1 Fish Disease Studies**

May be carried out as deemed appropriate. If carried out at NMP sampling points, the data should be forwarded to the database according to ICES guidelines.

#### **5.3.2 Dogwhelk Imposex Bioassay**

This will be applied once every five years by the Government Departments as deemed appropriate.

### **5.3.3 Mixed function oxidase test (EROD)**

This will be applied at intermediate and offshore sites by the Government Departments as deemed appropriate. This test is still under evaluation; where used, it will be carried out using techniques based on those specified by ICES (TIMES 13). If this work is extended to estuaries, then flounder may be substituted for dab.

## **6. Survey Sampling Frequency**

### **6.1 Estuarine Sites**

Water column samples	- four times per year, corresponding to seasons.
Sediment samples	- to be decided after analysis of the spatial survey.
Biological tissue samples	- to be decided after analysis of the spatial survey.
Benthos	- to be decided after analysis of the spatial survey.
Oyster embryo bioassay	- minimum twice per year: winter and summer.

### **6.2 Intermediate sites and offshore sites**

Water column samples	- once per year.
Sediment samples	- to be decided after analysis of the spatial survey.
Biological tissue samples	- to be decided after analysis of the spatial survey.
Benthos	- to be decided after analysis of the spatial survey.
Oyster embryo bioassay	- minimum once per year.

**Note:** If more frequent sampling consistent with NMP requirements is carried out, all data are acceptable to the NMP database.

## **7. Sampling Methods**

### **7.1 Water**

All samples from the water column are to be taken 1 metre below the surface and in accordance with JMG guidelines [6]. A better methodology, when available, would be either an integrating water sampler or one that takes multiple discrete samples.

#### **7.1.1 Estuarine Sites**

Water samples should be recovered at or near highwater and every effort should be made thereafter to recover samples under similar tidal conditions at each sampling site.

### **7.2 Sediment**

Sampling and analysis of sublittoral sediments should be carried out in accordance with ICES guidelines [6]. Sampling should be by means of either a tightly closing 0.1m<sup>2</sup> grab sampler or a suitable corer impacted on the sediment at a slow rate to minimise disturbance of the surface layer.

Where deposition and mixing rates are low, only the top 1 cm of sediment should be sampled for chemical determinands. In estuarine systems with high rates of both deposition and mixing the sampling depth is dependent on knowledge of mixing depth, eg as obtained from radiochemical studies of cores. In the absence of this information, sampling should be at a uniform 1 cm depth.

For benthic macrofauna, sediments from intermediate and offshore sites should be sieved to 1mm [3,4]; from estuarine sites, they should also be sieved to 0.5mm if grain size permits.

### 7.3 Shellfish

Analysis should be of whole soft tissue.

The shellfish species of choice is the mussel *Mytilus edulis*, preferably size 2-6 cm (mean 4-6 cm). Offshore, *Modiolus modiolus* (range 7-9 cm) may be used. If these are not available, other species are not acceptable to the NMP.

### 7.4 Fish

The first choice fish species is dab (*Limanda limanda*), preferably size 20-30 cm; second choice is flounder (*Platichthys flesus*) preferably size 15-35 cm. If these are not available, other species are not acceptable to the NMP.

## 8. Special Surveys of Additional Determinands

In addition to the routine survey described above, Government Departments will undertake more restricted surveys of additional determinands to assess whether to include them in wider scale studies under the NMP. Likely determinands and matrices are identified below; the initial studies should take place at sites believed to represent "worst case" areas.

#### Poly brominated biphenyls & diphenyl ethers

- surficial sediments, shellfish and fish liver.

#### Dioxins & furans

- surficial sediment samples

#### Chlordane

- surficial sediments, shellfish and fish liver.

#### Toxaphene

- surficial sediments, shellfish and fish liver.

#### TBT

- water samples, surficial sediments and shellfish, in conjunction with Dogwhelk survey.

#### PAH's

- sediment at all sites; shellfish at estuarial sites; fish muscle at intermediate and offshore sites; individual PAH's as listed in Table 1b.

These surveys will be undertaken by relevant Government Departments who will also assess the significance of results. Where concentrations are above the limit of detection and are believed to be a cause for concern, the inclusion of the determinand in the NMP at specific sites will be recommended. If the survey shows concentrations to be below the limit of detection, it should only be repeated if changes in methodology and inputs or concentrations of concern suggest that concentrations above the level of concern may be detectable.

## 9. Annual Report

An annual report on the NMP will be produced; this will include recommendations for changes in the determinands and station positions as necessary.

## 10. References

1. The Principles and Practice of Monitoring in UK Coastal Waters. A Report from the Marine Pollution Monitoring Management Group. DOE 1991.
2. The Principles and Practice of Monitoring in UK Coastal Waters. The Government Response to a Report from the Marine Pollution Monitoring Management Group. DOE 1991.
3. Procedures for the Monitoring of Marine Benthic Communities at UK Sewage Sludge Disposal Sites. Marine Pollution Monitoring Management Group. Scottish Fisheries Information Pamphlet Number 18, 1990.
4. 9th Report of the Benthos Ecology Working Group - ICES CM 1990/1.95.
5. ICES Environmental Data Reporting Formats. TF 6/INFO.2.1-E, Sixth Meeting of the North Sea Task Force.
6. ICES Cooperative Research Report (in press).
7. Rumohr, H. (ed) 1990. Soft-bottom Macrofauna: Collection and Treatment of Samples. ICES Techniques in Marine Environmental Sciences, No 8. 18pp
8. Rees, H L; Heip, C; Vincx, M and Parker, M M. Benthic Communities: Use in Monitoring Point-Source Discharges. ICES Techniques in Marine Environmental Sciences, No 16. 70pp.
9. Thain, J E 1991. Biological Effects of Contaminants: Oyster (*Crassostrea gigas*) embryo bioassay. ICES Techniques in Marine Environmental Sciences, No 11. 12pp



Table 1

## Analytical Requirements

Determinand			Matrix & Units					
		Code	UW	FW	SS	SF	FM	FL
<b>Metals</b>								
Al	(Aluminium)	AL	-	-	mg/kg	-	-	-
Hg	(Mercury)	HG	-	ng/l	µg/kg	mg/kg	mg/kg	-
Cd	(Cadmium)	CD	-	ng/l	µg/kg	mg/kg	-	mg/kg
Cu	(Copper)	CU	-	µg/l	mg/kg	-	-	-
Pb	(Lead)	PB	-	µg/l	mg/kg	mg/kg	-	mg/kg
Ni	(Nickel)	NI	-	µg/l	mg/kg	-	-	-
Zn	(Zinc)	ZN	-	µg/l	mg/kg	mg/kg	-	-
As	(Arsenic)	AS	-	-	mg/kg	-	mg/kg	-
Cr	(Chromium)	CR	-	µg/l	mg/kg	-	-	-
TBT	(Tributyl tin)	TBTIN	ng/l	-	µg/kg	mg/kg	-	-
<i>[in conjunction with Dogwhelk survey - See paragraph 8]</i>								
<b>Organic Compounds</b>								
PCB	(Polychlorinated biphenyls)	CB28, CB52, etc	-	-	µg/kg	µg/kg	-	µg/kg
<i>[congeners: 28, 52, 101, 105, 118, 128, 138, 153, 156, 170, 180]<sup>1</sup></i>								
α-HCH	(Alpha-hexachlorocyclohexane)	HCHA	ng/l	-	-	µg/kg	-	-
β-HCH	(Beta-hexachlorocyclohexane)	HCHB	ng/l	-	-	-	-	-
<i>[estuarine sites only]</i>								
γ-HCH	(Gamma-hexachlorocyclohexane: Lindane)	HCHG	ng/l	-	-	µg/kg	-	-
Dieldrin	<i>[Unfiltered Water: estuarine sites only]</i>	DIELD	ng/l	-	µg/kg	µg/kg	-	µg/kg
Aldrin	<i>[estuarine sites only]</i>	ALD	ng/l	-	µg/kg	µg/kg	-	µg/kg
Endrin	<i>[estuarine sites only]</i>	END	ng/l	-	µg/kg	µg/kg	-	µg/kg
Isodrin	<i>[estuarine sites only]</i>	ISOD	ng/l	-	-	-	-	-
HCB	(Hexachlorobenzene)	HCB	ng/l	-	µg/kg	µg/kg	-	-
PCP	(Pentachlorophenol)	PCP	ng/l	-	-	µg/kg	-	-
DDT	(Dichlorodiphenyltrichloroethane)	TDEPP, DDEPP	-	-	µg/kg	µg/kg	-	µg/kg
<i>[pp TDE, pp DDE, pp DDT]</i>								
op DDT	<i>[estuarine sites only]</i>	DDTTP	ng/l	-	-	-	-	-
HCBD	(Hexachlorobutadiene)	DDTOP	ng/l	-	-	-	-	-
<i>[estuarine sites only]</i>								
<i>[Priority Hazardous Substances to be analysed on Unfiltered Water samples at estuarine sites only - See Table 1a]</i>			µg/l	-	-	-	-	-
PAH's	(Polycyclic aromatic hydrocarbons)	<i>[See Table 1b]</i>	-	-	µg/kg	µg/kg	µg/kg	-
<i>[Part of Special Survey of Additional Determinands - See paragraph 8]</i>								
<b>Nutrients etc</b>								
NH <sub>4</sub> - N	(Ammonium)	AMON	-	mg/l*	-	-	-	-
NO <sub>3</sub> - N	(Nitrate)	NTRA	-	mg/l*	-	-	-	-
NO <sub>2</sub> - N	(Nitrite)	NTRI	-	mg/l*	-	-	-	-
PO <sub>4</sub> - P	(Orthophosphate)	PHOS	-	mg/l*	-	-	-	-
SiO <sub>4</sub> - Si	(Silicate)	SLCA	-	mg/l*	-	-	-	-
Dissolved Oxygen		DOXY	mg/l†	-	-	-	-	-
Suspended solids		SUSP	mg/l	-	-	-	-	-
Chlorophyll a		CPHL	µg/l	-	-	-	-	-
<b>Physical Measurements</b>								
Secchi depth or other appropriate measurement		SECCI	m	-	-	-	-	-
Salinity		<i>[See Table 1c]</i>	‰	-	-	-	-	-
Temperature		TEMP	°C	-	-	-	-	-
<b>Oyster Embryo Bioassay</b>								
Percent net response <sup>2</sup>		PNR	%	-	%	-	-	-

<sup>1</sup> Also Congeners 77, 126 and 169 if possible.<sup>2</sup>  $PNR = \frac{\% \text{ test abnormality} - \% \text{ control abnormality}}{100 - \% \text{ control abnormality}} \times 100$ 

Alternative units: Chemical measurements can alternatively be given as required by ICES, ie as g/l (\* = moles/l; † = l/l) or g/g in scientific notation expressed in the form: x.xxxxExxx. (See Appendix 3, p16)

Code: ICES Parameter/Contaminant Code, to be used as determinand identifier when recording data.

UW: Unfiltered water

FW: Filtered water - pore size 0.45 microns

SS: Total Surficial Sediment - Total analysis of &lt;2 mm fraction of sediment; dry weight

SF: Shellfish - wet weight (plus % solid and % lipid)

FM: Fish Muscle - wet weight (plus % solid and % lipid)

FL: Fish Liver - wet weight (plus % solid and % lipid)

**Table 1a**

**Determinand Codes for Priority Hazardous Substances\***  
**to be analysed on Unfiltered Water samples.**

Carbon Tetrachloride	CCL4
Chloroform	CHCL3
Trifluralin	TRF
Endosulfan	ENDOS
Simazine	SIMZ
Atrazine	ATRZ
Azinphos - Ethyl	AZE
Azinphos - Methyl	AZM
Dichlorvos	DCV
Fenitrothion	FENT
Fenthion	FEN
Malathion	MAL
Parathion	PAR
Parathion - Methyl	PARM
Trichloroethylene	TRCE
Tetrachloroethylene	TECE
Trichlorobenzene	TRCB
1,2 Dichloroethane	DCE
Trichloroethane	TCE

These determinands should normally be measured at estuarine sites only. However, if they are detected in unacceptable concentrations in an estuary, they should also be measured at the appropriate intermediate and offshore sites.

- \* Annex 1A to the Ministerial Declaration, Third International Conference on the Protection of the North Sea.

**Table 1b**

**Determinand Codes for PAH's**

Category A		Category B	
Napthalene	NAP	C <sub>1</sub> naphthalenes	NAPC1
Phenanthrene	PA	C <sub>2</sub> naphthalenes	NAPC2
Anthracene	ANT	C <sub>1</sub> phenanthrenes	PAC1
Fluoranthene	FLU	C <sub>2</sub> phenanthrenes	PAC2
Pyrene	PYR	Dibenzothiophene	DBT
Benz[a]anthracene	BAA	C <sub>1</sub> dibenzothiophenes	DBTC1
Chrysene/Triphenylene	CHRTR	C <sub>2</sub> dibenzothiophenes	DBTC2
Benzo[a]pyrene	BAP		
Benzo[c]pyrene	BEP		
Perylene	PER		
Benzo[ghi]perylene	BGHIP		
Indeno[1,2,3-cd]pyrene	ICDP		

Category A provides a basic list which covers inputs from combustion sources, and, in the absence of oil-derived PAH, can be implemented using HPLC techniques. The addition of determinands from Category B will allow PAH from both oil and combustion sources to be detected and the relative importance of these sources to be estimated, but would require the use of GC/MS to provide sufficient resolution.

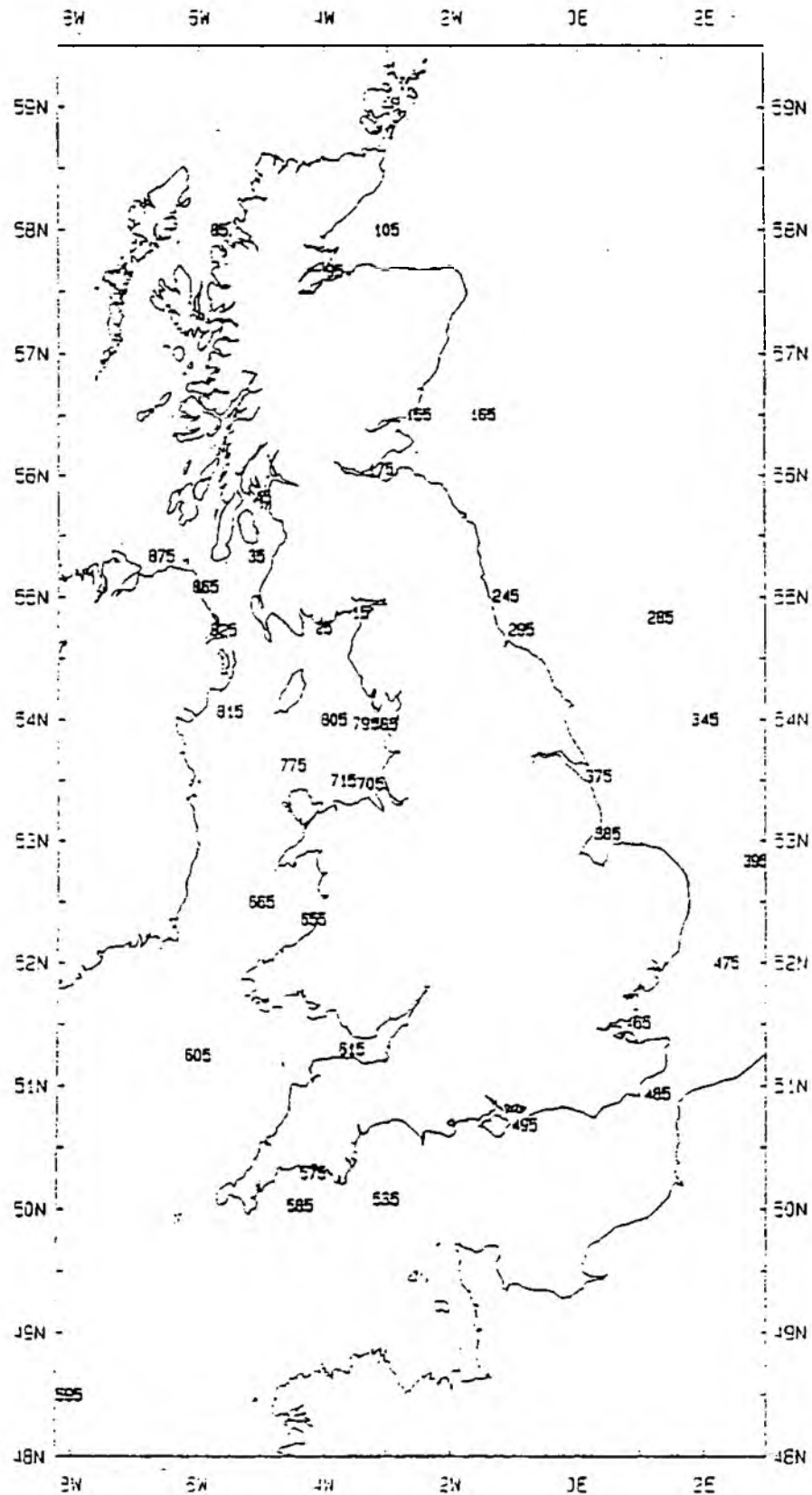
PAH should be determined in sediments at all sites, in shellfish at estuarine sites and in fish muscle at intermediate and offshore sites, subject to AQC methods becoming available. Units: µg/kg.

**Table 1c*****Determinand Codes for Salinity methods***

Method	Code
General Salinity measurement, method unspecified	PSAL
<b>Measurement from water sample</b> (temperature measurement by thermometer assumed)	
Titration by routine Mohr-Knudsen method (chlorinity ppt) (cf PSALX)	CHLRA
Titration by special precision method (chlorinity ppt) (cf PSALX)	CHLRB
Conductivity measurement by laboratory salinometer	PSALA
Refractive Index/direct density measurement	PSALB
<b>Conductivity/Salinity Measurement in situ</b> (temperature measurement by thermistor assumed)	
CTD/STD yielding precision in salinity $<0.01 \times 10^{-3}$	PSALC
CTD/STD yielding precision in salinity $>0.01 \times 10^{-3}$	PSALD
CTD/STD calibrated with at least one in situ sample yielding precision in salinity $<0.01 \times 10^{-3}$	PSALE
CTD/STD calibrated with at least one in situ sample yielding precision in salinity $>0.01 \times 10^{-3}$	PSALF
Instrument yielding precision in salinity $>0.5 \times 10^{-3}$ (eg Switchgear Bridge)	PSALG
UNESCO/SCOR/IAPSO formula: Salinity = $1.80655 \times$ Chlorinity	PSALX

**Figure 1**

**Intermediate and Offshore Sampling Station Positions**



# Appendix 1

## MPMMG UK National Monitoring Plan Sampling Stations

by RPB/NRA Region etc.

Estuary/ Location	Site	Type	Resp- onsible	N.G.R	Lat/Long
<b>Solway</b>					
15	Solway	I	NRA/RPB	NY 091 543	54 52.50 N 03 25.00 W
25	Offshore Solway	O	SOAFD		54 45.00 N 04 00.00 W
<b>Clyde</b>					
35	Firth of Clyde	O	SOAFD		55 20.00 N 05 05.00 W
45	Inner Firth of Clyde	I	RPB		55 49.30 N 04 58.70 W
55	Clyde	E	RPB	NS 193 765	55 56.85 N 04 53.65 W
65	Clyde	E	RPB	NS 330 747	55 56.28 N 04 40.46 W
75	Clyde	E WS	RPB	NS 459 727	55 55.40 N 04 27.95 W
<b>Highland</b>					
85	Minches	I	SOAFD		58 00.00 N 05 40.00 W
95	Moray Firth	I	SOAFD		57 40.00 N 03 49.00 W
105	Moray Firth	O	SOAFD		58 00.00 N 03 00.00 W
<b>Tay</b>					
115	Tay	E WS	RPB	NO 449 303	56 27.70 N 02 53.07 W
	Broughty Castle	E F	RPB	NO 464 303	56 27.73 N 02 52.18 W
125	Tay	E F	RPB	NO 469 290	56 27.05 N 02 51.71 W
135	Tay	E W	RPB	NO 307 234	56 23.85 N 03 07.34 W
	Kingoodie Flats	E S	RPB	NO 350 282	56 26.56 N 03 02.70 W
145	Tay	E W	RPB	NO 357 257	56 25.14 N 03 02.55 W
	Dog Bank	E S	RPB	NO 305 250	56 24.06 N 03 07.26 W
155	Tay	I	SOAFD		56 30.00 N 02 30.00 W
<b>Forth</b>					
165	Tay/Forth	O	SOAFD		56 30.00 N 01 30.00 W
175	Forth	I	RPB		56 03.00 N 03 06.00 W
185	Forth	E WS	RPB	NS 822 941	56 07.50 N 03 53.72 W
195	Forth	E WS	RPB	NS 879 920	56 06.45 N 03 48.17 W
205	Forth	E S	RPB	NS 973 845	56 02.55 N 03 38.92 W
	Blackness	E W	RPB	NT 062 824	56 01.52 N 03 30.32 W
	Blackness	E F	RPB	NT 059 801	56 00.28 N 03 30.55 W
<b>Northumbrian</b>					
215	Tyne	E	NRA	NZ 199 636	54 57.99 N 01 41.34 W
225	Tyne	E	NRA	NZ 304 657	54 59.09 N 01 31.49 W
235	Tyne	E	NRA	NZ 364 683	55 00.47 N 01 25.84 W
245	Off Tyne	I	MAFF/NRA	NZ 554 685	55 00.50 N 01 08.00 W
255	Wear	E	NRA	NZ 348 567	54 54.22 N 01 27.43 W
265	Wear	E	NRA	NZ 382 578	54 54.80 N 01 24.24 W
275	Wear	E	NRA	NZ 412 583	54 55.05 N 01 21.43 W
285	Off Tyne/Tees	O	MAFF		54 50.00 N 01 20.00 E
295	Off Tees	I	MAFF/NRA	NZ 719 382	54 44.00 N 00 53.00 W
305	Tees	E	NRA	NZ 431 158	54 32.22 N 01 20.05 W
315	Tees	E	NRA	NZ 449 184	54 33.52 N 01 18.33 W
325	Tees	E	NRA	NZ 552 284	54 38.95 N 01 09.49 W
<b>Yorkshire</b>					
335	Humber	E	NRA	TA 387 094	53 33.75 N 00 05.66 E
345	Off Humber/Wash	O	MAFF		54 00.00 N 02 00.00 E
<b>Anglian</b>					
355	Humber	E	NRA	SE 868 237	53 42.13 N 00 41.10 W
365	Humber	E	NRA	TA 162 233	53 41.57 N 00 05.66 E
375	Humber	I	MAFF/NRA	TA 546 066	53 32.00 N 00 20.00 E
376		I B	MAFF/NRA		53 20.00 N 00 35.00 E
385	Wash	I	MAFF/NRA		53 03.50 N 00 28.50 E
386		I B	MAFF/NRA		52 58.98 N 00 20.08 E
395	Southern Bight	O	MAFF		52 50.00 N 02 50.00 E
405	Ouse	E	NRA	TF 603 070	52 38.20 N 00 22.15 E
415	Ouse	E	NRA	TF 612 185	52 44.38 N 00 23.28 E
425	Ouse	E	NRA	TF 601 234	52 47.04 N 00 22.45 E

Estuary/ Location	Site		Type	Resp- onsible	N.G.R	Lat/Long	
<b>Thames</b>							
435	Thames	Woolwich	E	NRA	TQ 433 796	51 29.77 N 00 03.87 E	
445	Thames	West Thurrock	E	NRA	TQ 598 766	51 27.92 N 00 18.00 E	
455	Thames	Mucking	E	NRA	TQ 718 802	51 29.67 N 00 28.46 E	
465	Thames	Warp	NSTF19	I	MAFF/NRA	TR 058 836	51 30.80 N 00 58.00 E
466				I B		51 29.80 N 01 00.00 E	
475	Thames	Gabbard	NSTF25	O	MAFF		52 00.00 N 02 20.00 E
<b>Southern</b>							
485	South Varne		NSTF69	O	MAFF		50 56.00 N 01 16.80 E
495	Selsey Bill		NSTF70	I	MAFF/NRA		50 40.70 N 00 49.60 W
505	So'ton Water	Dock Head	E	NRA	SU 430 095	50 52.95 N 01 23.30 W	
515	So'ton Water	E Brambles Buoy	E	NRA	SU 544 989	50 51.14 N 01 12.77 W	
525	So'ton Water	Hook Buoy	E	NRA	SU 490 032	50 49.59 N 01 18.29 W	
<b>South West</b>							
535	Central Channel		NSTF72	O	MAFF		50 05.00 N 03 00.00 W
545	Tamar	Halton Quay	E	NRA	SX 413 655	50 28.00 N 04 14.31 W	
555	Tamar	Warren Point	E	NRA	SX 441 606	50 25.35 N 04 11.95 W	
565	Tamar	Hamoaze	E	NRA	SX 441 560	50 22.88 N 04 11.37 W	
575	Off Tamar		I	MAFF/NRA		50 17.70 N 04 09.73 W	
585	Off Plymouth Sound		NSTF73	O	MAFF		50 02.00 N 04 22.00 W
595	W Approaches	Reference Station*	O	MAFF		48 30.00 N 08 00.00 W	
605	Celtic Deep		O	MAFF		51 15.00 N 06 00.00 W	
615	Severn	Nash Point <sup>1</sup>	I	MAFF/NRA	SS 920 568	51 18.00 N 03 33.00 W	
<b>Welsh</b>							
625	Severn	Old Severn Rail Bridge	E	NRA	ST 672 042	51 50.17 N 02 27.95 W	
635	Severn	No 1 Beacon	E	NRA	ST 514 849	51 33.60 N 02 42.05 W	
645	Severn	English & Welsh Grounds	E	NRA	ST 304 727	51 26.89 N 03 00.10 W	
655	Cardigan Bay		I	MAFF/NRA	SN 519 756	52 21.50 N 04 10.50 W	
665	Off Cardigan Bay		O	MAFF		52 30.00 N 05 00.00 W	
675	Dee	Hawarden Bridge	E	NRA	SJ 312 694	53 13.01 N 03 01.82 W	
685	Dee	U/S Flint	E	NRA	SJ 269 725	53 14.65 N 03 05.73 W	
695	Dee	Buoy No 2	E	NRA	SJ 200 825	53 19.98 N 03 12.08 W	
<b>North West</b>							
705	Liverpool Bay	Burbo Bight	I	MAFF/NRA	SJ 164 980	53 28.29 N 03 15.58 W	
715	Liverpool Bay		O	MAFF		53 30.00 N 03 41.50 W	
725	Mersey	Monks Hall	E	NRA	SJ 593 875	53 22.95 N 02 36.71 W	
735	Mersey	Runcorn Old Quay	E	NRA	SJ 514 836	53 20.80 N 02 43.80 W	
745	Mersey	Brombrough E1 Buoy	E	NRA	SJ 365 825	53 20.11 N 02 57.22 W	
755	Mersey	Seacombe Ferry	E	NRA	SJ 330 908	53 24.56 N 03 00.48 W	
765	Mersey	Mersey Chnl C1 Buoy	E	NRA	SD 240 044	53 31.83 N 03 08.80 W	
775	Irish Sea		O	MAFF		53 37.50 N 04 30.00 W	
785	Off Lune/Wyre		I	MAFF/NRA	SD 317 523	53 57.70 N 03 02.50 W	
795	Off Morecambe Bay		O	MAFF		53 58.00 N 03 20.00 W	
805	SE Isle of Man		O	MAFF		54 00.00 N 03 50.00 W	
<b>Northern Ireland</b>							
815	Dundrum Bay	IS2	O	DANI		54 04.00 N 05 30.00 W	
825	Belfast Lough	IS1	I	DOE(NI)		54 44.00 N 05 36.00 W	
835	Belfast Lough	BL3	E	DOE(NI)	J 376 794 <sup>2</sup>	54 38.69 N 05 52.10 W	
845	Belfast Lough	BL5	E	DOE(NI)	J 415 825 <sup>2</sup>	54 40.10 N 05 48.40 W	
855	Belfast Lough	BL6	E	DOE(NI)	J 477 869 <sup>2</sup>	54 42.35 N 05 42.50 W	
865	N Channel Offshore	NC2	O	DANI		55 04.99 N 05 53.12 W	
875	N Coast Offshore	NC1	O	DANI		55 20.00 N 06 35.00 W	

\* To be monitored when practical.

<sup>1</sup> This point is shared with Welsh Region

<sup>2</sup> Irish Grid Reference

Type of Station:	E	Estuarial	W	Water sampling	B	Alternative site for Benthos
	I	Intermediate	S	Sediment sampling		sampling
	O	Offshore	F	Fish/Shellfish sampling		

(where omitted, all matrices are sampled)

## **Appendix 2**

### **Guidance on Analytical Methods**

The list of determinands and matrices in the National Monitoring Plan is based on those for ICES and the North Sea Task Force. Consequently much of the advice on sampling strategy is contained in documents produced by those organisations and the Joint Monitoring Group. For the NMP to be successful it is important that participants adopt sampling and analytical methodology which are capable of producing real, not "less than", concentration data. The list below is not exhaustive but it provides an initial source of information on specific methodology.

#### **Metals in Sea Water (Cd, Cu, Pb, Zn, Hg) and Metals in Biota (Hg, Cd, Pb, As, Zn)**

Harper, D.J., Fileman, C.F., May, P.V. and Portmann, J.E. (1989). Methods of analysis for trace metals in marine and other samples. MAFF Aquatic Environmental Protection: Analytical Methods, Number 3 1989.

#### **Metals in Sea Water (Cd, Cu, Pb, Zn, Ni)**

Danielsson, L.-G, Magnusson, B., Westerlund, S. and Zhang, K. (1982) Trace metal determinations in estuarine waters by electrothermal atomic absorption spectrometry after extraction of dithiocarbamate complexes into Freon. *Analytica Chimica Acta*, 144, 183-188.

#### **Metals in Sea Water (Cr)**

Grasshoff, K., Ehrhardt, M., and Kremling, K. (1983) *Methods of Seawater Analysis*, Verlag Chemie

#### **Metals in Sediments**

Loring, D.H. and Rantala, R.T.T. (1990). Sediments and suspended particulate matter. Total and partial methods of digestion. ICES Techniques in Marine Environmental Sciences, No. 9.

#### **PCB's (Congeners 31,28,52,101,118,153,105,138,156,180) in Sediments and Biota**

Allchin, C.R., Kelly, C.A. and Portmann, J.E. (1989). Methods of analysis for chlorinated hydrocarbons in marine and other samples. MAFF Aquatic Environment Protection: Analytical Methods, No.6.

#### **PAH's in Sediment and Biota**

Recommended determinands are listed in Annex 1 of the North Sea Task Force Monitoring Master Plan (1990), North Sea Environment Report No. 3.

Law, R.J., Fileman, T.W. and Portmann, J.E. (1988). Methods of analysis of hydrocarbons in marine and other samples. MAFF Aquatic Environment Protection: Analytical Methods, No. 2.

#### **Alpha and Gamma HCH, Dieldrin, Aldrin, Endrin, DDT, HCB**

As for PCB's.

#### **Volatile Organochlorines**

HMSO. (1985). Chlorobenzenes in water, organochlorine insecticides and PCB's in turbid waters, halogenated solvents and related species in sewage sludge and water.

#### **Nutrients in Sea Water, Dissolved Oxygen, Suspended Solids, Particulate Organic Carbon and Chlorophyll a**

Head, P.C. (1985). *Practical estuarine chemistry*, Cambridge University Press.

Grasshoff, K., Erhardt, M. and Kremling, K. (1983). *Methods of sea water analysis*, Verlag Chemie.

### Other Useful References

ICES publications in the "Techniques in Marine Environmental Sciences" series:

1. Cadmium and lead: Determination in organic matrices with electrothermal furnace atomic absorption spectrophotometry.
2. Trace metals in sea water: Sampling and storage methods.
3. Cadmium in marine sediments: Determination by graphite furnace atomic absorption spectroscopy.
4. Lipophilic organic material: An apparatus for extracting solids used for their concentration from sea water.
5. Primary production: Guidelines for measurements by  $^{14}\text{C}$  incorporation.
6. Quality control procedures: Good laboratory practice and quality control.
7. Suspended particulate matter: collection methods for gravimetric and trace metal analysis.
8. Soft bottom macrofauna: Collection and treatment of samples.
9. Sediments and suspended particulate matter: Total and partial methods of digestion (with a videotape).
10. Organic halogens: Determination in marine media of adsorbable, volatile, or extractable compound totals.
11. Biological effects of contaminants: Oyster (*Crassostrea gigas*) embryo assay.
12. Hydrocarbons: Review of methods for analysis in sea water, biota and sediments.

Cruz, I. and Wells, D.E. (1992) "Determination of pentachlorophenol by exhaustive methylation and capillary gas chromatography in sewage sludge, contaminated water and suspended particulates".

Principles and Methodology of JMP. Monitoring Manual of the Oslo and Paris Commissions, OSPARCOM 9/11/1.



## **Appendix 3**

# **Data Reporting Format**

### **Presentation of Data**

Data should be forwarded to the NMP Database Coordinator *[addresss to follow]* on 3.5in diskettes MSDOS formatted and in ASCII format. Diskettes should be forwarded within 2 months of the end of the period reported.

The NMP is following ICES data formats as far as possible. ICES requires that all records be 120 columns.

This appendix describes the record layout of the various types of record required for the NMP database, ie field lengths and contents. It does not pretend to be a data form that is convenient for an analyst to complete. It is expected that laboratories and reporting institutes will be able to obtain output in the required form from their own various systems.

Table 1, listing determinands, matrices and units, allows for two sets of units; conventional units, which will be used in any reports from the database, to be entered in floating point form, and the units used for reporting to ICES, to be entered in Scientific format. The database can cope equally well with either set, but NOT in the same data file. If, therefore, a reporting institute wishes to use both formats, it may do so in separate data files.

### **File Names**

File names should be: the 4-letter Reporting Institute Code (Table 3.1), followed by the date of the last record included, in MMYYY format, with the extension .F if in conventional units in Floating point, and .S if in ICES units in Scientific.

Thus a file from Reporting Institute ABUK including data up to December 1993 in ICES units would be ABUK1293.S

### **Record Types**

There are three fundamentally different types of record, Methods Records, Data Records and Comments Records.

**Comments Records** are inserted into the file immediately after the record on which they are commenting. If they are used at all, they can therefore be put in anywhere.

**Methods Records** describe how things are done; analytical methods, methods of taking and preserving samples etc. They define a method to such an extent that a record giving information on a monitoring measurement need refer only to a code and not have to describe analytical and/or sampling methods in full. Methods Records should be updated at the beginning of each year.

**Data Records** give information either about a sample or sub-sample or about the determinand values obtained from analysis.

Methods Records and Data Records can be mixed together in one file if the reporting institute so wishes, but it is likely to be more convenient for both data providers and data handlers of they are kept separate.

## **Records Required**

### **Seawater**

**Methods Records:**      Determinand Analytical Methods Record  
                                 Oyster Embryo Bioassay Methods Record

One for each method of analysing each determinand by each analytical laboratory used by each reporting institute.

**Data Records:**            Sample Master Record  
                                 Determinand Data Record

One Sample Master Record for each sample taken. One Determinand Data Record for each determinand measured; refers back to the Sample Master Record and the appropriate Methods Record. It is preferable that all data records referring to a master record should immediately follow it.

### **Sediment**

**Methods Records:**      Determinand Analytical Methods Record  
                                 Oyster Embryo Bioassay Methods Record  
                                 Sampling Methods Record

One Determinand Analytical Methods Record or Oyster Embryo Bioassay Methods Record for each method of analysing each determinand by each analytical laboratory used by each reporting institute. One Sampling Methods Record for each sampling method (eg relating to sampler type etc) used by each reporting institute.

**Data Records:**            Sample Master Record  
                                 Determinand Data Record or Benthic Macrofauna Data Record

One Sample Master Record for each sample taken. One Determinand Data Record for each determinand measured, and/or one Benthic Macrofauna Data Record for each species observed; refers back to the Sample Master Record and the appropriate Sampling Methods Record and Determinand Analytical Methods Record or Oyster Embryo Bioassay Methods Record. It is preferable that all data records referring to a master record should immediately follow it.

### **Fish/Shellfish**

**Methods Record:**        Determinand Analytical Methods Record

One for each method of analysing each determinand by each analytical laboratory used by each reporting institute.

**Data Records:**            Sample Master  
                                 Record Specimen/Sub-sample Data Record  
                                 Tissue Data Record  
                                 Determinand Data Record

One Sample Master Record for each sample taken. One Specimen/Sub-sample Data Record for each individual or sub-sample analysed; refers back to the Sample Master Record. One Tissue Data Record for each tissue sample taken from each individual or sub-sample; refers back to Specimen/Sub-sample record and to Sample Master Record. One Determinand Data Record for each determinand measured; refers back to the Tissue Data Record, the Specimen/Sub-sample Record and the Sample Master Record and the appropriate Sampling Methods Record and Determinand Analytical Methods Record. It is preferable that all data records referring to a tissue record should immediately follow it, all groups of tissue record plus determinand data records should immediately follow their Specimen/Sub-sample record etc.

## **Record Format**

Detailed descriptions of the various records follow.

# Determinand Analytical Methods Record

Column: Start	Data	Status	Field	Notes
1	3	3	"21C" M	Record Ident
4	1	A	M	Matrix
5	8	4	A	M Reporting Institute
9	12	4	A	M Analytical Lab.
13	14	2	A	M Monitoring Year
15	19	4	A	M Determinand Code
20	21	2	0	M Analytical Methods Link
22	23	2	A	M Method of collection
24	25	2	A	M Method of pre-treatment
26	29	4	A	M Method of extraction
30	1	0	M	Condition
31	32	2	A	M Method of Storage or Separation
33	35	3	A	M Method of Analysis
36	1	A		Wet or Dry Weight
37	45	9	X	Det. Limit Value
46	47	2	A	Last Intercomparison
48	81			Control Chart reference material data, as follows:
48	50	3	A	Basis
51	58	8	A	Ref. Material code
59	1	A		Basis for Mean value
60	68	9	X	Mean value
69	77	9	X	Standard Deviation
78	79	2	0	Number of measurements
80	81	2	0	Reference Period
82	120		B	

## NOTES:

**Data:** A = Alphanumeric; Left justify, blank fill

B = Blank

0 = Whole Number; Right justify and zero fill

X = Number in Scientific or Floating Point format  
(do NOT mix formats within one data file)

**Scientific:** present as udddExxx in units specified in the footnote to Table 1

where u = a single non-zero units digit

dddd = four decimals

E appears as "E"

xxx is the exponent: "-" and 2 digits

or 3 positive digits

zero-fill where necessary, eg 12.34 mg/kg = 1.234E-2 g/kg; represented as 12340E-02

**Floating point:** 9-column number in units specified in Table 1,

decimal point occupying one column (even if the value is a whole number)

left justified and blank-filled

**Status:** M = Mandatory in NMP database for appropriate matrices

blank = complete field if known; else leave blank

**"User Defined":** Each Analytical Laboratory to define its own codes for the methods it uses and to provide the NMP with descriptions.

# Oyster Embryo Bioassay Methods Record - for Sediment or Water

Column: Start	Data End	Status No.	Field	Notes
1	3	3	"23E" M Record Ident	
4	1	A	M Matrix	W=Water; S=Sediment
5	8	4	A M Reporting Institute	See Table 3.1
9	12	4	A M Analytical Lab.	See Table 3.1
13	14	2	0 M Monitoring Year	
15	19	4	A M Determinand Code	See Table 1
20	21	2	0 M Analytical Methods Link	Identifies a method of analysing this Determinand - [to be provided; until then, treat as User defined]
22	1	A	M Origin of Elutriation water	<b>Sediment:</b> O=Offshore; L=Local; A=Artificial X=other (specify on comment record) Water: Leave blank
23	25	3	2 M Dry Sediment/Elutriation water ratio	<b>Sediment:</b> ml/ml Water: Leave blank
26	27	2	0 M Elutriation duration	<b>Sediment:</b> hours of "shaking" Water: Leave blank
28	30	3	A M Method of Bioassay	If as TIMES No. 11, enter "T11", else 3-letter code [User Defined]
31	38	8	A M RUBIN code	
39	40	2	A M Origin of oysters	HC = Hatchery Conditioned; LW = Local Wild stock; OW = Other
41	42	2	0 M Month oysters collected	Month number
43	1	A	M Conditioning	L = lab conditioned; else leave blank
44	1	A	M Source of ref. water	O, L, A, X (see col 22, above)
45	47	3	0 M Mean live weight	grams
48	49	2	0 M No of control replicates	
50	51	2	0 M No of sample replicates	
52	54	3	1 M Vol of egg suspension	added to each replicate, in ml
55	1	A	M Aeration of replicates?	Y or N
56	58	3	0 M Storage of embryos	days stored in preservative before counting; blank if counted live
59	120			Leave blank

## NOTES:

**Data:** A = Alphanumeric; Left justify, blank fill  
 B = Blank  
 0,1,2 = Fixed Point Number with the given number of decimals  
 Align the point correctly, but do not enter it, and zero fill.  
 eg, to enter the value 1.2 into a 4-column field with Data=2, enter 0120.

**Status:** All fields in this record are Mandatory in NMP database for appropriate matrices

**"User Defined":** Each Analytical Laboratory to define its own codes for the methods it uses and to provide the NMP with descriptions.

# Sediment Sampling Methods Record

Column: Start	Data End	Status No.	Field	Notes
1	4	4	"21CS" M	Record Ident
5	6	2	"74" X	Country Code
7	10	4	A M	Reporting Institute
11	12	2	0 M	Monitoring Year
13	14	2	A M	Sampling Methods Link
15	16	2	A M	Sampler Type
17	19	3	0	Sampler Diameter
20	21	2	A	Method of Storage/Preservation
22	23	2	A	Grain Size Analysis Method
24	25	2	A	Sample Structural Analysis Method
26	120			

74=UK

See Table 3.1

2-letter code unique for method within reporting institute

GS=Grab Sample; BC=Box Corer; VC=Vibro Corer;

DC=Driver-operated Corer; DD=Drilling Device

OS=Other Sampling device

in mm

[User defined]

[User defined]

[User defined]

Leave blank

## NOTES:

**Data:** A = Alphanumeric; Left justify, blank fill  
 B = Blank  
 0 = Whole Number; Right justify and zero fill

**Status:** M = Mandatory in NMP database  
 X = Not used in NMP database, but may be needed for other databases  
 blank = complete field if known; else leave blank

**"User Defined":** Each Analytical Laboratory to define its own codes for the methods it uses and to provide the NMP with descriptions.

# Sample Master Record

Column: Start	Data End	Status No.	Field	Notes
1	2	2	"01" M Record type	
3	1	A	M Measurement type	C=contaminant, E=biological, X=both
4	1	A	M Matrix	W=Water; S=Sediment; F=Fish/Shellfish
5	8	4	A M Reporting Institute	See Table 3.1
9	10	2	0 M Monitoring Year	
11	14	4	0 M Sequence No	of samples reported by this institute this year for this matrix
15	16	2	"74" X Country Code	74=UK
17	18	2	A Ship code	[to be provided if wanted]
19	22	4	A Cruise ID	
23	28	6	D M Sampling Date	in YYYYMMDD format (DD=00 if not reported)
29	32	4	D Sampling Time	HHMM 24-hour (MM=00 if not reported)
33	34	2	0 M Latitude, °N	
35	38	4	2 M Latitude, 'N	minutes to 2 decimals, not minutes and seconds
39	44	6	2 M Longitude °, '	as cols 33-38
45	1	A	M Longitude	E or W
46	54	9	A X JMP area	but mandatory if in JMP network
55	59	5	A X ICES rectangle	[can be calculated if needed]
60	64	5	A M NMP station code	2-digit ID given in Appendix 1
65	72	8	A M Species RUBIN code	<b>Fish/Shellfish only</b> Water or Sediment: Leave blank
73	75	3	0 M No of specimens in sample	<b>Fish/Shellfish only</b> Water or Sediment: Leave blank
76	79	4	0 Water depth	in metres
80	82	3	0 Length of core	<b>Sediment:</b> in cms. Leave blank for box core samples etc Water or Fish/Shellfish: Leave blank
83	85	3	0 Est. sedimentation rate	<b>Sediment:</b> mm/yr Water or Fish/Shellfish: Leave blank
86	87	2	A M Sampling Method Link	<b>Sediment:</b> Copy from appropriate Sampling Methods Record Water or Fish/Shellfish: Leave blank
88	92	5	A M Data go to:	I=ICES; J=JMP; B=BMP; M=NSTF MMP
93	97	5	A X Purposes	S=Spatial, T=Trends, B=Biological effects if appropriate
98	120		B	Leave blank

## NOTES:

- Data:**
- A = Alphanumeric; Left justify, blank fill
  - B = Blank
  - 0,1,2 = Fixed Point Number with the given number of decimals  
Align the point correctly, but do not enter it, and zero fill.  
eg, to enter the value 1.2 into a 4-column field with Data=2, enter 0120.
  - D = Date or time; use format given in Notes for field.
- Status:**
- M = Mandatory in NMP database for appropriate matrices
  - X = Not used in NMP database, but may be needed for other databases
  - blank = complete field if known; else leave blank

# Fish/Shellfish Specimen/Sub-sample Data Record

Column: Data Status Field					Notes
Start End No.					
1	2	2	"04"	M	Record type
3		1	A	M	Measurement type (Copy from Sample Master record)
4		1	"F"	M	Matrix F=Fish/Shellfish
5	8	4	A	M	Reporting Institute (Copy from Sample Master record)
9	10	2	0	M	Monitoring Year (Copy from Sample Master record)
11	14	4	0	M	Sequence No (Copy from Sample Master record)
15		1	A	M	Individual/Bulk I=Individual; H=all specimens homogenised; B=some specimens bulked
16	17	2	0	M	Sub-sample no. sub-sample or individual within sample covered by master record
18	25	8	B		Leave blank
26	28	3	0	M	No of individuals in sub-sample; 001 if 1 individual
29	33	5	0	M	Minimum length in mm. Blank if individual
34	38	5	0	M	Maximum length Blank if individual
39	43	5	0	M	Mean length Actual length if individual
44	48	5	0	M	SD of length Blank if individual
49	54	6	1		Minimum weight in gm
55	60	6	1		Maximum weight
61	66	6	1		Mean/Actual weight
67	72	6	1		SD of weight
73		1	A		Sex M,F or X=mixed, I=immature, H=hermaphrodite
74	75	2	0		Minimum age in years
76	77	2	0		Maximum age
78	79	2	0		Mean/Actual age
80		1	A		Condition estimate R=ripe, able to spawn; M=maturing gonads; U=undeveloped gonads
81	85	5	2		Gonad weight in gm
86	89	4	1		Shell weight in gm
90	120				Leave blank

## NOTES:

- Data:** A = Alphanumeric; Left justify, blank fill  
 B = Blank  
 0,1,2 = Fixed Point Number with the given number of decimals  
 Align the point correctly, but do not enter it, and zero fill.  
 eg, to enter the value 1.2 into a 4-column field with Data=2, enter 0120.
- Status:** M = Mandatory in NMP database  
 blank = complete field if known; else leave blank



# Fish/Shellfish Tissue Data Record

Column: Start	Data	Status	Field	Notes
1	2	2	"07"	M Record type
3		1	A	M Measurement type C, E or X (copy from Sample Master Record)
4		1	"F"	M Matrix F=Fish/Shellfish
5	8	4	A	M Reporting Institute (copy from Sample Master Record)
9	10	2	0	M Monitoring Year (copy from Sample Master Record)
11	14	4	0	M Sequence No (copy from Sample Master Record)
15		1	A	M Individual/Bulk (copy from Specimen/Sub-sample Record)
16	17	2	0	M Sub-sample no. (copy from Specimen/Sub-sample Record)
18	25	8	B	Leave blank
26	27	2	A	M Tissue analysed SB = shellfish whole soft tissue MU = Fish Muscle; LI = Fish Liver
28	33	6	2	Mean/Actual weight per individual, of tissue taken (NOT tissue analysed) in grams
34	37	4	2	M % dry weight
38	41	4	2	M % extractable lipids
42		1	A	Extractable lipids method code <i>[User defined]</i>
43	46	4	2	M % fat total lipids
47	120			Leave blank

## NOTES:

**Data:** A = Alphanumeric; Left justify, blank fill  
 B = Blank  
 0,1,2 = Fixed Point Number with the given number of decimals  
 Align the point correctly, but do not enter it, and zero fill.  
 eg, to enter the value 1.2 into a 4-column field with Data=2, enter 0120.

**Status:** M = Mandatory in NMP database  
 blank = complete field if known; else leave blank

**"User Defined":** Each Analytical Laboratory to define its own codes for the methods it uses and to provide the NMP with descriptions.

# Determinand Data Record

Column: Start	Data End	Status	Field	Notes
1	2	2	"10" M Record type	
3	1	A	M Measurement type	C, E or X (copy from Sample Master Record)
4	1	A	M Matrix	W=Water; S=Sediment; F=Fish/Shellfish
5	8	4	A M Reporting Institute	(copy from Sample Master Record)
9	10	2	0 M Monitoring Year	(copy from Sample Master Record)
11	14	4	0 M Sequence No	(copy from Sample Master Record)
15	1	A	M Individual/Bulk	Fish/Shellfish: copy from Specimen/Sub-sample Record Water or Sediment: Leave blank
16	17	2	0 M Sub-sample no.	Fish/Shellfish: copy from Specimen/Sub-sample Record Water or Sediment: consecutive within sample
18	25	8	B	Leave blank
26	27	2	A M Matrix analysed	Water: BF=Unfiltered; AF=Filtered Sediment: US=Unfractionated; FS=fractionated Fish/Shellfish: SB, MU or LI, copied from Tissue Data Record
28	32	5	A M Determinand Code	See Table 1
33	1	A	Validity Flag	If QC checks made: A=acceptable; S=considered Suspect by originator Q=considered suspect by someone else; R=replaced; M=missing >, < or blank
34	1	A	Qualifier	
35	43	9	X M Value	
44	1	A	M Wet or Dry Weight	Fish/Shellfish: W or D Water or Sediment: Leave blank
45	48	4	0 M Size fraction	Sediment: max size in microns; should be <=2 Water or Fish/Shellfish: Leave blank
49	50	2	0 Replicate no.	Water or Sediment: on same sub-sample Fish/Shellfish: on same individual/sub-sample and tissue
51	54	4	1 Percentage recovery	Fish/Shellfish: % recovery of standard Water or Sediment: Leave blank
55	56	2	0 Analytical Methods Link	as on the Contaminant Analytical Methods Record for the method used in this analysis
57	60	4	A M Analytical Lab. Code	for lab. doing analysis. See Table 3.1
61	120	B		Leave blank

## NOTES:

**Data:** A = Alphanumeric; Left justify, blank fill

B = Blank

0 = Whole Number; Right justify and zero fill

X = Number in Scientific or Floating Point format  
(do NOT mix formats within one data file)

**Scientific:** present as udddExxx in the units specified in the footnote to Table 1

where u = a single non-zero units digit

dddd = four decimals

E appears as "E"

xxx is the exponent, "-" and 2 digits

or 3 positive digits

zero-fill where necessary, eg 12.34 mg/kg = 1.234E-2 g/kg; represented as 12340E-02

**Floating point:** 9-column number in units specified in Table 1,

decimal point occupying one column (even if the value is a whole number)

left justified and blank-filled

**Status:** M = Mandatory in NMP database for appropriate matrices

blank = complete field if known; else leave blank

**Columns 1 - 25** are identical for all determinands for any one sample or sub-sample,  
and can be copied across from one record to the next.

**Columns 44** onwards are likely to be identical for all determinands for any one sample or sub-sample,  
in which case they can be copied across from one record to the next.

# Benthic Macrofauna Data Record

(To be designed by the Group Coordinating Sea Disposal Monitoring, who will be considering the following fields for inclusion in the record.)

Column:	Data	Status	Field	Notes
Start	End	No.		
1	2	2	"11" M Record type	
3		1	A M Measurement type	C, E or X (copy from Sample Master Record)
4		1	"S" M Matrix	W=Water; S=Sediment; F=Fish/Shellfish
5	8	4	A M Reporting Institute	(copy from Sample Master Record)
9	10	2	0 M Monitoring Year	(copy from Sample Master Record)
11	14	4	0 M Sequence No	(copy from Sample Master Record)
			A M Sieve Size	1 = 1 mm; 0 = 0.5 mm
			A M Species NODC Code	
			0 M Number of Individuals	
			M Biomass	grams
			M Median phi	
			M Mean phi	
			M Sorting Coefficient	
			M Inclusive Graphic Skewness	
			M Percentage silt and clay (<63 µm)	
			B Leave blank	

## NOTES:

**Data:** A = Alphanumeric; Left justify, blank fill  
 B = Blank  
 0 = Whole Number; Right justify and zero fill

**Status:** M = Mandatory in NMP database for appropriate matrices  
 blank = complete field if known; else leave blank

**Columns 1 - 15** are identical for all species for any one sample/sieve size, and can be copied across from one record to the next.

## Comments Record

If a comment is needed, the comments record should go immediately after the record the comment is about.

Remember to say which field is being commented on.

Column:		Data	Status	Field	Notes
Start	End	No.			
1	2	2	"13"	M	Record type
3	7	5	B		Leave blank
8	87	80	A	M	Comment
88	120		B		Use additional comment records if necessary

**Table 3.1*****Reporting Institute & Analytical Laboratory Codes***

Code	Institute/Lab.
ALUK	SOAFD, Aberdeen
ASUK	Aquatic Science Research Division, DANI
AWUK	NRA Anglian
BLUK	MAFF, Burnham-on-Crouch
CRUK	Clyde RPB
DMUK	Dunstaffnage Marine Lab.
DOUK	MAFF, Weymouth
FRUK	Forth RPB
HGUK	Humber Estuary Management Group
HLUK	Harwell Lab.
ISUK	Industrial Science Centre
MAFL	MAFF, Lowestoft
NRUK	NRA Northumbrian
NWUK	NRA North West
PLUK	SOAFD, Pitlochry
PMLK	Plymouth Marine Lab.
STUK	NRA Severn-Trent
SWUK	NRA Southern
SWWK	NRA South West
TWUK	NRA Thames
WLUK	NRA Welsh
WRCK	Water Research Centre, Medmenham
YWUK	NRA Yorkshire

**Table 3.2**

## ***Sediment Extraction Method Codes***

### ***Inorganic contaminants***

- HCl - Extraction with dilute HCl.
- HAC - Extraction with acetic acid.
- HNO - Extraction with 1:1 HNO<sub>3</sub>.
- HHC - Extraction with HNO<sub>3</sub>, pressure digestion.
- AQR - Extraction with 'aqua regia' (HNO<sub>3</sub>:HCl = 1:3)
- SAD - Extraction with a mixture of strong mineral acids without HF (eg HClO<sub>4</sub> and/or H<sub>2</sub>SO<sub>4</sub> in addition to HNO<sub>3</sub>).
- HFO - 'Total' digestion with mineral acids including HF, in open vessels, evaporation of excess HF before analysis.
- HFC - as HFO above, but with digestion performed in closed vessels (pressurised decomposition)
- HFB - as HFC above, but with complexation of excess HF with H<sub>3</sub>BO<sub>3</sub>.
- ALK - Alkaline fusion digestion.
- SCE - Selective chemical extraction of metal species in particulate phases (e.g. by hydroxylamine, oxalate, H<sub>2</sub>O<sub>2</sub>, dithionite, ammonium acetate); define procedure(s) in plain language comment record(s).

### ***Organic contaminants***

- EXP - Extraction of organic contaminants by shaking with polar solvents.
- EXN - Extraction of organic contaminants by shaking with non-polar solvents.
- EXC - Extraction of organic contaminants by continuous treatment in a Soxhlet or similar apparatus.
- EXH - Separation of organic contaminants from sediment slurries using water steam distillation.
- EXO - Other principles of extraction/separation of organic contaminants from sediment samples: define procedure(s) in plain language comment record(s).

The method of sediment extraction code is a four character code.

The first three characters are as above; the fourth is a user defined code to describe the particular variant of the specified general method.

**Table 3.3****Intercomparison Exercise Codes**

<b>I/C type</b>	<b>Code</b>	<b>Intercomparison exercise</b>
Trace metals in biota	1A	ICES First Intercomparison Exercise on Trace Metals in Biological Tissue - 1972 - (1/TM/BT)
	1B	ICES Second Intercomparison Exercise on Trace Metals in Biological Tissue - 1975 - (2/TM/BT)
	1C	ICES Third Intercomparison Exercise on Trace Metals in Biological Tissue - 1975 - (3/TM/BT)
	1D	ICES Fourth Intercomparison Exercise on Trace Metals (Cadmium and Lead only) in Biological Tissue - 1977 - (4/TM/BT)
	1E	ICES Fifth Intercomparison Exercise on Trace Metals in Biological Tissue - 1978 - (5/TM/BT)
	1F	ICES Sixth Intercomparison Exercise on Trace Metals (Cadmium and Lead only) in Biological Tissue - 1979 - (6/TM/BT)
	1G	ICES Seventh Intercomparison Exercise on Trace Metals in Biological Tissue - Part A - 1983 - (7/TM/BT:A)
	1H	ICES Seventh Intercomparison Exercise on Trace Metals in Biological Tissue - Part B - 1985 - (7/TM/BT:B)
	1Z	Other Incomparision/Intercalibration Exercise on Trace Metals in Biological Tissue - Describe in comments
Organochlorines in biota	2A	ICES First Intercomparison Exercise on Organochlorines in Biological Tissue (Sample Nos. 2A, 2B) - 1972 - (1/OC/BT)
	2B	ICES Second Intercomparison Exercise on Organochlorines in Biological Tissue (Sample Nos. 3A, 3B) - 1974 - (2/OC/BT)
	2C	ICES Third Intercomparison Exercise on Organochlorines in Biological Tissue (Sample No. 4) - 1978 - (3/OC/BT)
	2D	ICES Fourth Intercomparison Exercise on Organochlorines (mainly PCBs) in Biological Tissue (Sample No. 5) - 1979 - (4/OC/BT)
	2E	ICES Fifth Intercomparison Exercise on Organochlorines (PCBs only) in Biological Tissue - 1982 - (5/OC/BT)
	2F	ICES Sixth Intercomparison Exercise on Organochlorines (PCBs only) in Biological Tissue - 1985 - (6/OC/BT)
	2G	ICES/IOC Seventh Intercomparison Exercise on Organochlorines (individual chlorobiphenyl congeners) in Biological Tissue - Phase 1, analysis of standard solutions - 1989 - (7/OC/BT:1)
	2H	ICES/IOC Seventh Intercomparison Exercise on Organochlorines (individual chlorobiphenyl congeners) in Biological Tissue - Phase 2 - 1991 - (7/OC/BT:2)
	2Z	Other Intercomparison/Intercalibration Exercise on Orgaonchlorines in Biological tissue - Describe in comments
Petroleum Hydrocarbons in biota	3A	ICES First Intercomparison Exercise on Petroleum in Hydrocarbon Analysis in Marine Samples -1982- (1/HC/BT) biota
	3B	ICES/IOC Second Intercomparison Exercise on the Determination of Petroleum Hydrocarbons in Biological Tissue (mussel homogenate) - (2/HC/BT)
	3C	ICES Third Intercomparison Exercise on PAHs in Biological Tissue: Phase 1, analysis of standard solution mixtures - 1989 - (3/HC/BT:1)
	3Z	Other Intercomparison/Intercalibration Exercise on Petroleum Hydrocarbons in Biological Tissue - Describe in comments

<b>I/C type</b>	<b>Code</b>	<b>Intercomparison exercise</b>
Trace metals in seawater	4A	ICES First Round Intercalibration for Trace Metals in Standard Solutions - 1976 - (1/TM/SW)
	4B	ICES Second Round Intercalibration for Mercury in Sea Water - 1976 - (2/TM/SW)
	4C	ICES Third Round Intercalibration for Trace Metals in Sea Water - 1977 - (3/TM/SW)
	4D	ICES Fourth Round Intercalibration for Trace Metals in Sea Water - 1978 - (4/TM/SW)
	4E	ICES/JMG Intercalibration for Mercury in Sea Water 1970 - (ICES/JMG/1/CD/SW)
	4F	ICES/JMG Intercalibration for Cadmium in Sea Water - 1979 - (ICES/JMG/1/HG/SW)
	4G	ICES Fifth Round Intercalibration for Trace Metals in Sea Water - Section 3, analyses for Cd, Cu, Fe, Ni, Mn, Pb and Zn - 1982/83 - (5/TM/SW:3)
	4H	ICES Fifth Round Intercalibration for Trace Metals in Sea Water - Section 4, analysis for Hg - 1983 - (5/TM/SW:4)
	4I	JMG Intercalibration for Trace Metals in Estuarine Waters - 1986
	4Z	Other Intercomparison/Intercalibration for Trace metals in Estuarine Waters - 1986
Organochlorines in seawater	5A	JMG Intercalibration on Analyses of PCB's in Sea Water - 1981
	5Z	Other Intercomparison/Intercalibration Exercise on Organochlorines in Sea Water - Describe in comments
Nutrients in seawater	6A	Fourth ICES Intercomparison Exercise on Nutrients in Sea Water - 1989 - (4/NU/SW)
	6Z	Other Intercomparison/Intercalibration Exercise on Nutrients in Sea Water - Describe in comments
Trace metals in sediments	7A	First JMG Intercalibration Exercise on Trace Metals in Marine Sediments - 1980
	7B	Second JMG Intercalibration Exercise on Trace Metals in Marine Sediments - 1983
	7C	Baltic Sediment Intercalibration Exercise - Part A - 1983
	7D	Baltic Sediment Intercalibration Exercise - Part B - 1984
	7E	ICES First Intercalibration Exercise on Trace Metals in Marine Sediments - 1984 - (1/TM/MS)
	7Z	Other Intercomparison/Intercalibration Exercise on Trace Metals in Marine Sediments - Describe in comments
Organochlorines in sediments	8A	JMG Intercalibration on Analyses of PCBs in Sediments - 1987
	8B	ICES/OSPARCOM First Intercomparison Exercise on Organochlorines (individual chlorobiphenyl congeners) in Marine Sediments - Phase 1, analysis of standard solutions -1989 - (1/OC/MS:1)
	8C	ICES/OSPARCOM First Intercomparison Exercise on Organochlorines (individual chlorobiphenyl congeners) in Marine Sediments - Phase 2 - 1991 - (1/OC/MS:2)
	8Z	Other Intercomparison/Intercalibration Exercise on Organochlorines in Marine Sediments - Describe in comments
Petroleum Hydrocarbons in sediments	9A	ICES Third Intercomparison Exercise on PAHs in Marine Sediments - Phase 1, analysis of standard solution mixtures - 1989 - (1/HC/MS:1)
	9Z	Other Intercomparison/Intercalibration Exercise on Petroleum Hydrocarbons in Marine Sediments - Describe in comments



## **Appendix 4**

# ***The Initial Spatial Survey***

### **Objectives of the Initial Spatial Survey**

1. Permit statistical comparison of the concentration of contaminants between sites (spatial distribution) and highlight areas with high concentrations of contaminants that are of concern and merit a trend survey.
2. Estimate the inherent variability in the recorded data in those areas whose concentrations of contaminants cause concern, arising from the natural variability of the determinands and from the methods used for sampling and analysis.
3. Compare biological effects between the various areas.

### **Introduction**

The sensitivity with which a monitoring programme can detect temporal or spatial differences in contaminant concentrations depends on the precision associated with the measurements, which derives in turn from the inherent variability (both spatial and temporal) of the population being sampled, the methods of extraction and preservation of samples, and the analytical process,

Knowledge of these variabilities enables decisions to be made on the number and frequency of samples to be taken for a trend survey and on when and where to sample most efficiently, as well as the significance of perceived differences between contaminant concentrations at different sites.

Limited information is already available in the literature on the likely magnitudes of these variabilities, but they depend on the specific sites, matrices and determinands being sampled and on the capabilities of the laboratories undertaking the analyses. Detailed, specific, information is available only in some instances.

The initial spatial study should therefore ideally be used to obtain enough data, either from previous surveys or by new monitoring, to enable the areas at risk to be identified so that statistical techniques can then be used to estimate the variability deriving from each source separately. This will comprise replicate sampling at and around a site with duplicate analyses in one or more laboratories as necessary.

Sampling of the water column is already sufficiently well established, either as a result of international agreements or by common practice, that it is possible to design an annual monitoring programme from the start. It is therefore proposed that the water monitoring programme described in annex 5 should be started as soon as possible and continued annually. The data will be reviewed after three years, with the sediment and biota data from this spatial study, to produce a revised annual monitoring programme, for water, sediments and biota.

## **Sampling strategy**

To obtain a meaningful spatial distribution of contaminant concentrations, the samples taken from each sampling site should truly represent the locality. Ideally, this requires not only replicate sampling at a point (which will tell how well the samples represent that point) but also sampling from different points within the locality. The precision of the estimate of a mean concentration will depend on the "field" and "analytical" variances associated with the measurements.

Although published information does not give a sufficiently accurate estimate of the variability to be expected as a result of the factors affecting the data in the database, there are some general indications that the field variance for metals is generally less than 20% in coastal and offshore sediments and about 30% in estuarine sediments, whereas in fish and shellfish, it is much higher, in the order of 50-150%. For organics, the variability is 20-50% in sediments and of the order of 150% in fish. Analytical variances tend to be generally less than 20% within a laboratory and up to 50% between laboratories for sediments and even more for fish and shellfish.

These high variabilities, and the uncertainties surrounding them, require several samples to establish a reasonably accurate estimate of a mean, or even to establish variances with enough precision to be able to design the trend monitoring survey efficiently. It can be calculated, for instance, that, if the above variances are correct, then 9 samples at each of two offshore points would be enough to establish statistical significance in the concentration of metals if the means differ by more than 12 per cent and they are analysed in the same laboratory. At the other end of the scale, there would have to be a difference of 81 per cent between the means of organic determinands measured at two offshore points analysed in different laboratories.

## **Sediments**

The NMP proposes that, when sampling sediments where insufficient data are available about the local spatial variability, 8 further samples should be taken at the corners and mid-points of a rectangular grid around the selected sampling point (see below). In the absence of suitable past data, the variability in data from the 9 points can provide an estimate of the reliability that can be placed on results from the site (simultaneously representing variability in the immediate locality of the site and of repeat samples at the same place) and thus of the site's suitability for the NMP.

For Benthic Macrofauna, information in the literature is even more limited than for contaminant measurements. ICES recommends [4] a minimum of five replicates. For the NMP, five samples, taken as near as possible from the centre and the corners of the grid, must be seen as an absolute minimum; if data are available on more replicates (eg from each of the 9 points on the sediment sampling grid), then all data should be forwarded to the NMP.

Sampling should be as described in section 7.2.

## **Intermediate and Offshore Sites**

In an offshore or intermediate site, where it can be assumed that the effect of contaminant inputs is diffuse and hydrodynamic processes are on a large scale, a sampling point will represent a wide area and the size of the area sampled should also be large. For the initial spatial survey, the intermediate and offshore sites in Appendix 1 should consist of a grid 500m square, with 9 sampling points symmetrically positioned at 250m intervals within.

## **Estuarine Sites**

At estuarine sites the representativeness of a sampling station will be affected by local inputs and hydrodynamic processes. The area covered by the initial survey will therefore be dictated by the need to avoid undue variability from these sources. The prevailing processes normally operate parallel to the longitudinal axis of the estuary. Thus, for the initial spatial survey, the estuarine sites in Appendix 1 should, unless local conditions dictate otherwise, be a grid whose major and minor axes are proportional to those of the section of estuary being monitored, and of length generally no less than 200m. There should be 9 sampling points symmetrically positioned in the grid.

## **Fish and Shellfish**

The species to be sampled are given in paragraphs 7.3 and 7.4. As contaminant concentrations vary with the size and age of the individual, it is important to keep as far as possible an even spread of sizes within the range specified in those paragraphs.

The field variance between biota samples is extremely large, 50-150%; upwards of 100 individuals are needed in a sample before the variance can be brought down to the order of those in sediments. The number of individuals that may reasonably be sampled, bearing in mind the narrow range of permissible sizes, limits the precision achievable. Reasonable sample sizes, as recommended by ICES, may be taken to be 25 for fish and 50 for shellfish, both less than ideal. It is not practicable to take fish or shellfish from 9 sampling points at and around any site, but it is recommended that the sediment sampling grid should be regarded, as near as possible, as a constraint for the sampling of fish and shellfish. Mussels should be taken from different parts of the area at random.

ICES recommends homogenisation of the relevant tissue from all individuals in a sample and splitting the homogenised sample into two for duplicate analysis, providing an estimate of variation between analyses within a laboratory. However, variation between analyses is well known in most laboratories and the ICES method does not allow estimates to be built up of the variances between individuals at any site - an equally important element in site-to-site comparisons and in the design of a temporal survey. For this it is necessary to divide samples of individuals into several pools, five pools giving both an element of flexibility and a reasonable opportunity to estimate the underlying individual-to-individual variability. Data from every site would thus contribute to the overall estimates of variability. Individuals should be allocated at random to the pools, with numbers per pool being as equal as possible.

The present, limited, information indicates that this sampling plan will provide estimates of mean concentrations with standard errors between 6% and 17% (shellfish) or between 8% and 22% (fish), if inter-laboratory differences are ignored. These estimates will be updated by the analysis of the data from the Spatial Survey.

If the number of individuals is less than 16, the accuracy of any estimate falls to unacceptable levels. Such data in the Spatial Survey can be used in estimating the components of variability, but not to give an estimate of concentrations of determinands in tissue.

### **Inter-Laboratory Differences**

For the analysis of sediments, it is clear that the inter-laboratory variability is critical to the precision of any results from the survey. For fish and shellfish, it is less so, but only because the variation between individuals is so great.

It would be unrealistic to delay the introduction of the NMP until all laboratories can be harmonised to the extent that variability among them is no longer a factor. It is therefore important to design a level of comparability into the spatial survey. Thus nearby sites (eg those in the same estuary and the associated intermediate and offshore sites) should ideally be analysed by the same laboratory. In addition, there should be some element of overlap, with different laboratories analysing some of the same samples, so that any bias between laboratories can be allowed for when comparing results.

In the annual monitoring programme, it will be essential that samples from any particular site are always analysed by the same laboratory or laboratories.

### **Analytical Quality Control**

All laboratories submitting data to the NMP will be expected to participate in the accompanying AQC programme organised by the NMAQC for the determinands and matrices for which they submit data. This will involve recurrent rounds of proficiency testing and periodic Workshops which will be held to train those unfamiliar with particular techniques and to investigate analytical problems with a view to making improvements in comparability. Links with other programmes such as ICES and QUASIMEME are also being developed, in order to reduce duplication for the laboratories involved in more than one programme and to receive feedback on performance and improved technology from these parallel programmes. Data submitted to the NMP from laboratories which either do not participate in the NMAQC or consistently perform poorly will be flagged in the database as unreliable, and in the future may not be accepted.

### **Frequency of Spatial Surveys**

The rate at which sediments or biota respond to changes in inputs depends not only on the changes themselves, but also on accumulation rates and mixing depths in the case of sediments, and on bioaccumulation factors and migration patterns in the case of biota. For seawater, the response to inputs may be quicker but is affected more readily by hydrographic factors; sampling of water will start immediately with the frequency given in Section 6.

Assuming accumulation rates between 0.5 and 10 mm per year and annual mixing depths between 10 and 100 mm for sediments, it can be calculated that a decrease of 50% in annual input of a determinand, maintained over time, will result in a change in the top cm of sediment of up to 5% in 1 year, 20% in 5 and 33% in 10.

Future spatial surveys will take place infrequently, either in response to concern about new compounds or to new concerns about existing compounds, eg when large increases in inputs or concentrations are suspected in determinands classified as not being of "special concern" in previous surveys.

## **Existing Data**

For many sites, some data are already available, although rarely to the standard proposed in this Plan. Discussions should take place with the MPMMG, who will be analysing the data from the spatial survey, to establish the extent to which existing data can be used in place of collecting fresh data. An important element in the decision will be the necessity for each site in the initial survey to contribute to the estimate of underlying variability, thus many of the requirements for fresh data, eg the link between benthos and sediment samples, will still be imperative. To be usable by the database, past data must be presented as set out in Appendix 3.

## **Timing of Survey**

Owing to the large amount of analysis required in the Spatial Survey, which will start in 1993/4, it is recommended that it take place over two years, sediments and benthos being sampled in the first year and fish and shellfish, including other biological effects, in the second. To allow time for benthos sampling in the initial spatial survey, if it has not already been done, the first year will be taken to be February 1993 - May 1994. Analysis should be completed within three years of the start of the survey. Water will be sampled and analysed each year, as in Appendix 5.

## **Design of Spatial Survey**

### **Samples**

Sampling of sediments and benthos will take place in the first year of the Spatial Survey. This will be taken to be February 1993 to May 1994 for the initial survey, ie benthos may be sampled in either 1993 or 1994. One sediment sample is to be taken from each point on a grid (see below).

Other biota sampling will take place in the second year of the Spatial Survey (1994/5 for the initial survey) and requires 25 fish and 50 shellfish in the acceptable size range to be taken, as far as possible, at random within the area of the sediment sampling grid (see below). Sampling methods are to be as in Section 7. If it is not possible to catch the required number of individuals, data on the individuals caught should still be provided so that they may contribute as well as they can to estimates of underlying variability.

The data required concerning the collection of samples are as in the Sediment Sampling Methods Record and the Sample Master Record in Appendix 3.

### **Location of Sediment Sampling**

At each sampling site in Appendix 1 a spatial sampling grid should be constructed. For intermediate and offshore sites, it should be a 500m x 500m square. For estuarine sites the grid should be a rectangle of approximately the same shape as the area represented and with the longer axis at least 200m, unless local conditions dictate otherwise. Sampling will be from 9 points symmetrically spaced in that grid, ie at the corners, the midpoint and the midpoints of the sides. For analysis of Benthic Macrofauna, sampling will, at the very minimum, be from as near as possible to the centre and corners of the grid (ie at least five replicates).

### **Analysis of Samples**

For samples taken from a given matrix, all determinands for which units are listed in Table 1 or 1b should be analysed. Appendix 2 gives references to some methods and will be extended as soon as possible to include recommended ranges of determination to be achieved. The data required are as in the Data Records shown in Appendix 3.

Samples of fish and shellfish should be pooled for analysis, into five pools, as near as possible to equal numbers of individuals being assigned at random to each pool.

Analysis of all sediment, benthos, fish and shellfish samples should take place within three years of the start of the Spatial Survey (before the end of March 1996 for the initial survey). Analysis of water samples (see Appendix 5) should take place as soon as possible, the same laboratory analysing all samples from nearby sites.

### **Treatment of Data**

The data should be forwarded to the NMP database co-ordinator (Appendix 3). Statistical analysis will be performed by MPMMG, to establish the spatial and temporal variability at the various sites and the comparability of the analytical results and to make recommendations about the conduct of the temporal monitoring survey at each site.

If some of the above data already exist at one or more sites, it should be established in consultation with MPMMG to what extent these will serve the purposes of the spatial survey, with particular reference to estimating the underlying variability of samples at that site.

# **The Annual Monitoring Plan**

*[To be amended in the light of results from the initial survey]*

## **Objectives of the Annual Monitoring Plan**

1. Estimate with appropriate accuracy any trends in both contaminant concentrations and biological well-being in the areas identified as being of concern.
2. Identify patterns in these trends in estuaries and the sea around the United Kingdom.

## **Introduction**

The design of the annual monitoring plan will depend on the findings of the Initial/Spatial survey (see Appendix 4).

However, sampling of the water column is already sufficiently well established, either as a result of international agreements or by common practice, that an annual monitoring programme of contaminant concentrations in water and associated oyster embryo bioassays may start immediately within the National Monitoring Plan. It will be reviewed when the initial survey of sediments and biota is completed in three years, but valuable data will be collected from the start.

## **Sampling Strategy**

Variability of contaminant concentrations in the water around any chosen site in estuaries is so great that sampling around the grid suggested for sediment sampling could introduce sources of variation (eg mixing zones of discharges) that would become confused with the variability that the NMP seeks to measure. On the other hand, seawater in offshore and intermediate sites can be considered relatively homogeneous, so that sampling at one site would be adequate. It is proposed, therefore, that water samples should be taken only from the actual sampling point listed in Appendix 1, but with the frequency given in Section 6. For nutrients, this may enable Objective 1 above to be achieved over a run of several years, but not in the short term.

It is envisaged that individual regions will wish to do more intensive sampling to the standard of the NMP in selected areas; in this case these results can also be included in the database.

## **Inter-Laboratory Differences**

It would be unrealistic to delay the introduction of the NMP until all laboratories can be harmonised to the extent that variability among them is no longer a factor. It is therefore important to design a level of comparability into the Plan. Thus nearby sites (eg those in the same estuary and the associated intermediate and offshore sites) should be analysed by the same laboratory, and there should be some element of overlap, with different laboratories analysing some of the same samples, so that any bias between laboratories can be allowed for when comparing results.

It is essential that all samples from any site are always analysed by the same laboratory, ie all water samples from repeated sampling at the site and the sediment and biota samples collected from the same site as part of the initial/spatial survey (Appendix 4) should be analysed by the same laboratory or laboratories. If it ever becomes necessary to transfer a site's analysis from one laboratory to another, a period of overlap (two or more samples) will be necessary to ensure comparability.

## **Existing Data**

For many sites, some data are already available, although rarely to the standard proposed in this Plan. Discussions should take place with the MPMMG, who will be analysing the data from the Plan, to establish the extent to which existing data can be used in place of or in addition to collecting fresh data.

## **Design of Annual Monitoring Plan (Water Samples)**

### **Samples**

Sampling of the water column will start as soon as possible as described in Section 7.1, and continue with the frequency given in Section 6. Samples will be taken from the points located in Appendix 1.

The data required concerning the collection of samples are as in the Sample Master Record in Appendix 3.

### **Analysis of Samples**

For water samples, all determinands in Table 1 for which units are listed or in Table 1a should be analysed on filtered or unfiltered samples as appropriate as soon as possible after the samples are extracted. Appendix 2 gives references to some methods and will be extended as soon as possible to include recommended ranges of determination to be achieved. The data required are those in the Determinand Data Record shown in Appendix 3.

The same laboratory should analyse all samples from all matrices from nearby sites.

### **Treatment of Data**

The data should be forwarded to the NMP database co-ordinator (Appendix 3). Statistical analysis will be performed by MPMMG, to establish the spatial and temporal variability at the various sites and the comparability of the analytical results, and to report on any patterns found in trends in the state of the marine environment around the UK.





**HMIP**  
March 1994

## **ANNEX 15**

### **Numbers of Samples**

**Anticipated numbers of samples to be taken for the monitoring requirement set out in Tables 2 & 3 of this report (Except for the Urban Waste Water Treatment Directive)**

## Annex 15

### Anticipated Numbers of Samples to be Reported

Assumed sampling frequencies are the minimum frequencies set out in this report.  
Dates are the years from which the number of sites have been calculated.

SURFACE WATER DIRECTIVE [1993]			NITRATE DIRECTIVE [1991]
REGION	NO. OF SITES	NO. OF SAMPLES	NO. OF SAMPLES
Anglian	34	136	432
Northumbria\Yorkshire	42	108	1008
North West	90	360	1080
Severn Trent	32	128	384
Southern	27	108	264
South Western	79	316	1056
Thames	31	124	396
Welsh	124	496	1524
<b>TOTAL</b>	<b>559</b>	<b>1836</b>	<b>6144</b>
	Assuming 4 samples per site per year.	Assuming sampling at all Surface Water Directive Sites.  Assuming 12 samples per site per year.	

FRESHWATER FISHERIES DIRECTIVE [1993]		
REGION	NO. OF SITES	NO. OF SAMPLES
Anglian	94	1128
Northumbria\Yorkshire	566	6792
North West	583	6996
Severn Trent	165	1980
Southern	100	1200
South Western	355	4260
Thames	179	2148
Welsh	172	2064
<b>TOTAL</b>	<b>2214</b>	<b>26568</b>
Assuming 12 samples per site per year.		

DANGEROUS SUBSTANCES DIRECTIVE								
LIST I MONITORING [1993]					NATIONAL NETWORK MONITORING [1993]		LIST II MONITORING	
	Water Sampling		Sediment/Biota Sampling					
REGIONS	Number of Sites	Number of Samples	Number of Sites	Number of Samples	Number of Sites	Number of Samples	Number of Sites	Number of Samples
Anglian	57	684	52	52	13	52	82	984
Northumb\Yorks	82	984	47	47	31	124	338	3108
North West	39	468	26	26	7	28	40	480
Severn Trent	85	1020	29	29	14	56	420	5040
Southern	23	276	7	7	10	40	52	624
South Western	96	1152	76	76	38	152	178	2136
Thames	65	780	59	59	20	80	21	252
Welsh	8	96	3	3	2	8	56	672
<b>TOTAL</b>	<b>455</b>	<b>5460</b>	<b>299</b>	<b>299</b>	<b>135</b>	<b>540</b>	<b>860</b>	<b>10320</b>
Assuming 12 water samples per site per year.			Assuming 1 sediment sample per site per year. Only sediment or biota monitoring is required, not both.		Assuming 4 samples per site per year.		Assuming 12 samples per site per year.	

# **HARMONISED MONITORING SCHEME**

<b>HARMONISED MONITORING SCHEME</b>			<b>EXCHANGE OF INFORMATION DIRECTIVE</b>		<b>ENVIRONMENTAL CHANGE NETWORK</b>	
<b>REGIONS</b>	<b>Number of Sites</b>	<b>Number of Samples</b>	<b>Number of Sites</b>	<b>Number of Samples</b>	<b>Number of Sites</b>	<b>Number of Samples</b>
Anglian	15	180	0	0	5	60
Northumbria\Yorkshire	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
<b>TOTAL</b>	<b>170</b>	<b>2040</b>	<b>14</b>	<b>168</b>	<b>13</b>	<b>156</b>
Assuming 12 samples per site per year. No minimum sampling frequency is set out in the report.			Assuming 12 samples per site per year.		Assuming 12 samples per site per year.	

PARIS COMMISSION SURVEY [1993] river sites only			ANNEX 1A OF THE 3RD NORTH SEA CONFERENCE DECLARATION [1993] river sites only	
REGION	Number of Sites	Number of Samples	Number of Sites	Number of Samples
Anglian	17	204	18	216
Northumb\Yorks	13	156	12	144
North West	14	168	14	168
Severn Trent	3	36	3	36
Southern	9	108	5	60
South Western	35	420	31	372
Thames	10	120	2	24
Welsh	62	744	48	576
<b>TOTAL</b>	<b>163</b>	<b>1956</b>	<b>133</b>	<b>1596</b>
Assuming 12 samples per site per year.			Assuming 12 samples per site per year.	

BATHING WATER DIRECTIVE			[1993]
REGION	Number of Sites	Number of Samples	
Anglian	33	660	
Northumbria/Yorkshire	56	1120	
North West	33	660	
Severn Trent	0	0	
Southern	67	1340	
South Western	176	3520	
Thames	3	60	
Welsh	51	1020	
TOTAL	419	8380	
Assuming 20 samples per site per year.			

SHELLFISH WATER DIRECTIVE			[1991]
REGIONS	Number of Sites	Number of Samples	
Anglian	7	84	
Northumbria/Yorkshire	1	12	
North West	0	0	
Severn Trent	0	0	
Southern	5	60	
South Western	9	108	
Thames	0	0	
Welsh	4	48	
TOTAL	26	312	
Assuming 12 samples per site per year.			

TITANIUM DIOXIDE DIRECTIVE [1991]				
WATER SAMPLING			SEDIMENT/BIOTA SAMPLING	
REGIONS	Number of Sites/Depths	Number of Samples	Number of Sites	Number of Samples
Anglian	6	18	5	5
Northumb/Yorks	14	42	6	6
<b>TOTAL</b>	<b>20</b>	<b>60</b>	<b>11</b>	<b>11</b>
Assuming 3 water samples per site per year. Assuming 1 sediment/biota sample per site per year. Both sediment and biota monitoring are required.				

UK NATIONAL (MARINE) MONITORING PROGRAMME [1994 Plan]					
REGIONS	Number of Estuaries	Number of Estuarine Sites	Number of Intermediate Sites	Number of Water Samples	Number of Sed./Biota Samples
Anglian	3	5	4	24	9
Northumb/Yorks	4	10	2	42	12
North West	1	5	2	22	7
Severn Trent	0	0	0	0	0
Southern	1	3	1	13	4
South Western	1	3	2	14	5
Thames	1	3	1	13	4
Welsh	2	6	1	25	7
<b>TOTAL</b>	<b>13</b>	<b>35</b>	<b>13</b>	<b>153</b>	<b>48</b>
Assuming 4 water samples per estuarine site per year. Assuming 1 water sample per intermediate site per year. Assuming 1 sediment/biota sample per site per year.					



PART 2



**NRA PROGRAMME FOR THE MONITORING OF  
WATER QUALITY**

**PART 2:  
DESIGN OF MONITORING PROGRAMMES FOR  
GENERAL QUALITY ASSESSMENTS**

## 1. THE NEED FOR A NEW APPROACH TO THE DESIGN OF SAMPLING PROGRAMMES FOR GQA PURPOSES

One of the objectives of NRA monitoring activities is to obtain information on the general status of water quality and the changes which have occurred over time. In the case of rivers and estuaries this activity has been formalised by the use of classification schemes. These schemes have facilitated the provision of Region-wide or national information on water quality to the general public and other interested parties and have been used, in particular, to summarise data collected during the quinquennial surveys undertaken by NRA, and previously by the Water Authorities. These schemes were also used as the basis for defining local water quality objectives for the purpose of water quality planning.

Until now the foundation for NRA's routine non-statutory monitoring programmes for rivers has been the Classification Scheme devised by the former National Water Council (NWC), which was used to provide a general description of water quality and also provided the basis of many local, non-statutory River Quality Objectives. Difficulties have been encountered in the past with the NWC Scheme, mainly because it was open to subjective interpretation and, in consequence, had been applied differently across the country. Another difficulty was that the NWC Scheme attempted to combine general quality classifications with use-related elements.

To overcome the problems associated with the NWC Classification a new General Quality Assessment (GQA) Scheme has been developed. This provides a general measure of water quality status for periodic assessment and reporting at a national level, irrespective of uses. It runs in parallel with the system of local, use-related standards defined by the statutory WQO Use Classes.

The principal elements of the new GQA for rivers and canals are separate assessments of chemical and biological quality. The two different classifications will be reported alongside each other and will form different, but complementary 'windows' through which changes in the state of rivers and canals can be viewed.

Currently the chemical component of the GQA for rivers is complete and alternatives for a biological component are under evaluation. There will need to be a greater degree of convergence between chemical and biological sampling programmes than has been the case hitherto. Hence similar sampling strategies will apply for both chemical and biological components. The NRA has proposed that the GQA for rivers should also encompass additional assessments of nutrient status and aesthetic considerations. Schemes for estuaries, coastal waters and lakes are also currently under development so that the schemes may eventually embrace all types of surface waters. These additional schemes are being developed through the NRA's R&D programme. The chemical component of the rivers GQA is described in section 2.2 of these guidelines. Further details and background information are available in the Water Quality Series report *The Quality of Rivers and Canals in England and Wales (1990 to 1992)* (Ref: NRA 1994a).

The new monitoring programmes established for GQA purposes will form the basic foundation for future non-statutory monitoring activities, including assessment of

compliance with existing RQOs, and will eventually provide the system of stretches and associated monitoring programmes for statutory WQOs. Hence the definition of NRA's strategy for non-statutory monitoring begins with the ground rules for the GQA Scheme set out in this document. Separate guidelines, in Part 3 of this manual, deal with non-statutory sampling to meet local rather than national aims - often referred to as "permissive" monitoring.

The past few years have seen a number of significant advances in the information and tools available to NRA for the design of water quality monitoring programmes, particularly for the chemical monitoring of rivers. The *Handbook on the Design and Interpretation of Monitoring Programmes* (Ref: WRc 1989) sets out the basic theory, and a number of software tools, AARDVARK, LAPWING and others, are available within NRA to put this theory into practice. However, until now there have been no comprehensive national guidelines on the design of environmental monitoring programmes and this has led to inconsistencies between Regions. It is now recognised that there is a pressing need to ensure that all NRA monitoring programmes represent value for money by providing the maximum amount of useful, relevant information as efficiently as possible.

A strategic R&D project - A2(93)2 479 'Improved Environmental Monitoring' is currently in progress and will be completed by mid 1996. The aim of this project is to develop more efficient and integrated approaches to the design of environmental monitoring programmes and to test them in selected catchments. One outcome of that project may be that improved approaches to monitoring for GQA purposes are recommended. Additionally, a number of initiatives being undertaken via the Water Quality Monitoring Project may also affect the NRA's approach to GQA monitoring; hence these guidelines may be subject to amendment once the results of these projects are known.

## **2. DESIGN OF MONITORING PROGRAMMES FOR THE CHEMICAL COMPONENT OF THE GQA FOR RIVERS AND CANALS**

### **2.1 Rationale**

The approach taken to the 1990 NRA River Quality Survey firmly established the principle that an entirely objective approach to the determination of river quality class should be followed. This guideline will extend this principle of objectivity to embrace not only data analysis but initial design of monitoring programmes. Additionally, the methods presented here have been chosen to fulfil as far as currently practicable the need to design monitoring programmes which obtain the required information as efficiently and cost-effectively as possible.

In order to develop and then cost a national monitoring programme it is necessary to clearly distinguish those activities which address national needs and those which are carried out for local operational purposes. Therefore, Regional sampling programmes will consist of three 'tiers'. The first of these is the statutory programme defined in Part 1 of this manual. On top of this tier will come monitoring for RQO and GQA purposes which will make as much use as possible of those sampling locations and samples already defined at tier one. Permissive monitoring programmes designed to address other local needs will then form the final tier of Regional monitoring programmes and again, as much use as possible should be made of the sites and samples already defined.

In order to ensure that any monitoring programme represents value for money it is essential to have a clearly defined objective and then to ensure that sufficient information is collected to achieve that objective. Hence it is necessary to frame the objectives of monitoring in statistical terms. This is achieved in these guidelines by the use of the river quality data analysis package 'LAPWING' to suggest which sampling site locations might be eliminated. Details are given in section 2.6 and Annex 1.

## 2.2 The Chemical Component of the GQA for Rivers and Canals

Details of the chemical component of the GQA for rivers and canals can be found in the 1990/92 River Quality Survey report (Ref: NRA 1994a) which presents the results of applying the Scheme to data collected for the 1990 NRA River Quality Survey and the following two years. Table 1 below summarises the grade limits for the new scheme.

**Table 1 - Chemical Component of the GQA Scheme for Rivers and Canals**

Grade	DISSOLVED OXYGEN % SATN	BOD(ATU) mg/l	TOTAL AMMONIA AS N mg/l
	10 percentile	90 percentile	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	-	-

## 2.3 Transition from NWC Classification to GQA and Statutory WQOs

In the past the NWC Classification Scheme has been used both to assess absolute river quality, to detect trends in quality, and to set river quality objectives which were at least partially use-related. The new GQA/WQO approach provides a new framework for undertaking these activities; use-related standards will be used to set statutory WQOs according to local needs and the separate standards of the GQA Scheme will be used to provide a general measure of water quality irrespective of uses. The two schemes together entirely replace the use of the NWC Classification. Details of the River Ecosystem WQO Scheme procedures are given in Annex 2.

In the interim, until statutory WQOs are established in all catchments, existing River Quality Objectives (RQOs) must be translated from an NWC-based description to the new River Ecosystem Use class. The method by which this should be achieved is detailed in the *Operational Guidance Paper: Implementation of New Water Quality Schemes* (Ref: NRA - Draft 1994a).

## 2.4 Routine Monitoring of Additional Determinands

The monitoring of the chemical quality of rivers and canals for classification purposes involves only the three determinands BOD, total ammonia and dissolved oxygen. However, there are a small number of additional determinands which provide invaluable further information with which to detect or explain long-term trends or changes in water quality; these are included in Table 2.

To support the new nutrients component soluble reactive phosphorus (SRP) and total inorganic nitrogen (TIN) should be monitored at all GQA chemistry sites from 1 January 1995.

The monitoring of determinands other than those listed in Table 2 at GQA sites, or any of these determinands at non-GQA sites is regarded as 'permissive' and must follow the separate guidelines for the management of permissive sampling.

**Table 2 - GQA for Rivers and Canals - Suite of Determinands**

pH value	
BOD (5 day ATU)	
Temperature	
Oxygen(dissolved) mg/l	
Oxygen (dissolved) %sat	
Ammonia as N	
Ammonia (un-ionised)	(Calculated)
Alkalinity	(for use with RIVPACS)
Hardness (CaCO <sub>3</sub> )	(Only where
Dissolved copper	required for
Total zinc	introducing WQOs)
Soluble reactive phosphorus (SRP)	(for new nutrients
total oxidised nitrogen	component)
total inorganic nitrogen (calculated	
as total ammonia + total oxidised nitrogen)	

## 2.5 River Stretches

The concept of a river stretch is a convenient device for splitting rivers into distinct sections for management purposes and to enable the NRA to report reasonably accurately on the quality of whole lengths of river rather than isolated points. In order to be a useful tool for local river management and the reporting of river quality nationally, a river stretch must be a length of river along which there are no changes



in water quality which are of practical significance and there is no obvious potential for such a change in the future. No stricter definition is possible; stretches can only be defined locally, with reference to the physical features of the river and known river quality. However, the ends of stretches will correspond to positions where river quality changes, or there is a risk that it might change. Therefore they will generally be located at sites receiving significant inputs, such as tributaries or effluent discharges, or at other physical features such as weirs.

For the future, greater emphasis will be placed on a more integrated approach to water quality, fisheries and conservation monitoring than is the case now. Hence Regional stretch networks will need to be suitable for use with these other types of monitoring. This can only be achieved by defining stretches in terms of the natural or man-made physical characteristics of the river.

These Regional stretches will also be the building blocks for the system of WQO stretches and will be the basis of the WQO compliance assessment regime.

Note that an alternative definition of stretches as the portions of river between successive chemical sampling sites, has been rejected for the following reasons.

- The locations of chemical sampling points are to a large extent the result of a compromise between the desire to gather information about a particular place and the need to sample at places which are safe and accessible. They are often bridges or other features which have no connection at all with changes in water quality. Hence, in the majority of Regions chemistry sites do not occur at the end of river lengths of consistent quality and although they are often located towards the downstream change point, large numbers of existing sites are actually located in the middle of stretches, well away from change points. Whilst in some cases it may be possible to relocate sampling sites nearer to the change points the restrictions noted above often mean that the existing site is the only possible site.
- The use of chemical sampling sites is too narrow a view to meet the needs of biological, fisheries or conservation monitoring. For example, in the future every chemistry site is expected, as far as possible, to have a 'twin' biology sampling site associated with it.

### 2.5.1 Definition

With the above points in mind then, a river stretch is defined simply as a length of river along which there are no changes in water quality which are of practical significance. The end points of a stretch will generally be defined by physical features, either natural or manmade, which cause a significant change in river quality or might cause such a change. The ends of stretches may also be defined as points where the RQO or WQO changes. They may be defined by successive sampling sites **only** if those sites closely approximate the positions of changes in river quality. Regions adopting this approach must ensure that their stretches genuinely represent lengths of river of consistent quality.

The lengths of river stretches will inevitably vary between Regions due to differences in geography and the type and intensity of uses to which rivers are put. There is therefore no minimum or maximum permitted length of a stretch.

Note that chemistry and biology GQA sampling must be referenced to the same set of stretches. In other words, Regional reach networks should be regarded as multipurpose and suitable for use with different types of water quality measurement. In the future aesthetics and nutrient status may form part of the GQA and Regional stretch networks should be capable of accommodating these new measures.

It is anticipated that existing Regional stretch networks will generally fulfil the above definition and that extensive reviews of Regional networks will not be required. However, it is recognised that stretch networks need to be amended from time to time to address changes in the river environment, new discharges etc. In order to ensure that meaningful comparisons can be made from one survey to the next all changes to Regional stretch networks must be reported to the national River Quality Survey database.

### **2.5.2 Upstream Limit of Classified Stretches**

The criterion for defining the upstream limit of classified stretches, used in previous quinquennial surveys, is a natural summer flow of at least 0.05 m<sup>3</sup>/s (that is 1 million gallons per day, or an average flow of at least 0.31 m<sup>3</sup>/s), with other watercourses included if they are regarded as significant. 'Significant' in this context should be interpreted as meaning, for example, of high conservation value or of particular local interest. Regions should endeavour to comply with these criteria as far as practicable. However, it is not intended that Regions should make large changes in the extent of classified river above that sampled for classification purposes in 1992. In some cases this may result in stretches which satisfy the flow criterion, but which have not been sampled in previous quinquennial surveys, continuing to be omitted from the classified river system.

#### **Stretches which do not satisfy the flow criterion and were not classified in 1992**

The extent of classified river should not be increased from the situation in 1992 so such a stretch should not be added to the classified network unless there is a compelling argument that it is significant or it is very likely that it will have statutory WQOs set in the near future.

## **Stretches which do not satisfy the flow criterion and were classified in 1992**

Such a stretch should be retained if

- a) it is "significant"; or
- b) it is not significant but can be classified using a site in a stretch further downstream which definitely will be classified. That is, retain the stretch if it will not increase sampling costs. This will help minimise the difference in length of classified river between 1992 and the 1995 survey.

Note b) is included here to promote inter-Regional consistency in achieving the compromise between the need to ensure that we do not perpetuate inappropriate sampling programmes and the need to keep the extent of classified river similar to that in 1992.

### **2.5.3 Downstream Limit of Classified Stretches**

The downstream limit for rivers is that the chloride content should not exceed 200 mg/l at high water of mean spring tides and during low freshwater flow, or the presence of a physical barrier. This criterion has been in use since the 1980 survey, however, it may be adapted by Regions if a particular stretch of naturally freshwater has elevated chloride levels due to pollution. It is anticipated that, except for correcting errors, the downstream limits used will be those marked on the 1985 River Quality Survey (1:250,00 scale) Regional maps. The limits on these maps were used to identify Controlled Waters or 'Relevant rivers and watercourses' under section 103 of the Water Act 1989 and so are now the Water Resources Act 1991 freshwater limits.

## **2.6 Location of Sampling Sites**

A review of GQA site locations was initiated early in 1994, following these guidelines and is now almost complete. Once this work is finished further reviews of all sites should not be required. However, the guidelines below will continue to apply to the siting of new sites.

### **2.6.1 General Principles**

It is assumed that Regional rivers sampling programmes have developed for specific reasons and are generally sensible, but require adjustment to improve efficiency and consistency. Hence the approach taken here is to start with existing programmes and eliminate unnecessary sampling points where possible, using the approach detailed below, rather than building up new programmes from a zero base. The aims of the approach detailed here are:

- (a) to ensure that a national monitoring programme can be defined and costed by disentangling monitoring for GQA purposes from permissive sampling;

- (b) to achieve a better balance in the distribution of monitoring effort across Regions; and
- (c) to improve the overall efficiency of monitoring for chemistry GQA purposes.

### **Achieving a Balance**

Although some initiatives have taken place since the formation of the NRA to improve consistency in approach, there are still large differences between Regions in their current monitoring programmes. For the sites used for water quality classification purposes there is nearly a twofold difference in the average number of sites per unit river length between Regions with the lowest (Severn Trent) and highest (South Western & Southern).

The recent internal audit of water quality sampling recommended that action should be taken to achieve more consistent levels of service in monitoring across the NRA Regions. There are very valid reasons why this should be done. A more balanced monitoring framework is required for reporting upon river quality status using the new GQA Scheme, for introducing WQOs and for developing Catchment Management Plans. A consequence of achieving a better balance may be that resources allocated to monitoring may need to be re-distributed from those Regions with the highest sampling intensities to those with the lowest.

### **Improving Efficiency**

For rivers and canals that fall within the existing classified network, the average distance between sampling points was around 4 km before 1994. There is a widely held view both within the NRA and Government that the level of routine monitoring should be reduced. There is a strong argument that resources could be more effectively utilised in preventing pollution at source rather than monitoring its presence. Schemes are under development for extending the GQA to cover nutrient status and aesthetic quality and to improve monitoring of estuaries, coastal waters and groundwaters. Resources to implement these schemes will have to be found from an overall budget which will not increase over the forthcoming years. The consequence of this is that resources currently allocated to the intensive monitoring of rivers will inevitably need to be re-distributed to allow improvements in monitoring programmes for other controlled waters to be made and to target greater effort towards pollution prevention work.

There are several areas where substantial improvements in efficiency can be made. These were highlighted in the recent internal audit of water quality sampling and a series of actions for improvement have been agreed. Most of those relate to the management control of the process including programme design, planning, implementation, quality control and data management. These areas are currently being addressed by the Water Quality Monitoring Steering Group. However, there is a limit to how far the "more for less" principle can be extended. It seems doubtful that these measures will fully achieve the efficiency savings that are required without leading to reductions in the coverage of the existing monitoring network. At the outset of the review of GQA sites a target reduction of 20% nationally in the number

of chemistry sites was placed upon Regions. Now that Regions are nearing the end of the review, it is clear that a reduction of 15% has been achieved. The impact of this reduction on the NRA's ability to describe water quality is currently being assessed. Preliminary results of the review are contained in a report presented to the Water Quality Monitoring Steering Group in July 1994. A second version will report on the final results of the chemistry and biology reviews in November 1994. Results to date are given in Table 3.

### Consequences for Regional Programmes

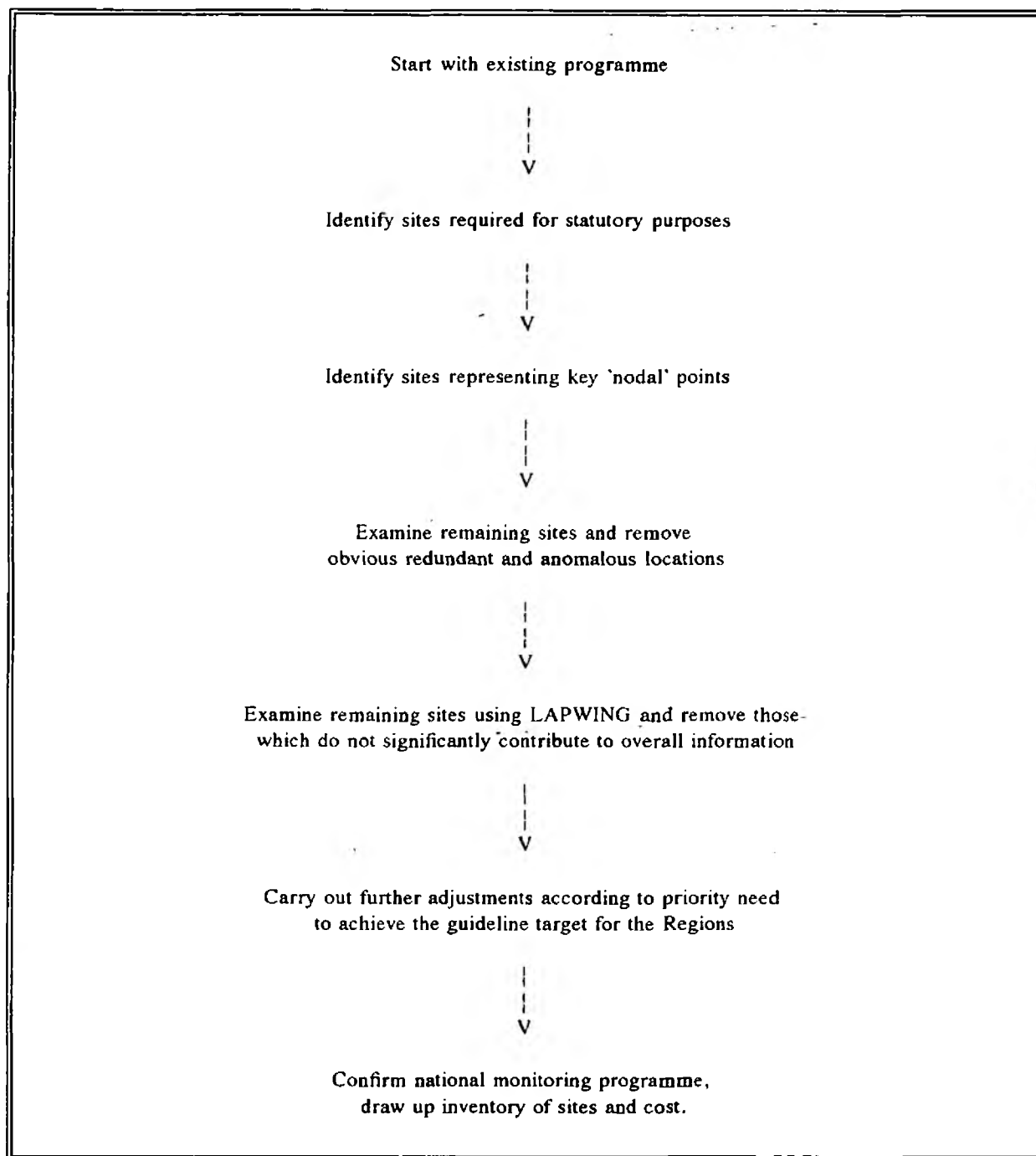
Bringing about a greater balance between Regions and producing an overall reduction in the national programme has meant that Regional programmes have been adjusted to differing degrees. Table 3 shows the differing reduction in numbers of chemistry sites achieved by different Regions.

The flow chart in Figure 1 shows an overview of the process by which Regions have reviewed their existing GQA monitoring programmes, and which should be used for making future adjustments.

**Table 3 - Results of GQA Site Review**

REGION	CHEMISTRY SITES AT START OF REVIEW	CHEMISTRY SITES AT END OF REVIEW	CHEMISTRY % CHANGE IN NUMBER OF SITES	ANTICIPATED NUMBER OF SAMPLES PER YEAR
Anglian	890	759	-15%	9108
North West	1022	937	-8%	11244
N/Yorks	1017	870	-14%	10440
S/Trent	1519	1255	-17%	15060
Southern	527	526	0	6312
S/Western	1610	1306	-19%	15672
Thames	560	565	+1%	6780
Welsh	1138	853	-25%	10236
Total	8283	7071	-15%	84852
Figures as supplied to Water Quality Monitoring Steering Group in July 1994. These may be subject to some slight adjustment. The anticipated number of samples is based on a sampling frequency of 12 times per year.				

**Figure 1 - Overview of Sampling Programme Review Process**



In locating sampling sites for chemical GQA purposes Regions should use the following principles;

- a) Wherever possible use should be made of those locations which are already in use for statutory sampling purposes (as defined in Part 1 of this manual).
- b) Every classified stretch must have associated with it a chemical sampling site which reflects the water quality for the whole stretch. A stretch must not include more than one chemical GQA site. A single site may be used to characterise the quality in more than one stretch provided the stretches can genuinely be considered to have the same quality for GQA purposes. This allows Regions to take advantage of cases where adjacent stretches have the same quality to reduce the number of sampling sites without having to amend stretch networks.
- c) Every chemical sampling site must have, where feasible, a 'twin' biology site which characterises the same stretch or group of stretches. The chemical and biological GQA sites associated with a particular stretch or group of stretches should be located as close together as possible. If a stretch is very long it may cross from an upland area to lowland: in this case the chemistry and biology sites must be in the same area. It is recognised that it will rarely be possible to have coincident chemistry and biology sites and that the ideal chemical sampling site is very different from the ideal biology site. Hence the location of sites must be a compromise between biology and chemistry; the two networks of sites must not be designed in isolation.
- d) A basic network of GQA sampling sites should be established by locating sites in those stretches satisfying one or more of the criteria in the Table 4.
- e) Additional sampling sites should be retained in the GQA network only where essential to adequately characterise existing or anticipated future changes in river quality. To achieve this Regions should first remove any obviously redundant or anomalous sites from current programmes and then review the locations of all remaining current river sampling sites using the river quality data analysis program LAPWING to establish whether any of a group of closely related sites can be deleted. See the detailed guidance on the use of LAPWING in Annex 1.
- f) There is no minimum or maximum distance between successive sampling sites. If, for a particular length of river, the statistical analysis of existing historical data suggests that sampling sites can be located a considerable distance apart, it is permissible to introduce extra sites if the risk of a future change in quality is high. However, Regions should not seek to impose a constant upper limit on the distance between sampling sites and each case should be considered individually.

**Table 4 - Criteria for the Location of the Basic Network of Chemical GQA Sites for Rivers and Canals**

A basic network of GQA sites should be located in the following stretches:

- a. on the main river, stretches upstream and downstream of all major tributaries, and minor tributaries which cause the main river to change chemical or biological grade or which have the potential to cause the main river to change grade;
- b. on all significant tributaries satisfying the flow criterion in section 2.5.2, the stretch immediately upstream of the confluence with the main river; and
- c. stretches upstream and downstream of effluents defined as 'critical' according to the criteria laid down by the effluent monitoring group, here summarised in Table 5.



**Table 5 Criteria for 'Critical Effluents'**

- The RQO or statutory WQO is not currently achieved and the effluent is a contributory cause of the failure.
- The discharge is close to the boundary of river stretches in different grades and a deterioration in effluent quality may cause the boundary to move.
- The effluent discharges upstream of, and may adversely affect the water quality at, a point where water is abstracted for potable supply.
- The effluent may adversely affect SSSIs or substantial fisheries, especially EC designated salmonid waters).
- The receiving water quality is in the lower quarter of grades A-D and may be adversely affected by the discharge.
- The effluent contains significant quantities of substances listed in Annex 1A of the Third North Sea Conference Declaration.
- The effluent had been the source of repeated public complaint which may have some potential justification.
- The combined effect of several separate discharges causes in excess of 10% deleterious change in a significant water quality parameter.

N.B. In deciding upon the 'critical' status of an effluent and the required frequency of sampling, due account should be taken of the previous effluent quality, with greater emphasis being placed on those discharges known to be unreliable or variable in quality.

### **2.6.2 Correspondence Between Sampling Site Networks and Stretch Network**

This guideline has adopted the principal that the stretch network should generally be defined (see section 2.5) by natural or manmade inputs, or other physical features, such that a stretch represents a length of river of consistent quality, with endpoints corresponding to those places where changes in water quality occur or might occur. Regions may define their networks with direct reference to the positions of sampling sites provided that the stretches so defined genuinely represent lengths of river of consistent quality. The definition adopted has the consequence that successive stretches may have the same observed quality. In many cases it will be possible to rationalise networks by amalgamating stretches with the same quality into one longer stretch. However, it is recognised that in some cases, and particularly where there is an established risk that the grade may change in the future, it would not be sensible to amalgamate stretches in this way. In these cases it is acceptable to retain existing stretches although water quality for a particular stretch may actually be assessed at a single sampling site located in one of the neighbouring stretches.

It is expected that once the review of sampling sites has been completed, Regions' stretch and site networks will remain essentially unchanged apart from minor updates and that these networks will be suitable for assessing compliance with future statutory WQOs.

### **2.7 Procedures for Sampling**

Regions should use the methods set out in the National Sampling Procedures Manual, to be introduced in November 1994. Regions should pay particular attention to the following:

- a) It is vital to ensure that samples are representative. Sampling sites must be downstream of the mixing zone of any effluent or tributary. Homogeneity should be established by cross-sectional sampling, using a tracer if appropriate.
- b) Where sampling is from a bridge samples should be taken at mid-channel except where site characteristics, such as proximity of discharge, determine otherwise.
- c) A high proportion of bankside samples is taken in most Regions. Particular care is needed to ensure that representative samples are obtained in these circumstances. Samples should be taken away from pools or stagnant zones and not less than 30 cm from the bottom, if possible, to avoid disturbing sediment.

## 2.8 Sampling Frequencies

Wherever possible use should be made of samples collected for statutory or other purposes.

All GQA chemistry sampling sites should be sampled 12 times per annum, that is monthly, for the chemical determinands listed in Table 3.

Where a Region wishes to take additional chemical (or biological) samples at a site these must be justified according to specific local needs following the principles for the management of permissive monitoring, set out in part 3.

In arriving at the guidance in this section a number of factors have been considered. Firstly, it is highly unlikely that resources will be available in the future to increase sampling frequencies above their current levels. Indeed, it is probable that pressure to decrease sampling in order to reduce costs will continue.

Secondly, the purpose of the General Quality Assessment is to provide periodic summaries of water quality throughout England and Wales which are not directly related to local Uses or Objectives. Hence, there are no sites which are considered to be more important than others so the criteria for deciding sampling frequencies for **national GQA purposes** are the same at every site. Of course Regions may have operational reasons for requiring an increase in sampling frequency above this defined minimum, in which case the additional sampling will need to be justified according to local priorities.

Finally, whilst the approach of defining sampling objectives in statistical terms and deriving sampling frequencies which take into account the local variability of water quality is attractive, it is considered impractical to derive individual sampling frequencies for all the 7,000 or so chemical monitoring sites likely to be in use for GQA purposes following the review. The rigorous application of statistical methods is most appropriate for the design of permissive monitoring programs where it is essential to ensure that sufficient data are collected to achieve the original monitoring objective. For GQA purposes a fixed sampling frequency is more efficient and will simplify the management of monitoring programmes.

For the 1990 Survey the average risk of placing a site in the wrong GQA chemical grade due to sampling error was 25% and the average sampling frequency was 10 per annum. Therefore the move to a consistent sampling frequency of 12 times per year ensures that the average error rate for the next quinquennial survey will not be increased. In fact actual numbers of samples taken which can be used for GQA purposes will be slightly higher than 12 pa at each site because some samples taken for statutory purposes at a higher frequency will be available.

## 2.9 Timing of Sampling Occasions

It is important to ensure that adoption of a standard 'sampling run' does not result in all samples at a site being taken during a very narrow time window or on the same day of the week.

The water quality standards defining the grade limits of the GQA Scheme were derived empirically from data collected during standard working hours. Only data from samples taken during standard working hours should therefore be used in assigning GQA grades to any particular stretch. This does not of course preclude the taking of samples outside normal working hours where it is considered appropriate to do so for operational reasons. This is a matter for local judgement and it is therefore considered to be a permissive sampling activity.

## **2.10 Data Management and Reporting**

The national River Quality Survey database is administered by Anglian Region and currently includes summaries of chemistry data for the 1990 survey and for 1991, 1992 and 1993, and biology summaries for 1990. Data should be submitted to the Regional Water Quality Planning Manager at Anglian Region by the 31st of May each Year. Details of the database structure and technical background are given in Annexes 3 and 4 respectively.

### **2.10.1 Procedures for Notifying Changes in the Stretch or Sampling Site Networks**

All changes to Regional stretch or sampling site networks should be reported to the national River Quality Survey database at Anglian Region. In particular, where changes to stretch networks are made it will be necessary for Regions to describe the water quality according to the new network, the old one, and in all the 'sub-stretches' defined by the overlap between the two networks so that comparisons can be made from one survey to the next.

### **2.10.2 Use of Data from Discontinued Sites**

Where the current sampling site characterising a particular stretch is discontinued in favour of a new location to characterise the same stretch, data from both of the sites may be used, if necessary, to calculate the appropriate summary statistics to arrive at the GQA grade for that stretch. This may be necessary, for example, if a site is discontinued during the three year time period of data used for the quinquennial survey. Similarly, where a current sampling site is discontinued because quality at that site can be inferred from quality at a neighbouring site, existing data from the discontinued site may be combined with data from the neighbouring site if necessary to arrive at the target sampling frequency of 12 per annum, provided that this would not result in the over-representation of particular sampling dates or a particular period of time within the total period over which the grade is calculated.

### **3. DESIGN OF MONITORING PROGRAMMES FOR THE BIOLOGICAL COMPONENT OF THE GQA FOR RIVERS AND CANALS**

#### **3.1 Rationale**

For the next quinquennial river quality survey in 1995, a biological grade will be reported alongside the chemical grade, for all classified stretches. The work undertaken for the 1990 Survey provided a great deal of information on possible approaches to the definition of biological classification schemes, but research is continuing. Possible options for a national biological classification scheme are discussed in the 1990/92 River Quality Survey report (Ref: NRA 1994a). Whilst the scheme itself is not yet finalised the sampling requirements are reasonably clear now and are detailed in sections 3.2 to 3.4. However, the R&D project 'Testing and Further Development of RIVPACS' is investigating a number of issues which may affect future approaches to biological monitoring and the Water Quality Monitoring business area project on 'Biological Assessment Techniques' may also recommend changes to biological monitoring for classification purposes. Further, as mentioned in Section 1, the R&D project - A2(93)2 479 'Improved Environmental Monitoring' will be considering ways of increasing the efficiency and effectiveness of all the NRA's water quality monitoring activities and may recommend changes to the NRA's approach to monitoring for GQA purposes.

An analysis of the 1990 River Quality Survey data (Ref: NRA - R&D 1993), which concentrated in particular on the comparison of the chemical and biological quality for individual stretches, revealed major weaknesses in the design of Regional monitoring programmes, caused by a lack of consistency between the approach taken to the location of chemistry sites and the location of biology sites. Hence, whilst these biology guidelines are provisional and will be amended once the results of current research are known, it is particularly important that Regions review the locations of biology sampling sites, using the guidelines in sections 2.5 and 3.2, at the same time that the locations of chemical sites are reviewed. Hence these guidelines concentrate on this aspect of biological sampling programme design.

#### **3.2 Location of Sampling Sites**

A network of biology sampling sites should be defined according to the following principles:

- a) Every chemistry sampling site should, as far as possible, have a 'twin' biology sampling site which is used to classify the same stretch or stretches that the chemistry site classifies;
- b) twin biology and chemistry sites should be as close together as practicable; and,
- c) twin biology and chemistry sites must genuinely represent the same water quality within a stretch.

### 3.3 Procedures for Sampling

Sampling, sorting and analysis procedures for the 1995 survey are set out in *Procedure for collecting and analysing river macro-invertebrate samples for GQA Surveys* (Ref: NRA - Draft 1994b) and *Procedure for collecting and analysing river macro-invertebrate samples for RIVPACS application* (Ref: NRA - Draft 1994c).

Training will be provided during Spring 1995.

### 3.4 Sampling Frequencies

Sites should be monitored twice per year, in Spring and Autumn, in the Quinquennial Survey year only (ie 1995). RIVPACS environmental variables should be monitored twice for existing sites, in Spring and Autumn, and three times, in Spring, Summer and Autumn, for new sites.







# **ANNEX 1**

## **Lapwing**

**Detailed guidance on the use of the river quality data analysis program LAPWING**

## **Annex 1**

### **DETAILED GUIDANCE ON THE USE OF THE RIVER QUALITY DATA ANALYSIS PROGRAM LAPWING**

#### **1. INTRODUCTION**

The policy defined in the preceding sections of this manual sets out the procedure for a review of all river and canal sampling site locations to be undertaken between January and June 1994 in order to define a National Inventory of GQA sampling sites. The various stages of the review are shown in Figure 1 on page 77. The fifth stage of this review process is the use of the river quality data analysis programme LAPWING to identify sites which can be eliminated from the GQA sampling site network without significant loss of information. This annex sets out some broad guidance to Regions on how to use LAPWING for this review.

It should be noted, however, that it is not possible to anticipate all possible variations in types of data and local problems which Regions will encounter. Hence these guidelines should not be viewed as a recipe to be followed in every case. The LAPWING user must take account of local conditions, availability of data, changes in quality over time etc. Similarly the interpretation of the LAPWING outputs must take account of local conditions and priorities.

If further information on the statistical background to LAPWING is required it should be sought from the LAPWING User Guide and the 'Handbook on the Design and Interpretation of Monitoring Programmes'.

Training in the use of LAPWING was provided to staff engaged in the sampling site review during Spring 94.

#### **2. CHOICE OF DATA**

##### **2.1 Determinands to be analyzed.**

The three GQA determinands; DO, BOD and total ammonia, must always be included in the analysis. Generally pH, unionised ammonia and nutrients (that is, whichever nitrogen and phosphorus-related determinands are available), and where appropriate, dissolved copper and total zinc should also be examined, wherever data is available.

##### **2.4 Date range of data to be used.**

###### **2.4.1 As an absolute minimum the three most recent full calendar years of data (ie 1991, 1992, 1993) should be used.**

- 2.4.2 If additional years' data is considered to be reliable (that is, it has passed through adequate AQC and validation) it should also be included to improve the precision of the LAPWING analysis. Note that LAPWING can accept up to 10 years data.
- 2.4.3 Where there have been changes in quality *over time* during the period to be used for the analysis the following procedure should be adopted;
- i) If the quality changes occur at all sites, ensure that the LAPWING seasonal correction (detrending) option is used.
  - ii) If the changes occur only at some sites they may trigger LAPWING's ANOVA interaction term. In this case a more detailed investigation of the raw data may be required to determine which sites have differing behaviour. In some cases it may be necessary to restrict the choice of data for analysis to a time period over which there have been no marked temporal quality changes or to exclude the anomalous site(s) from the analysis.

## 2.5 Outliers

- 2.5.1 It is desirable to identify outliers using the procedure given in the Code of Practice on Data Handling; the Test Data Facility subroutine MOT, which is provided with the Code, can be used, and exclude them from the data set prior to running the LAPWING analysis. However, this is not essential provided that the user consults the various diagnostic outputs produced by LAPWING, particularly the residuals-by-site table. Where a problem is suspected the potential outlier should be investigated and excluded if appropriate.

## 2.6 Choice of sites for inclusion in analysis

- 2.6.1 The set of sites analyzed should exclude:

those obviously redundant or anomalous sites already marked for removal from the network;

but must include:

all other river quality monitoring sites currently in use for routine sampling purposes, including all those statutory sampling sites and key nodal sites (see section 2.6 and table 5) which have already been marked for retention. This will ensure that sites which are redundant because they have the same quality as sites already marked for retention will be identified.

- 2.6.2 Where there are more than 20 sites on the main river more than one LAPWING analysis will be required. Care should be taken to ensure that the groups of sites in different analyses 'overlap' so that the sites at the endpoints are compared with both their upstream and downstream neighbours.

### 3. LAPWING PROGRAM OPTIONS

#### 3.1 Data transformations

- 3.1.1 Assume normality for Dissolved Oxygen and pH and log-normality for all other determinands.

### 4. ELIMINATION OF SITES

#### 4.1 Interpretation of LAPWING outputs

- 4.1.1 The results of the LAPWING analysis should be used to identify sites which are candidates for elimination from the GQA site network. The decision on whether to eliminate a particular site must take account of local conditions and priorities, and the risk that future patterns of quality changes may be different from existing ones. However a number of situations in which it will generally be appropriate to eliminate sites are listed below:

- (i) Two or more neighbouring sites have the same mean levels.

Where two or more neighbouring sites have the same mean levels, that is the means are not significantly different for all of the determinands considered, only one of the sites should be retained within the GQA network.

- (ii) Two or more neighbouring sites have significantly different mean levels for one or more of the determinands examined, but all sites are well within the same GOA chemical grade.

Where a LAPWING analysis reveals that two or more neighbouring sites have significantly different mean levels for one or more of the determinands examined, but all sites are well within the same GQA chemical grade (or FE Use Class for unionised ammonia, pH, zinc and copper) it will often be appropriate to eliminate all but one of the sites.

- (iii) Two or more neighbouring sites have significantly different mean levels for at least one determinand, and are in different GOA chemistry grades, but the differences in mean are small.

Sites whose chemical quality is close to the boundary of their grade may have very similar quality, in practical terms, to their neighbours, despite being in a different grade. Where this is the case there may be scope for elimination of one or more sites.

In general, whilst sites must be retained in the network wherever clear changes of river grade occur, sites should not be retained solely because the river grade is borderline for that site.

**Note** In each of the three cases listed above sites should not be eliminated unless the

'decision' from all determinands is unanimous.

- 4.1.2 The site to be retained should be that which best characterises the quality of the whole length of the reach or reaches. This will often be the most downstream site, but consideration should also be given to;

the risk that quality at the site may change in the future;

whether the site is also in use for statutory monitoring purposes (such sites should be chosen wherever possible); and

whether the site is a good 'twin' for the biology site to be used to characterise the same reaches.

- 4.1.3 Care should be taken when interpreting the results if considerably less than 36 samples were available for any site. If LAPWING concludes that there is no significant difference in mean quality between two adjacent sites, one or both of which have fewer than 36 samples, it may still be the case that the *true* mean difference between the sites is large and that the sites would be significantly different if the comparison was made on the basis of a full three years data (this will generally be 36 samples). It will be necessary to estimate the possible size of the true difference between the sites so that an assessment can be made of whether such a difference would be of practical importance. The following procedure should be adopted.

First estimate the 90% confidence interval for the true mean difference using the procedure described in the 'Handbook on the Design and Interpretation of Monitoring Programmes' sections 8.2 and 9.5.8. Suppose this runs from  $D_{min}$  to  $D_{max}$ . Then  $D_{max}$  indicates the largest possible value for the true mean which is consistent with the analyzed data.

If the magnitude of  $D_{max}$  does not cause concern (for example, if the two sites would still be in the same class even if the true difference were this large) then one of the sites can be eliminated.

However, if  $D_{max}$  is unacceptably large, calculate the higher numbers of samples needed at the two sites, given the observed variances, for which the observed difference would have been statistically significant. Again the details of the method can be found in the 'Handbook on the Design and Interpretation of Monitoring Programmes'. If that amount of sampling will in fact be carried out in the future both sites should be retained. However, if that amount of sampling is higher than the planned future sampling frequency noting will be gained from sampling both sites and one should be eliminated.

The LAPWING User Guide contains an approximate alternative procedure to the above which may be used instead.

It is recognised that this is a difficult and time-consuming procedure and Regions may not wish to follow it in every case where fewer than 36 samples have been collected.

Often other information, such as local priorities, risk of a future change in quality at the site, etc. may be used to assist in the decision on whether to retain or eliminate such sites.

#### **4.2 Correspondence between biology and chemistry sites**

- 4.2.1 A single chemical sampling site should not be used to characterise the quality of more than one reach unless those reaches also have consistent biological quality. Chemical and biological sampling sites characterising a reach or a group of reaches of consistent quality should be located as close together as possible and always within the same reach.

## **ANNEX 2**

### **Water Quality Objectives**

**Procedures used by the National Rivers Authority for the purpose of the Surface Waters (River Ecosystem) (Classification) Regulations 1994**

# **WATER QUALITY OBJECTIVES:**

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**Procedures used by the National Rivers Authority  
for the purpose of the Surface Waters  
(River Ecosystem) (Classification) Regulations 1994**



## Preface

*The Surface Waters (River Ecosystem) (Classification) Regulations 1994*, SI 1994 No. 1057, prescribe a system for classifying the quality of rivers and canals, to provide the basis for setting statutory water quality objectives (WQOs) under section 83 of the Water Resources Act 1991 in respect of individual stretches of water.

The River Ecosystem classification comprises five hierarchical classes, in order of decreasing quality: RE1, RE2, RE3, RE4 and RE5. The criteria which samples of

water are required to satisfy are set out, for ease of reference, in Table (i), below.

Regulation 3 of *The Surface Waters (River Ecosystem) (Classification) Regulations 1994* provides that certain matters relevant to the assessment of compliance with the requirements prescribed for each of the quality classes RE1-RE5 are to be determined by the NRA in accordance with the procedures and principles set out in this document.

Table (i) RIVER ECOSYSTEM CLASSIFICATION: WATER QUALITY CRITERIA

Class	Dissolved Oxygen % saturation	BOD (ATU) mg/l	Total Ammonia mg N/l	Un-ionised Ammonia mg N/l	pH lower limit as 5 percentile:  upper limit as 95 percentile	Hardness mg/l CaCO <sub>3</sub>	Dissolved µg/l	Total µg/l
	10 percentile	90 percentile	90 percentile	95 percentile			95 percentile	95 percentile
RE1	80	2.5	0.25	0.021	6.0-9.0	≤ 10 > 10 & ≤ 50 > 50 & ≤ 100 > 100	5 22 40 112	30 200 300 500
RE2	70	4.0	0.6	0.021	6.0-9.0	≤ 10 > 10 & ≤ 50 > 50 & ≤ 100 > 100	5 22 40 112	30 200 300 500
RE3	60	6.0	1.3	0.021	6.0-9.0	≤ 10 > 10 & ≤ 50 > 50 & ≤ 100 > 100	5 22 40 112	300 700 1000 2000
RE4	50	8.0	2.5	-	6.0-9.0	≤ 10 > 10 & ≤ 50 > 50 & ≤ 100 > 100	5 22 40 112	300 700 1000 2000
RE5	20	15.0	9.0	-	-	-	-	-

# WATER QUALITY OBJECTIVES:

## Procedures used by the National Rivers Authority for the purpose of the Surface Waters (River Ecosystem) (Classification) Regulations 1994

30th March 1994

### 1.0 INTRODUCTION

The National Rivers Authority (NRA) uses various schemes for the assessment of river water quality. These procedures include periodic chemical and biological surveys, and reporting upon compliance with the requirements of EC Directives. *The Surface Waters (River Ecosystem) (Classification) Regulations 1994* introduce a component of a new scheme, the purpose of which is to place water quality targets on a statutory footing. This new scheme is known as the statutory water quality objectives (WQO) scheme.

The Water Resources Act 1991 contains provision to develop new schemes for the classification of Controlled Waters. On the basis of these classification schemes, the Act empowers the Secretaries of State for the Environment and for Wales to set statutory WQOs for specific stretches of water in order to secure specific water quality standards for them by given dates.

WQOs specify formal minimum quality standards, and have already been set to give effect to the EC Dangerous Substances legislation arising from Directive 76/464/EEC, and subsequent daughter Directives, (via the Surface Waters (Dangerous Substances) (Classification) Regulations 1989

(SI 2286) and 1992 (SI 337)), and the EC Bathing Waters legislation arising from Directive 76/160/EEC (via the Bathing Waters (Classification) Regulations 1991 (SI 1597)). The requirements of these Directives, and the methodologies necessary for compliance assessment, are contained within the Directives and the domestic Regulations and Notices arising from them.

*The Surface Waters (River Ecosystem) (Classification) Regulations 1994* specify the classification scheme which will apply when setting WQOs for the River Ecosystem Use in rivers and watercourses in England and Wales. The Regulations specifically require that certain matters relevant to the assessment of compliance with WQOs, set using the River Ecosystem classification, are to be determined by the NRA strictly according to the procedures and principles laid out in this document. These cover frequency, location and methods of sampling; analytical requirements for samples; and statistical methods for the assessment of compliance with the standards in the Regulations.

The relevant NRA Regional General Manager will be responsible for ensuring that the procedures laid down in this manual are followed at all times.

## 2.0 MONITORING ACTIVITIES TO SUPPORT COMPLIANCE ASSESSMENT

In order to assess compliance with WQOs it is necessary to obtain reliable, accurate and appropriate data on the quality of rivers. The requirements of WQOs therefore govern the design of components of the NRA's monitoring programme.

### 2.1 Location of Sampling Points

WQOs are established for lengths of river ('river stretches') which share the same quality target. River stretches are defined according to their upstream and downstream limits: a target River Ecosystem Class is applied, together with a date for its achievement. Physical features such as tributaries, weirs or significant discharges often mark the ends of river stretches owing to their potentially significant effects on water quality.

In order to assess quality (and hence compliance with WQOs), the NRA will identify and select those key 'nodal' sampling points which reflect the quality of those river stretches. In many circumstances the quality of the river stretch can be ascertained using a single sampling point; in others, more than one sampling point may be used. Sampling points will be chosen having regard to the avoidance of mixing zones immediately downstream of tributaries or discharges, where quality would be unrepresentative. They will also be chosen with regard to their accessibility throughout the year, with particular regard to aspects of health and safety for those carrying out the sampling.

Once selected, sampling points will not generally change over time. However, it may sometimes be necessary to agree a change in the location of a sampling point due to, for example, changes in significant discharges or road-building schemes.

### 2.2 Methods of Sampling

Spot sampling methodology in the NRA follows detailed procedures, work instructions (for detailed applications) and records to be used for control purposes. The procedures and work instructions include lists of references, definitions, equipment to be used for sampling, and actions to be taken. In general, these methods conform with British Standard BS6068 Part 6 and accompanying glossaries in Part 0 and Part 1 of the same Standard. The NRA's spot sampling methodology will be subject to agreed, effective quality control procedures, which may include field blanks, field use of synthetic standards, or the taking of duplicate samples. Spot data collected in situ using hand-held meters, where these are recognised as meeting the required standards of accuracy, precision and limit of detection, may be used in the assessment of compliance with WQOs. For the

purposes of both spot samples collected for subsequent laboratory analysis, and data collected using hand-held meters, audit checks will be employed and all relevant documentation will be subject to revision control procedures.

The introduction of widespread continuous monitoring would have implications for the revision of standards, as the published River Ecosystem standards have been derived on the basis of spot sampling during daytime sampling windows. Currently, few of the determinands covered by the Regulations can be effectively monitored, to the required standards of accuracy, with available automatic monitoring equipment. Any results from such equipment will not therefore be used currently in the assessment of compliance with WQOs. This position will however be kept under review as continuous monitoring technology develops, and any subsequent widespread introduction of continuous monitoring equipment would be accompanied by a significant review of standards.

### 2.3 Frequency of Sampling

All chemical sampling sites will be regularly spot sampled by the NRA at a minimum 12 times per year. This sampling frequency represents a compromise between statistical confidence and cost-effectiveness. No reduction to the NRA's routine monitoring programme is implied by this requirement; reviews of sampling regime are governed by separate processes within the NRA.

The NRA will continue to take samples outside the working day and working week for the purposes of investigative work and other pollution control activities. However, for the purpose of assessing compliance with WQOs, only those samples collected during the Authority's routine, predetermined sampling programmes during the working week and the working day will be considered. Significant diurnal variations in river water chemistry are known to occur as a result of biological, physico-chemical and anthropogenic factors. The River Ecosystem standards have been explicitly set on the assumption that sampling will be carried out during working hours. To require sampling outside of these times for the purpose of assessing compliance with WQOs would be exceptionally costly as it would be necessary to distribute sampling on a 24 hour basis throughout the 7-day week, and it would also be inconsistent with the way in which the River Ecosystem standards have been set. Care will be taken to ensure that samples taken for the purpose of compliance assessment at a particular site are reasonably distributed throughout the working day and working week, and throughout the calendar year. This will ensure that the adoption of a standard 'sampling run' does not result in all samples at a site being taken during a very narrow time window or on the same day of the week.

It is not necessary to report compliance for all determinands for some River Ecosystem classes or where exceptions have been applied as set out in section 5 below. The NRA will nevertheless take spot samples

appropriate for all determinands for the purpose of monitoring the current quality of the water. This will assist in the assessment of potential target class when WQOs are subject to periodic review.

### 3.0 ANALYTICAL REQUIREMENTS

The analytical requirements for measuring determinands in samples are qualified by specified performance measures. All performance measures are applicable to standard methods with direct traceability to those set out in the Standing Committee of Analysts publications. The procedures include: specifying requirements for accuracy, precision and limit of detection; ensuring all laboratories have audited quality control systems; and ensuring that similar quality criteria are used for field instrumentation.

- **Accuracy** is the overall difference between the reported results and the true values. (The term "bias" may also sometimes be used in this context.) It is the mean of many measurements and is usually expressed as a percentage.

- **Precision** is the degree of agreement when measuring the same sample repeatedly. It is based on the standard deviation of differences between replicate measurements and is also usually expressed as a percentage.
- **Limit of Detection** is the concentration below which it is not possible to distinguish between the presence or absence of the material, according to the limitations of the analytical technique employed.

Analytical requirements for assessment of compliance with WQOs are detailed in Table 1.

Table 1: Summary of Analytical Requirements

Determinand	Accuracy (% of relative standard deviation)	Precision (% of relative standard deviation)	Limit of Detection
Dissolved Oxygen	10%	5%	(0.2 mg/l O)
BOD[ATU]	10%	8%	1.0 mg/l
Total Ammonia	10%	5%	0.025 mg/l
Un-ionised Ammonia	Un-ionised ammonia is calculated from total ammonia, pH & temperature		
pH	10%	5%	-
Hardness (CaCO <sub>3</sub> )	10%	10%	5 mg/l CaCO <sub>3</sub>
Dissolved Copper	10%	5%	0.5 µg/l Cu
Total Zinc	10%	5%	3.0 µg/l Zn
Temperature	Temperature will be measured with a proven traceability to the National Standard with a total uncertainty of ±0.2°C.		

## 4.0 STATISTICAL METHODS FOR ASSESSING COMPLIANCE

### 4.1 Introduction to Compliance Assessment

Standards for several different WQO Use Classes may eventually apply to a particular stretch of river. In these circumstances, the most stringent requirements for each determinand will provide the planning target. However, compliance with each WQO Use Class will be assessed independently, using the standards appropriate to that Use Class. Compliance will be assessed on the basis of data gathered by the NRA over **complete** calendar years, commencing with the first full calendar year following the date specified in the Notice establishing the WQO. If, for example, a date of 1st January 1998 is specified, data gathered during the course of 1998 would constitute the first year-class of data upon which compliance will be assessed.

Where at least three full years have elapsed since the date specified in the Notice establishing the WQO, sampling data gathered during the preceding three years (that is, three year-classes of data) will be used to assess compliance. However, where three years have not elapsed since the date specified in the Notice, the maximum available number of year-classes of data available (in practice, either one or two years) would be used. This approach will ensure the most cost-effective use of monitoring data.

Only the results from routine, predetermined sampling programmes will be used. All validated results from these sampling programmes will be placed on the Water Resources Act Public Registers. None of these results will be set aside when assessing compliance, unless the exceptions set out in section 5 below are applicable. The WQO will not have been achieved if any one of the relevant determinands fails to meet the requirements in the Classification.

It is inevitable that the concentration of substances in some samples will be found to be lower than the limits of detection. These results will be quoted as "**less-than**" values on the Registers. Such results will be taken as "zero" in the assessment of compliance. On rare occasions, results will be qualified as "greater-than" values. These will be taken as the value specified.

### 4.2 Assessment of Compliance

In order to assess compliance with River Ecosystem standards, which are defined as percentiles, recognised parametric statistical methods will be used. First it is necessary to calculate the mean and standard deviation values for each determinand from monitoring data held

on Public Registers. For a set of  $n$  results,  $x_1, x_2, \dots, x_n$ , the mean,  $m$ , is given in:

$$m = \frac{1}{n} \sum_{i=1}^n x_i$$

The standard deviation,  $s$ , is given in:

$$s = \sqrt{\frac{1}{(n-1)} \sum_{i=1}^n (m - x_i)^2}$$

From these mean and standard deviation values, it is then necessary to calculate percentile values, and to do so in a way that recognises that the taking of spot samples provides only an **estimate** of the underlying water quality which is being sampled. Thus, the confidence limits within which the "real" quality is assumed to lie are calculated. This is necessary to establish, with a known degree of confidence, that a failure to meet the relevant standards has occurred, in order to avoid unnecessary expenditure on improvements to discharges which are not truly justified. The level of confidence chosen for assessment of compliance with WQOs is 95%. Thus, to take account of the uncertainty resulting from spot sampling, compliance assessment will be based on calculation of confidence limits, rather than on a straight calculation of percentiles.

A prescribed **parametric method** is used to estimate percentiles. Percentiles are a weighted sum of the standard deviation and the mean:

Percentile = mean + (weighting factor \* standard deviation)

After calculating mean and standard deviation values, the procedure is slightly different for each determinand, depending upon the nature of the standard and the assumed distribution of concentration over time.

- There are two **types of standard** used in the River Ecosystem classification, and the statistical methods used to assess compliance vary according to which type of standard is applicable. For those standards for which an upper limit is applicable (such that it must not be exceeded, as a 90-percentile or a 95-percentile), the weighting factor used in calculating the percentile is positive. For those standards for which a lower limit is applicable (such that quality must not be less than the standard, as a 5-percentile or a 10-percentile), the weighting factor used in calculating the percentile is negative.

- Two types of distribution are found to approximate to the observed behaviour of class-limiting determinands in rivers: a **normal distribution** or a **log-normal distribution**. (Any error introduced by the assumption of these particular distributions is small compared with the errors from chance in sampling).

For those determinands for which an upper limit standard is applicable (BOD[ATU], Total Ammonia, Un-ionised Ammonia, high pH, Copper and Zinc), for which a 90-percentile or 95-percentile standard is therefore applicable, the lower confidence limit is used for compliance assessment. For those determinands for which a lower limit standard is applicable (Dissolved Oxygen and low pH), for which a 10-percentile or 5-percentile standard is therefore applicable, the upper confidence limit is used for compliance assessment.

For a **normal distribution**, the lower confidence limit for a 90- or 95-percentile is given as  $q_l$  in:

$$q_l = m + (w * s)$$

and the upper confidence limit for a 5- or 10-percentile is given as  $q_u$  in:

$$q_u = m - (w * s)$$

where, in both cases,  $m$  is the mean,  $s$  is the standard deviation, and  $w$  is the weighting factor.

For a **log-normal distribution**, the values of the mean,  $m$ , and the standard deviation,  $s$ , are converted to the values for the logarithms of the data using the **method of moments**:

$$S = \sqrt{\ln(1 + s^2/m^2)}$$

$$M = \ln\left(\frac{m}{\sqrt{1 + s^2/m^2}}\right)$$

$M$  and  $S$  stand for the mean and standard deviation of the logarithms of the data. The lower confidence limit,  $q$ , is then the exponential of  $(M + (w * S))$ :

$$q = e^{(M + (w * S))}$$

where, once again,  $w$  is the weighting factor.

Appendix 1 provides factors for the calculation of 95% confidence limits on estimates of 10-percentiles or 90-percentiles, and 5-percentiles or 95-percentiles, for different sampling frequencies.

## 4.2.1 Dissolved Oxygen

The **Oxygen Saturation**,  $\%Sat$ , is computed for each sample, using the following equation<sub>1</sub>. The calculation uses the concentration of oxygen in mg/l,  $mgO$ , and the temperature,  $t$ , in degrees C:

$$\%Sat = 100 * mgO / (14.16 - 0.3943 * t + 0.00771 * t^2 - 0.0000646 * t^3)$$

For Dissolved Oxygen, a normal distribution and the upper confidence limit are used. A site will fail the WQO for Dissolved Oxygen if the upper confidence limit is less than the standard.

## 4.2.2 BOD[ATU]

For BOD[ATU] (the Biochemical Oxygen Demand, analyzed in the presence of allylthiourea [ATU] to suppress the uptake of oxygen by ammonia), a log-normal distribution and the lower confidence limit are used. A site will fail the WQO for BOD[ATU] if the lower confidence limit exceeds the standard, unless the exceptions set out in section 5 below are applicable.

## 4.2.3 Total Ammonia

For Total Ammonia, a log-normal distribution and the lower confidence limit are used. A site will fail the WQO for Total Ammonia if the lower confidence limit exceeds the standard.

## 4.2.4 Un-ionised Ammonia

The concentration of **Un-ionised Ammonia**,  $UnAmm$ , is computed for each sample, using the following equation<sub>2</sub>. The calculation uses the concentration of Total Ammonia,  $TotAmm$ , the temperature,  $t$ , in degrees C, and the pH:

$$UnAmm = TotAmm / (1.0 + 10.0^{(10.055 - 0.0324 * t - pH)})$$

In this equation, values of pH which exceed 8.0 are set equal to 8.0. This is done to take account of the observed toxicity of Un-ionised Ammonia in rivers of high pH.

For Un-ionised Ammonia, a log-normal distribution and the lower confidence limit are used. A site will fail the WQO for Un-ionised Ammonia if the lower confidence limit exceeds the standard.

<sub>1</sub> This equation is provided in Truesdale G.A. and Gameson A.L.H. (Water Pollution Research Laboratory) (1957). *The Solubility of Oxygen in Saline Water*. Etrait du Journal du Conseil International pour l'Exploration de la Mer. Vol.XXII. No.2.

<sub>2</sub> This equation is provided in Water Research (1973). Vol.7. pp1011-1022. Water quality criteria for European freshwater fish - Report on ammonia and inland fisheries.

#### 4.2.5 Copper and Zinc

For dissolved Copper and total Zinc, a log-normal distribution and the lower confidence limit are used. A site will fail the WQO for these determinands if the lower confidence limit exceeds the appropriate standard, unless the exceptions set out in section 5 below are applicable.

However, the concentration of either or both of these metals may be found to be consistently 20% of, or less than 20% of, the value specified as the class-limiting standard, and therefore unlikely to cause a breach of standard. In such a case, for each affected metal, samples need to be analyzed only on a low frequency basis to ensure that the metal remains at a low concentration. In these circumstances, the methods of calculation specified above will not apply.

#### 4.2.6 Hardness

Samples will be analyzed for hardness every time they are analyzed for zinc and/or copper. If hardness remains within one banding for all samples, this hardness band will be used for the purpose of assessing compliance with metal standards. However, if hardness data gathered over one, two or three years spans more than one band, the average hardness will be used to assign a hardness band for the purpose of assessing compliance with metal standards.

#### 4.2.7 pH Range

For the pH range, the upper and lower limits of the range are treated as 95-percentile and 5-percentile respectively. A Normal Distribution is used. A site will fail the WQO for pH if the upper confidence limit calculated for the 5-percentile is less than the 5-percentile standard, or if the lower confidence limit calculated for the 95-percentile exceeds the 95-percentile standard, unless the exceptions set out in section 5 below are applicable.

### 4.3 Comparison with Other Assessment Schemes

Some of these statistical methods differ from those generally used to assess compliance with existing EC Directives. The reason for using different methods for assessing compliance with WQOs is that the methods in Directives take no account of the random errors introduced by spot sampling. The methods used to assess compliance with WQOs make allowance for this error by assessing the statistical significance of compliance or failure in a way which makes maximum use of the information obtained from monitoring. This controls the risk of wasting resources on improvements to discharges into compliant sites which might be declared wrongly to have failed because of the effect of chance in sampling. Such differences in method may lead occasionally to differences in compliance, at any given site, assessed against the requirements of a Directive and against the same or similar requirements for the WQO. These will be sites at which the failure is not statistically significant.

## 5.0 DEALING WITH EXCEPTIONAL CIRCUMSTANCES

### 5.1 The Principles Involved

In some instances, exceptional circumstances may require that some or all of the results for certain determinands are not taken into account for the purpose of assessing compliance with a WQO. This will occur in areas where natural conditions give rise to reduced pH and/or elevated metal concentrations, or where these arise from anthropogenic effects which are not readily amenable to controls operated by the NRA. The need to discount data in assessing compliance with WQOs may also arise in respect of BOD where high values arise from dense growths of planktonic algae, which corrupt the analytical techniques used to assess BOD levels. Where, in accordance with the procedures laid down below, 'exceptional circumstances' are identified by the NRA as applying, these will be noted in WQO consultation documentation, and Public Registers will be annotated once WQOs have been set.

WQOs are one of a suite of water quality and pollution control schemes operated by the NRA and, in the short to medium term, may not be the primary vehicle for addressing all water quality problems, for example resulting from acidification. Nevertheless, the approach of proposing an exception as applying due to 'exceptional conditions' will serve to highlight the fact that a problem exists, and the problem will thus remain in the public eye not only during the WQO consultation period but also during periodic reviews, at which time a solution may be identified. This approach also ensures that, where it is not practicable to secure compliance with one or more of these determinands, the remaining River Ecosystem determinands continue to operate to maintain the overall quality of the relevant river stretches, and thus to control the quality of relevant discharges. Where an exception applies to a particular determinand for a subset of samples, compliance will be assessed on the basis of less than 12 samples. Although it is not necessary to assess compliance on the basis of data for all determinands where exceptions have been applied, the NRA will nevertheless analyze samples for all determinands for the purpose of monitoring the current quality of the water. This will assist in the assessment of potential target class when WQOs are subject to periodic review, and in the quantification of problems when evaluating potential solutions.

Given the diversity of sources of copper, zinc and low pH, and the variability in algal abundance, it is not possible to apply a precise statistical definition of 'exceptional circumstances'. Therefore, the results of sample analyses will be treated, for compliance assessment purposes, according to the descriptive procedures set out in sections 5.2 and 5.3 below.

### 5.2 Elevated Values of BOD Resulting from Algae

Substantial growths of planktonic algae can occur in slower flowing, nutrient-rich rivers. Where the algal growth is dense, the algal cells themselves can exert a high BOD during laboratory analysis. However, these elevated BOD values do not necessarily represent the BOD exerted in rivers, or that resulting directly from effluent discharges. If this impact is not excluded from classification and compliance assessment, spurious results may be reported and there is therefore a risk that investment, put in place to improve discharges, will not be targeted efficiently.

In those river stretches where the NRA considers that 'exceptional conditions' exist because planktonic algae are the predominant cause of anomalously high BOD results, the affected BOD data may be set aside when assessing compliance with the WQO. Identification of 'exceptional circumstances' is aided by examination of other factors, for example where non-compliance is driven solely by BOD but values of dissolved oxygen and ammonia are fully compliant with the relevant standards, or where available data indicate high chlorophyll concentrations. Given the diversity of river types occurring throughout England and Wales, nationally consistent mathematical rules for identifying 'exceptional conditions' have not proved possible to derive. Detailed procedures for identifying affected river stretches will therefore be applied at a regional level, according to the descriptive procedures set out above. In many cases, BOD data may be treated as exceptional on a seasonal basis. Thus, if the BOD is found to be adversely affected by algae in four of the twelve samples taken in a calendar year, only the remaining eight un-corrupted data will be used for the purpose of assessing compliance.

### 5.3 Reduced pH and Elevated Zinc and Copper Concentrations

Both low pH and elevated zinc and copper concentrations can arise from natural causes or from anthropogenic inputs, which may be either diffuse or point sources. Point source discharges should be amenable to control through the setting of discharge consents and, for this reason, analytical results will be fully taken into account in assessing compliance with WQOs in river stretches contaminated by point sources.

#### 5.3.1 Natural Sources

Rivers in areas containing base-poor rocks are particularly subject to, and often characterised by, low pH. In these situations, where the water is poorly buffered, natural sources of acidity typically include decaying vegetation (such as peat bogs) or geological mineralisation (for example where



sulphides in underlying rocks oxidise to sulphates during dry periods, resulting in a flush of acidic water when rain subsequently falls).

Natural sources of metal enrichment result from geological mineralisation. The process of mineralisation is accelerated at low pH, when metals become more soluble. Metal concentrations may therefore be temporarily elevated as an indirect result of mineralisation arising from the periodic low pH conditions described above. Acid deposition, which may itself have an anthropogenic cause, tends to accelerate the mineralisation process in acid-vulnerable areas.

Where 'exceptional circumstances' attributable to the above causes have been identified by the NRA as applying permanently, the analytical data for affected parameters (whether pH, zinc or copper, or any combination) will be set aside in assessing compliance. The Public Register will be annotated to this effect in respect of such a WQO.

Where 'exceptional circumstances' relate only to particular weather conditions, the register will be annotated to the effect that in these circumstances analytical data for parameters (whether pH, zinc or copper, or any combination) affected as a result of exceptional circumstances will need to be disregarded in assessing compliance: the affected samples will be annotated to this effect on the Register.

### 5.3.2 Diffuse Sources

Typical relevant sources of diffuse inputs to rivers include runoff, leachate, mine drainage, acidic rainfall or contaminated baseflows. These commonly arise from such sources as waste tips, contaminated land, abandoned mines, runoff from urban areas, the burning of fossil fuels or other anthropogenic activities.

## 6.0 REPORTING ON WQOs AND COMPLIANCE ASSESSMENT

Details of WQOs assigned to river stretches, compliance with WQOs, and the monitoring data upon which compliance assessment is based, together with any of the 'exceptional circumstances' covered by Section 5 above which have been identified by the NRA as applying, will be included on the Public Register.

The NRA will report upon compliance with the requirements of WQOs at each relevant sampling point.

It may be difficult in practice to assess whether reduced pH and/or elevated metal concentrations, apparently arising from genuinely natural causes, are free from all diffuse anthropogenic influences. Equally, diffuse emissions of identifiably anthropogenic origin may not be readily amenable to control though the powers available to the NRA, or indeed may not be causing a permanent problem (for example, where pH is not reduced as the acidic inputs do not exceed the buffering capacity of the catchment).

An approach is adopted accordingly, to situations where compliance with a WQO is jeopardised in respect of pH and/or metals, which addresses whether the source of the problem is, in practicable terms, soluble over an identified timescale, as follows.

Where problems arise which are **attributable to a known responsible party**, and where the responsible party is committed to the improvements necessary to secure compliance with the River Ecosystem Class determinands by the date specified in the Notice establishing the WQO, analytical data will be fully taken into account in assessing compliance with the WQO.

Where problems are identified, but a **solution is possible only in the longer term**, analytical data for the affected determinands (whether pH, zinc or copper, or any combination) will be set aside when assessing compliance, though only on the basis of a time limit specified for this purpose in association with the WQO, and annotated as such in respect of the Public Register entry for the WQO.

Where problems arise but **no practicable solution can yet be identified**, the analytical data for the affected determinands (whether pH, zinc or copper, or any combination) will be set aside when assessing compliance, pending periodic review and the possible identification of a solution. In these circumstances, the Public Register will be annotated to this effect in respect of the WQO.

For many river stretches, a single sampling point will represent the water quality in the stretch for which the WQO has been applied. However, for the formal purpose of assessing compliance with WQOs where multiple sampling points exist within a river stretch, the stretch will only be deemed to comply with its WQO if all sampling points within the stretch comply with the requirements of the WQO.

## Appendix 1: Weighting Factors for the Calculation of Confidence Limits for the Purpose of WQO Compliance Assessment

The weighting factor used in the calculation of 95% confidence limits are shifted T-test numbers<sub>3</sub>. For convenience, the weighting factors for calculation of confidence limits for up to 72 analytical results are listed below.

No. Samples	10 or 90-%iles	5 or 95-%iles	No. Samples	10 or 90-%iles	5 or 95-%iles
4	0.4428	0.7434	39	0.9655	1.2928
5	0.5177	0.8179	40	0.9691	1.2967
6	0.5737	0.8748	41	0.9725	1.3005
7	0.6180	0.9204	42	0.9758	1.3041
8	0.6541	0.9581	43	0.9790	1.3077
9	0.6845	0.9900	44	0.9821	1.3111
10	0.7105	1.0174	45	0.9851	1.3144
11	0.7330	1.0413	46	0.9881	1.3176
12	0.7529	1.0625	47	0.9909	1.3207
13	0.7706	1.0815	48	0.9936	1.3237
14	0.7866	1.0985	49	0.9963	1.3267
15	0.8011	1.1140	50	0.9989	1.3295
16	0.8143	1.1282	51	1.0014	1.3323
17	0.8264	1.1412	52	1.0038	1.3350
18	0.8375	1.1532	53	1.0062	1.3376
19	0.8477	1.1643	54	1.0085	1.3402
20	0.8573	1.1747	55	1.0108	1.3427
21	0.8662	1.1843	56	1.0130	1.3451
22	0.8745	1.1934	57	1.0151	1.3475
23	0.8824	1.2019	58	1.0172	1.3498
24	0.8897	1.2099	59	1.0192	1.3521
25	0.8967	1.2175	60	1.0212	1.3543
26	0.9033	1.2247	61	1.0232	1.3564
27	0.9095	1.2315	62	1.0251	1.3585
28	0.9154	1.2379	63	1.0269	1.3606
29	0.9210	1.2441	64	1.0288	1.3626
30	0.9264	1.2499	65	1.0305	1.3646
31	0.9315	1.2555	66	1.0323	1.3665
32	0.9364	1.2609	67	1.0340	1.3684
33	0.9411	1.2660	68	1.0356	1.3702
34	0.9456	1.2709	69	1.0373	1.3720
35	0.9499	1.2756	70	1.0389	1.3738
36	0.9540	1.2802	71	1.0404	1.3755
37	0.9580	1.2846	72	1.0420	1.3772
38	0.9618	1.2888			

These weighting factors can be calculated from Pearson E.S. and Hartley H.O. (1972). *Biometrika Tables for Statisticians*. Vol.II. Cambridge University Press.

## **ANNEX 3**

### **General Quality Assessment Databases**

#### **General Quality Assessment River Chemistry and Biology Databases**

## **Annex 3**

Procedural Manual: 5.1

# **General Quality Assessment**

## **RIVER CHEMISTRY & BIOLOGY**

### **Databases**

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# DATABASES FOR GENERAL QUALITY ASSESSMENT

## 1 HOW THIS MANUAL IS ORGANISED

- 1.1 These notes define the items of data stored on the databases and the exact format for each type of item. There is an Index on page 28.
- 1.2 For ease of management, the structure has been arranged as several linkable databases:
  - the **STRETCH DATABASE**: a database of fixed information like the Stretch Name, Stretch Code and Map References. This is described in Section 2. Turn to Section 10 for advice on how this is updated.
  - a supporting database of Chemical and Biological Sampling Points. This gives the history of each stretch since 1990 in terms of the Sampling Points used to classify the stretch. This is described in Section 3. This is updated automatically when you send in data for a new year (Section 9).
  - supporting databases, each holding information on water quality, the calculated results of the Survey, and the calculated values of the Risk of Misclassification. These are called the 1988/90 **SURVEY DATABASE**, the 1991/2 **CHEMICAL GQA DATABASE**, the 1991/3 **CHEMICAL GQA DATABASE** etc; These are described in Sections 4 and 5.
  - supporting databases, one for each year, each holding the information on water quality provided by Regions and used to classify the stretches. These are called the 1991 **CHEMICAL GQA DATABASE**, the 1992 **CHEMICAL GQA DATABASE** etc. These are described in Sections 6.
  - databases that hold information for Nutrients and Aesthetic Pollution. These are called the 1995 **NUTRIENT GQA DATABASE**, the 1995 **AESTHETIC GQA DATABASE** etc. These are described in Section 7 and 8.
- 1.3 The individual fields in each database are listed and defined in this Manual. Each database has its own section separate, stand-alone section even though this does make for some duplication of the text.
- 1.4 The structure of the databases was based on the principle that each **Record** is a Stretch of river. This is because the only practical database is one in which each Record has only one field in which to specify river length. Whenever we need to sub-divide the length of river represented by an existing record we re-define the existing Record as two (or more) Records (See Paragraph 2.5 e.) .
- 1.5 Not all fields were mandatory for the 1990 Survey. Those which were have paragraph numbers in bold type, as in 2.3, 2.5.
- 1.6 Quite a lot on non-mandatory fields have been added since 1990. Part of the purpose

of this is to allow Regions to have a single data-base for both Regional and National purposes.

- 1.7 Some of the original fields are now considered redundant. These appear as text. The values previously assigned to these fields may still be recoverable at present, but they are no longer dealt with as part of the official data-base, and they may be deleted without warning at some future date.
- 1.8 Where there is no entry for a field, it will have been left blank.
- 1.9 Items which originated in Regions are indicated by normal numbering of the paragraphs as in 4.7. Items which were calculated at Anglian and passed back to Regions are indicated by a suffix<sup>1</sup> as in 4.16<sup>1</sup>.
- 1.10 Data were transferred between Regions as ASCII or dBASE files. Several Regions set up dBASE systems. For ASCII files, the fields were separated by a unique character (for example, the pipe-character |).
- 1.11 The fields for each database are set out below, starting overleaf.

## 2 STRETCH DATABASE

2.1 These notes define the items of data stored on the STRETCH DATABASE and the exact format for each type of item. There is an Index on page 28.

2.2 the **Code Number** for the your **Region** (*2 right adjusted numeric characters, space-filled with zeroes*). The codes are:

01	Anglian
02	Northumbria
03	North West
04	Severn Trent
05	Southern
06	South West
07	Thames
08	Welsh
09	Wessex
10	Yorkshire

These are the old Regions. We shall retain these codes until the 1995 Survey in order to simplify checking.

2.3 the **River Name** (*up to 25 left-adjusted characters*).

2.4 the **Stretch Name** (*up to 40 left-adjusted characters*).

2.5 the **Stretch Code** (*13 characters in 5 fields*).

The Code must be unique to your Region (so that, with the Region Code, [2.2], it is a unique code within the NRA). Past codes were made up from the following items:

- a. the **Hydrometric Area Number** (*3 right-adjusted characters, space-filled with zeroes*);
- b. the **River Basin Number** (*2 right-adjusted numeric characters, space-filled with zeroes*);
- c. the **River Number** (*5 right-adjusted numeric characters, spaced-filled with zeroes*);



- d. the **Stretch Number** (2 right-adjusted numeric characters, space-filled with zeroes);

to which we add:

- e. a code, the **Split Code**, allowing you to split the Stretch into smaller stretches (1 character, an upper-case letter in the sequence, A, B, C, etc in the upstream direction). Leave blank where not needed;

As in:

036	01	0030	01	
-----	----	------	----	--

- 2.6 a **Saline Code** identifying whether the Stretch is on an estuary (1 character, the upper-case letter, S, for Saline). Leave a blank field if the Stretch is not estuarine. In the past, before the creation of the NRA, the Saline Code was part of the Stretch Code. This meant that an estuarine stretch and a river stretch could have the same Stretch Code apart from the saline indicator. You may prefer to distinguish these stretches by using the Split Code (Paragraph 2.5 e.) to relabel one of the stretches.
- 2.7 a **Canal Code** identifying whether the Stretch is a Canal (1 character, the upper-case letter, C). Leave this blank if the Stretch is not a canal.
- 2.8 a **Divide Code** identifying whether the Stretch is formed by a bifurcation of the river (1 character, the upper-case letter, D, indicating a Divided Stretch). Leave blank if this does not apply.
- 2.9 the **Length** of the Stretch (in km.) (6 right-adjusted numeric characters) (to one place of decimals). As in:

■	■	■	1.0
---	---	---	-----

In this and elsewhere, ■ indicates a space.

- 2.10 the **Category of the River Flow** (1 character). Stretches are placed in categories according to an estimate of the long term average natural flow at the end of the stretch:

1	<	0.31 cumecs
2	<	0.62
3	<	1.25
4	<	2.5
5	<	5.0
6	<	10
7	<	20
8	<	40
9	<	80
0	>	80

**2.11** the **Upstream Map Reference** (*12 characters*);

If you can provide only 8 or 10 figure map references then code these with intervening spaces and not zeros. As in:

TL876■ ■ 123■

and not:

TL8760012300

except for a true 12-figure Map Reference.

**2.12** the **Downstream Map Reference** (*12 characters, see 2.11*).

**2.13** whether the BOD is Exempted (*1 character, blank to include, E to exempt*).

**2.14** the River Ecosystem Class which forms the **Quality Objective** for the Stretch (*one characters: 1, 2, 3, 4, or 5*). Leave this blank if unavailable.

This field will be made mandatory if we are asked or decide to do maps which show water quality relative to what is required as well as in the absolute terms expressed by the GQA. This was an occasional criticism of the 1990 GQA Survey.

The Objective should be that achieved now or within 5-10 years and not some ultimate Objective.

**2.15** whether the Stretch is designated under the Fisheries Directive. (*one characters: 1, 2, or 0 for Salmonid, Cyprinid and Undesignated, respectively*). Leave this blank if unavailable.

**2.16** the code name of the **CURRENT Chemical Sampling Point** (if any) (*up to 15 left-adjusted characters*). Leave blank if none).

**2.17** the **Grid Reference** for the Current Chemical Sampling Point (*12 characters, see 2.11*). For Stretches which have more than one sampling point, split the Stretches and report each section separately (using the Split Code defined at 2.5e, above).

**2.18** the **Name of the Current Chemical Sampling Point** expressed in English, for example:

River Stour at the B123 Road Bridge

(*up to 50 left-adjusted characters*) (See Section 3 for previous Sampling Points)

## STATUTORY REASONS FOR MONITORING

- 2.19 whether the Point is designated for List I of the Dangerous Substances Directive (*one characters: Y or N for Yes or No*).
- 2.20 whether the Point is designated for List II of the Dangerous Substances Directive. (*one character: Y or N for Yes or No*).
- 2.21 whether the Point is part of the Harmonised Monitoring Programme (*one character: Y or N for Yes or No*).
- 2.22 whether the Point is used for monitoring for the Paris Commission and Annex Ia (*one characters: Y or N for Yes or No*).
- 2.23 whether the Point is designated under the Surface Water Directive (*one characters: Y or N for Yes or No*).
- 2.24 whether the Point is part of the National Network (*one characters: Y or N for Yes or No*).
- 2.25 whether the Point is monitored for the purposes of the Urban Waste Water Treatment Directive (*one characters: Y or N for Yes or No*).

## GQA SAMPLING

- 2.26 A single character indicating the prime reason for sampling for GQA - upstream or downstream of a tributary (T), upstream or downstream of a discharge from a Sewage Treatment Works (S), upstream or downstream of a discharge from Industry (I), a site of actual or potential change in water quality (Q).
- 2.27 A single character indicating the reason the point was retained after the GQA Review in 1994 - results of LAPWING (L), change in GQA or River Ecosystem Class (C), change in biology (B), sole site on classified tributary (T), Regional Need (R).

## BIOLOGY

- 2.28 the Within-Region Biological Site Reference of the Current **Biological Sampling Point** (if any) (*up to 4 characters, leave blank if none*).

This field is the hook into our biological databases and so the code must be EXACTLY the same as the one used by the biologist for Site Registration for the 1990 Survey.

The Full Biological Site Reference is made up of:

- a. the characters 'NRA';
- b. the two digit code for the NRA Region (as Item 2.2).

(These two items were pre-printed on the Biological Site Registration Form used for the 1990 Survey).

- c. a four character code, provided by the biologist, which is a unique code for the site within your Region.

Only item c is entered in this field.

2.29 the code name of the **CURRENT Biological Sampling Point** (if any) (*up to 15 left-adjusted characters. Leave blank if none*).

2.30 the **Grid Reference** for the Biological Sampling Point (*12 characters, see 2.11*). For Stretches which have more than one sampling point, split the Stretches and report each section separately (using the Split Code defined at Paragraph 2.5 e.).

2.31 the **Name of the Biological Sampling Point** expressed in English, for example:

River Stour at the B123 Road Bridge

*(up to 50 left-adjusted characters)*

### 3 SAMPLE POINT CODES

3.1 This database gives for every Record, the Chemical Sampling points used to classify for 1990, 1991, 1992 etc.

3.2 the **Stretch Code** (*13 characters in 5 fields*).

The Code must be unique to your Region (so that, with the Region Code, [2.2], it is a unique code within the NRA). Past codes were made up from the following items:

- a. the **Hydrometric Area Number** (*3 right-adjusted characters, space-filled with zeroes*);
- b. the **River Basin Number** (*2 right-adjusted numeric characters, space-filled with zeroes*);
- c. the **River Number** (*5 right-adjusted numeric characters, space-filled with zeroes*);
- d. the **Stretch Number** (*2 right-adjusted numeric characters, space-filled with zeroes*);

to which we add:

- e. a code, the **Split Code**, allowing you to split the Stretch into smaller stretches (*1 character, an upper-case letter in the sequence, A, B, C, etc in the upstream direction*). Leave blank where not needed;

As in:

036	01	0030	01	
-----	----	------	----	--

3.3 the code name of the **Chemical Sampling Point** for 1988/90 (if any) (*up to 15 left-adjusted characters. Left blank if none*)

3.4 the code name of the **Chemical Sampling Point** used in 1991 (if any) (*up to 15 left-adjusted characters. Leave blank if none*)

(This field will have been filled automatically as the 1990 Sampling Point and then overwritten by whatever point was specified by the Region in the data sent to Anglian for 1991).

3.5 the code name of the **Chemical Sampling Point** used in 1992 (if any) (*up to 15 left-adjusted characters. Leave blank if none*).

This field will have been filled automatically as the previous Sampling Point and then overwritten with whatever (non-blank) point was specified by

Regions in the data sent to Anglian for 1992.

- 3.6 the code name of the **Chemical Sampling Point** used in 1993 (if any) (*up to 15 left-adjusted characters. Leave blank if none*).

This field will have been filled automatically as the previous Sampling Point or with whatever point specified by Regions when they submitted data to Anglian for 1993.

## 4 1988/90 SURVEY DATABASE

4.1 This database holds the results for Chemical Quality and Biological Quality which were provided by Regions. It also contains the results of classification and the Risks of Mis-classification.

4.2 The **Stretch Code** (13 characters in 1 to 5 fields). As specified in the STRETCH DATABASE in Field [2.5].

The Code must be unique to your Region (so that, with the Region Code, [2.2], it is a unique code within the NRA). Past codes were made up from the following items:

- a. the **Hydrometric Area Number** (3 right-adjusted characters, space-filled with zeroes);
- b. the **River Basin Number** (2 right-adjusted numeric characters, space-filled with zeroes);
- c. the **River Number** (5 right-adjusted numeric characters, space-filled with zeroes);
- d. the **Stretch Number** (2 right-adjusted numeric characters, space-filled with zeroes);
- e. a code, the **Split Code**, allowing you to split the Stretch into smaller stretches (1 character, an upper-case letter in the sequence, A, B, C, etc in the upstream direction). This field is left blank where not needed;

As in:

036	01	0030	01	
-----	----	------	----	--

## CHEMICAL DATA FOR 1988/90

4.3 the **Mean BOD** in mg/l for the three calendar years from 1988 to 1990 (up to 6 right-adjusted numeric characters) (to two places of decimals). As in:

■ ■ 1.56
----------

4.4 the **Standard Deviation of BOD** in mg/l for the three calendar years from 1988 to 1990 (up to 6 right-adjusted numeric characters) (to two places of decimals).

- 4.5 the **Number of Samples for BOD** for the three calendar years from 1988 to 1990 (*up to 4 right-adjusted numbers*), expressed as an integer (no decimal point). As in:

■ ■ 35

- 4.6<sup>1</sup> the **90-percentile BOD** in mg/l for 1988/90 as calculated by the standard procedure for the 1990 Chemical Grade (*up to 6 right-adjusted numeric characters*) (to two places of decimals). As in:

■ ■ 5.65

(The suffix <sup>1</sup> indicates that this item was calculated at Anglian Region.)

- 4.7 the **Mean Ammonia** in mgN/l for the three calendar years from 1988 to 1990 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 4.8 the **Standard Deviation of Ammonia** in mgN/l for the three calendar years from 1988 to 1990 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 4.9 the **Number of Samples for Ammonia** for the three calendar years from 1988 to 1990 (*up to 4 right-adjusted numbers*) (an integer - no decimal point).
- 4.10<sup>1</sup> the **90-percentile Ammonia** in mgN/l for 1988/90 as calculated for the 1990 Chemical Grade (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 4.11 the **Mean Dissolved Oxygen** as % saturation for the three calendar years from 1988 to 1990 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 4.12 the **Standard Deviation of Dissolved Oxygen** as % saturation for the three calendar years from 1988 to 1990 (*no more than 6 right-adjusted numeric characters*) (to two places of decimals).
- 4.13 the **Number of samples for Dissolved Oxygen** for the three calendar years from 1988 to 1990 (*up to 4 right-adjusted numeric characters*) (an integer - no decimal point).
- 4.14<sup>1</sup> the **10-percentile Dissolved Oxygen** as % saturation for 1988/90 as calculated for the 1990 Chemical Grade in 1992 (*no more than 6 right-adjusted numeric characters*) (to two places of decimals).



## CHEMICAL GQA CALCULATED FOR 1988/90

- 4.15<sup>1</sup> the Face-value **Chemical GQA Grade** for **1988/90** (*one character*; the values: A,B,C,D, E or F). Left blank if the stretch was not graded or for estuaries.
- 4.16<sup>1</sup> the Percentage Confidence that the site was in **Chemical Grade A** in 1988/90 (*up to 5 right-adjusted numeric characters*) (to one place of decimals) as in:
- 56.4
- 4.17<sup>1</sup> the Percentage Confidence that the site was in **Grade B** in 1988/90 (*up to 5 right-adjusted numeric characters*) (to one place of decimals);
- 4.18<sup>1</sup> the Percentage Confidence that the site was in **Grade C** in 1988/90 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 4.19<sup>1</sup> the Percentage Confidence that the site was in **Grade D** in 1988/90 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 4.20<sup>1</sup> the Percentage Confidence that the site was in **Grade E** in 1988/90 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 4.21<sup>1</sup> the Percentage Confidence that the site was in **Grade F** in 1988/90 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).

## BIOLOGICAL DATA FOR 1990

- 4.22 the **Combined-two-season ASPT** for **1990** (*up to 5 right-adjusted characters*) (to two places of decimals). As in:
- 4.11
- 4.23 the **RIVPACS** prediction of the **Combined-two-season ASPT** for **1990** (*up to 5 right-adjusted numeric characters*) (to two places of decimals).
- 4.24 the **Combined-two-season Number of Taxa** for **1990** (*up to 4 right-adjusted numeric characters, no decimal places*). As in:

■ ■ 24

- 4.25 the RIVPACS prediction of the **Combined-two-season** Number of Taxa for **1990** (*up to 5 right-adjusted numeric characters*) (to one place of decimals).  
As in:

■19.3

- 4.26 the **Number of Biological Samples** used to compute the results for **1990** (*up to 2 right-adjusted numeric characters*). This will usually be 2. There may be some cases where the Combined-two-season results are based on one sample.
- 4.27 the **EQI for the Combined-two-season ASPT** for **1990** (*up to 5 right-adjusted numeric characters*, two decimal places).
- 4.28 the **EQI for the Combined-two-season Number of Taxa** for **1990** (*up to 5 right-adjusted numeric characters*, two decimal places).

#### **BIOLOGICAL GQA\GRADING CALCULATED FOR 1990**

- 4.29<sup>1</sup> the calculated **Face-value Biological Grade** for **1990** according to the ANTAX System (*1 character*: the values: 1, 2, 3, 4). Left blank if ungraded or for estuaries. Where Stretches ended up with segments in different Grades. You would have split these up into new Stretches (using the Split Code defined at Paragraph 2.5 e.) and reported each segment as a separate Stretch with its own record.
- 4.30<sup>1</sup> the **Percentage Confidence** that the site was in **Biological ANTAX-Grade 1** in **1990** (*up to 5 right-adjusted numeric characters*) (to one place of decimals)  
as in:

■65.1

- 4.31<sup>1</sup> the **Percentage Confidence** that the site was in **Biological ANTAX-Grade 2** in **1990** (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 4.32<sup>1</sup> the **Percentage Confidence** that the site was in **Biological ANTAX-Grade 3** in **1990** (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 4.33<sup>1</sup> the **Percentage Confidence** that the site was in **Biological ANTAX-Grade 4** in **1990** (*up to 5 right-adjusted numeric characters*) (to one place of decimals).

## 5 1991/x CHEMICAL GQA DATABASE

- 5.1 These databases hold the results for Chemical Quality which were provided by Regions. It will have been updated by any subsequent corrections.
- 5.2 The databases also contains the results of classification and the Risks of Misclassification. These results were sent to Regions as .CSV files on diskettes.
- 5.3 The databases contain no information on Biology.
- 5.4 There is one of these databases for 1991/2, 1991/3 and all other combinations of years for which reports have been requested by National Head Office.
- 5.5 They are called the 1991/2 CHEMICAL GQA DATABASE, the 1991/3 CHEMICAL GQA DATABASE, etc
- 5.6 Regions provided sets of data for each calendar year. These were combined to give a set of data for 1991/2 or 1991/3 etc using the method described in the Procedural Manual.
- 5.7 The 1991/2 database provided the results for the first national report on the GQA<sup>1</sup>
- 5.8 the **Stretch Code** (13 characters in 1 to 5 fields). As given in the STRETCH DATABASE in Field [2.5].

### CHEMICAL DATA FOR 1991/x

- 5.9 the **Mean BOD** in mg/l for the calendar year of 1991/2 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.10 the **Standard Deviation of BOD** in mg/l for the calendar year of 1991/2 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.11 the **Number of Samples for BOD** for the calendar year of 1991/2 (*up to 4 right-adjusted numbers*), expressed as an integer (no decimal point).
- 5.12<sup>1</sup> the **90-percentile BOD** in mg/l for 1991/2 as calculated by the standard procedure for the 1992 Chemical Grade (*up to 6 right-adjusted numeric characters*) (to two places of decimals).

---

<sup>1</sup> National Rivers Authority. *The Quality of Rivers and Canals in England and Wales (1990 to 1992)*. Water Quality Series No.19. May, 1994.

- 5.13 the **Mean Ammonia** in mgN/l for the calendar year of 1991/2 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.14 the **Standard Deviation of Ammonia** in mgN/l for the calendar year of 1991/2 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.15 the **Number of Samples for Ammonia** for the calendar year of 1991/2 (*up to 4 right-adjusted numbers*) (an integer - no decimal point).
- 5.16<sup>1</sup> the **90-percentile Ammonia** in mgN/l for 1991/2 as calculated for the 1992 Chemical Grade (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.17 the **Mean Dissolved Oxygen** as % saturation for the calendar year of 1991/2 (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.18 the **Standard Deviation of Dissolved Oxygen** as % saturation for the calendar year of 1991/2 (*no more than 6 right-adjusted numeric characters*) (to two places of decimals).
- 5.19 the **Number of Samples for Dissolved Oxygen** for the calendar year of 1991/2 (*up to 4 right-adjusted numeric characters*) (an integer - no decimal point).
- 5.20<sup>1</sup> the **10-percentile Dissolved Oxygen** as % saturation for 1988/90 as calculated for the 1990 Chemical Grade in 1992 (*no more than 6 right-adjusted numeric characters*) (to two places of decimals).

#### CHEMICAL GRADING CALCULATED FOR 1991/x

- 5.21<sup>1</sup> the **Face-value Chemical Grade** for 1992 (1991/2) (*1 character: the values: A, B, C, D, E or F*). Left blank if the stretch was not graded or for estuaries.
- 5.22<sup>1</sup> the **Percentage Confidence** that the site was in **Chemical Grade A** in 1991/2 (*up to 5 right-adjusted numeric characters*) (to one place of decimals) as in:

■ 56.4

- 5.23<sup>1</sup> the **Percentage Confidence** that the site was in **Grade B** in 1991/2 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 5.24<sup>1</sup> the **Percentage Confidence** that the site was in **Grade C** in 1991/2 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).
- 5.25<sup>1</sup> the **Percentage Confidence** that the site was in **Grade D** in 1991/2 (*up to 5*

*right-adjusted numeric characters*) (to one place of decimals).

5.26<sup>1</sup> the Percentage Confidence that the site was in **Grade E** in 1991/2 (*up to 5 right-adjusted numeric characters*) (to one place of decimals).

5.27<sup>1</sup> the Percentage Confidence that the site was in **Grade F** in 1991/2 (*up to 5 right-adjusted numeric characters*) (to one place of decimals)

## 6 199x CHEMICAL GQA DATA

- 6.1 This database holds the results for Chemical Quality which were provided by Regions. It contains no information for biology.
- 6.2 There is one of these Databases for 1991, 1992, 1993 and all subsequent years for which the GQA is reported on the national scale.
- 6.3 the **Stretch Code** (13 characters in 1 to 5 fields). As given in the STRETCH DATABASE in Field [2.5].

The Code must be unique to your Region (so that, with the Region Code, [2.2], it is a unique code within the NRA). Past codes were made up from the following items:

- a. the **Hydrometric Area Number** (3 right-adjusted characters, space-filled with zeroes);
- b. the **River Basin Number** (2 right-adjusted numeric characters, space-filled with zeroes);
- c. the **River Number** (5 right-adjusted numeric characters, space-filled with zeroes);
- d. the **Stretch Number** (2 right-adjusted numeric characters, space-filled with zeroes);
- e. a code, the **Split Code**, allowing you to split the Stretch into smaller stretches (1 character, an upper-case letter in the sequence, A, B, C, etc in the upstream direction). Leave blank where not needed;

As in:

0	3	6	0	1	0	0	3	0	0	1		
---	---	---	---	---	---	---	---	---	---	---	--	--

- 6.4 the code name of the **Chemical Sampling Point** (if any) (up to 15 left-adjusted characters. Leave blank if there is no sampling point).
- 6.5 the **Mean BOD** in mg/l for the calendar year of 199x (up to 6 right-adjusted numeric characters) (to two places of decimals).
- 6.6 the **Standard Deviation of BOD** in mg/l for the calendar year of 199x (up to 6 right-adjusted numeric characters) (to two places of decimals).
- 6.7 the **Number of Samples for BOD** for the calendar year of 199x (up to 4 right-adjusted numbers), expressed as an integer (no decimal point).
- 6.8 the **Mean Ammonia** in mgN/l for the calendar year of 199x (up to 6 right-adjusted numeric characters) (to two places of decimals).

- 6.9 the **Standard Deviation of Ammonia** in mgN/l for the calendar year of 199x (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 6.10 the **Number of Samples for Ammonia** for the calendar year of 199x (*up to 4 right-adjusted numbers*) (an integer - no decimal point);
- 6.11 the **Mean Dissolved Oxygen** as % saturation for the calendar year of 199x (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 6.12 the **Standard Deviation of Dissolved Oxygen** as % saturation for the calendar year of 199x (*no more than 6 right-adjusted numeric characters*) (to two places of decimals).
- 6.13 the **Number of Samples for Dissolved Oxygen** for the calendar year of 199x (*up to 4 right-adjusted numeric characters*) (an integer - no decimal point).

## 7 199x NUTRIENT GQA DATA

### Illustrative draft only .....

7.1 This database holds the results for Nutrient Quality which will be provided by Regions.

7.2 the **Stretch Code** (13 characters in 1 to 5 fields). As given in the STRETCH DATABASE in Field [2.5].

The Code must be unique to your Region (so that, with the Region Code, [2.2], it is a unique code within the NRA). Past codes were made up from the following items:

- a. the **Hydrometric Area Number** (3 right-adjusted characters, space-filled with zeroes);
- b. the **River Basin Number** (2 right-adjusted numeric characters, space-filled with zeroes);
- c. the **River Number** (5 right-adjusted numeric characters, space-filled with zeroes);
- d. the **Stretch Number** (2 right-adjusted numeric characters, space-filled with zeroes);
- e. a code, the **Split Code**, allowing you to split the Stretch into smaller stretches (1 character, an upper-case letter in the sequence, A, B, C, etc in the upstream direction). Leave blank where not needed;

As in:

036	01	0030	01	
-----	----	------	----	--

7.3 the code name of the **Chemical Sampling Point** (if any) (up to 15 left-adjusted characters. Leave blank if there is no sampling point.

7.4 the **Median Phosphate** in mg/l for the calendar year of 199x (up to 6 right-adjusted numeric characters) (to two places of decimals).

7.5 the **Mean Phosphate** in mg/l for the calendar year of 199x (up to 6 right-adjusted numeric characters) (to two places of decimals).

7.6 the **Standard Deviation of Phosphate** in mg/l for the calendar year of 199x (up to 6 right-adjusted numeric characters) (to two places of decimals).

7.7 the **Number of Samples for Phosphate** for the calendar year of 199x (up to 4 right-adjusted numbers), expressed as an integer (no decimal point).



- 7.8 the **Median Total Oxidised Nitrogen** in mgN/l for the calendar year of 199x (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 7.9 the **Mean Total Oxidised Nitrogen** in mgN/l for the calendar year of 199x (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 7.10 the **Standard Deviation of Total Oxidised Nitrogen** in mgN/l for the calendar year of 199x (*up to 6 right-adjusted numeric characters*) (to two places of decimals).
- 7.11 the **Number of Samples for Total Oxidised Nitrogen** for the calendar year of 199x (*up to 4 right-adjusted numbers*) (an integer - no decimal point).

**Illustrative draft only .....**

8.1 This database holds the results for Aesthetic Quality which will be provided by Regions.

8.2 the **Stretch Code** (*13 characters in 1 to 5 fields*). As given in the STRETCH DATABASE in Field [2.5].

The Code must be unique to your Region (so that, with the Region Code, [2.2], it is a unique code within the NRA). Past codes were made up from the following items:

- a. the **Hydrometric Area Number** (*3 right-adjusted characters, space-filled with zeroes*);
- b. the **River Basin Number** (*2 right-adjusted numeric characters, space-filled with zeroes*);
- c. the **River Number** (*5 right-adjusted numeric characters, space-filled with zeroes*);
- d. the **Stretch Number** (*2 right-adjusted numeric characters, space-filled with zeroes*);
- e. a code, the **Split Code**, allowing you to split the Stretch into smaller stretches (*1 character, an upper-case letter in the sequence, A, B, C, etc in the upstream direction*). Leave blank where not needed;

As in:

036	01	0030	01	
-----	----	------	----	--

8.3 the code name of the **Chemical Sampling Point** (if any) (*up to 15 left-adjusted characters*). Leave blank if there is no sampling point or if the point is the same as in the STRETCH DATABASE).

8.4 the nine scores recorded for Aesthetic Quality [ ? ]

## 9 ADDING NEW CHEMICAL DATA FOR A YEAR

9.1 This section describes how the National Database is updated with water quality data for a new year.

9.2 As set out above, the National Database consists of several linked databases. There is:

- the **STRETCH DATABASE**. This holds fixed information like the Stretch Name, Stretch Code and Map References; and,
- supporting databases, one for each year, holding information on water quality for that year. These are called the **1990 WATER QUALITY DATABASE**, the **1992 WATER QUALITY DATABASE** etc.

### Stretch Code

9.3 The key field is the Stretch Code [2.5]. This is the sole guaranteed unique identifier of the stretch and it is used to define the link between databases and to patch in new or updated data.

### Data for 199x

9.4 You need to send 9 new numbers for each stretch that will be assigned a GQA Class, and two identifying fields. These cover:

- the **Stretch Code**; and,
- the **Chemical Sampling Point Code**; plus:
- the mean, standard deviation and number of samples for BOD;
- the mean, standard deviation and number of samples for Dissolved Oxygen (% saturation); and,
- the mean, standard deviation and number of samples for Ammonia.

9.5 To help with identification you may like to add the River Name and the Stretch Name.

9.6 Stretches on the **STRETCH DATABASE** for which you send no data for 199x will be assumed to have no samples for 199x.

9.7 Please impose **NO** cut-off points in respect of numbers of samples. If there are only 2 or 3 sample results for a Sampling point then the results for these should be included.

- 9.8            There is no need for you to provide estimates of any percentiles. However it may be simplest for you to use the systems your Region used to send me the data for past Surveys. If this means that you send me more than asked for then this is no problem so long as you explain which fields are surplus.
- 9.9            You must use the rules devised for the 1990 Survey in assembling your data and for the calculation of means and standard deviations.
- 9.10          No biological data are required.
- 9.11          Send no water quality data for estuaries.
- 9.12          The lengths and formats of the fields are specified in this Manual. The data may be sent either as dBASE files or as ASCII files.
- 9.13          Please send your files on diskettes. If appropriate include a note which identifies any differences from the sequences of fields listed in this Manual).
- 9.14          For any queries concerning the transfer of data please contact Carolyn Ullmer at Anglian Region.
- 9.15          Carolyn Ullmer will check your data and chase you about:
- any Stretches on the STRETCH DATABASE, assigned a Class in the past, for which you send no data for 199x; and,
- any Stretches for which you send data for 199x that are not included on the STRETCH DATABASE.
- 9.16          Carolyn will also send you lists of stretches which appear to change quality from one year to the next. This will help track down errors in river quality data.
- 9.17          The data for 199x will be merged with that held already for previous years and the GQA reported for the three year period to 199x.
- 9.18          The results will be returned to you on diskette.

## 10 HOW TO UPDATE THE STRETCH DATABASE

- 10.1 One or two of us may need to update the **STRETCH DATABASE**. This may be necessary, for example, if we have created new stretches or discovered errors in some of the old records.
- 10.2 Some of the original Stretches may need to be split into two or more smaller Stretches.
- 10.3 You may have merged stretches which were reported separately in the past. Whatever you may have done at Region, such stretches will still appear as separate records on the National Database, though perhaps with an identical Sampling Point for 199x. This discipline is necessary in order to preserve our ability to re-produce the results of the 1990 Survey.
- 10.4 Separate Stretches can be merged into a single record only if all the entries for all the fields are identical from 1990 to 1993.
- 10.5 Our experience from 1992 has required that we stipulate that requests for updates of the **STRETCH DATABASE** should be sent to Anglian as a fax or memo.
- 10.6 Please specify in this the names and Stretch Codes of new stretches which must be added to the **STRETCH DATABASE** and the names and Stretch Codes of stretches whose data have changed (and which must replace the entries currently in the **STRETCH DATABASE**).
- 10.7 For stretches which have been split we need to know the name and Stretch Code of the original stretch and the names and Stretch Codes of the new stretches. Carolyn can then prepare the Database to accept new data.
- 10.8 For each new or updated record on the database, we shall then need to know all the correct entries for all the fields, specified in Section 2, for the **STRETCH DATABASE**. Where the number of records is small you can send these data on hard copy. Contact Carolyn for other options.
- 10.9 For the present, it may be that some fields can be left blank for the present, Map References and Biological Sampling Points, for example. For split stretches it may be that you can instruct us to carry over into the new stretches some of the entries made for the original stretch.
- 10.10 If your modifications are extensive, please contact Carolyn Ullmer to discuss them.

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## **ANNEX 4**

### **General Quality Assessment Technical Background**

#### **General Quality Assessment River Chemistry Technical Background**



## **Annex 4**

Procedural Manual: 000

# **General Quality Assessment RIVER CHEMISTRY Technical Background**

# GENERAL QUALITY ASSESSMENT: River Chemistry

## Technical Background

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## GENERAL QUALITY ASSESSMENT: River Chemistry

### 1 INTRODUCTION

- 1.1 This Manual describes how we put rivers in a Chemical Grade. Anyone using these notes, with the data stored on the Public Registers, should be able to check our calculations.
- 1.2 Our reports include maps showing the Gradings of rivers. For this we place stretches in the **Face-value Grade**. Our procedure for doing this is in Section 2.
- 1.3 The Face-value Grade is the result of the normal and straightforward way most people have assigned Grade in the past. Nearly always this gives the estimate of that Grade which is the most likely - the Grade which has the greatest statistical confidence that it is the **True Grade**.
- 1.4 Section 3 discusses errors in grading and explains how we control their impact.

### 2 ASSIGNING GRADE

#### 2.1 Procedure

- 2.1.1 In fixing a Grade to a river we adopt the following procedure throughout England & Wales:
  - For each sampling site, we assign the stretch of river which the site could characterise.
  - If the site falls into a Grade, then the entire stretch is given that Grade.
  - Only the results from the routine, predetermined sampling programmes are used.
  - We use the data collected over three years.
  - Within these programmes, all the chemical results collected over the three years 1988-90 are included. No outliers are excluded.
  - Sites with less than 9 samples for BOD, Ammonia and Dissolved Oxygen are not graded.

- It is inevitable that a small number of the results are found to be smaller than the capabilities of the laboratory to detect low concentrations. These results are quoted as "less-than" values on the NRA's archives. Such results are taken as half the "less-than" value when used to assign Grade. On rare occasions, the results for BOD are declared as "greater-than". These are taken as the value specified.
- A standard **Parametric Method** (described from paragraph 2.4) is used to estimate percentiles for the chemical determinands.
- The estimates of the percentiles are compared with the standards in Table 1. Grade is assigned according to the worst determinand.

**Table 1: Chemical Standards for Grading Rivers**

Grade	Dissolved Oxygen	Biochemical Oxygen Demand (ATU)	Ammonia
	(% saturation)	(mg/l)	(mgN/l)
	10-percentile	90-percentile	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	-	-

## 2.2 Effect of Algae

- 2.2.1 Some clean rivers with low velocity will have been placed in poor Grades solely because of the effect of algae on the measurement of BOD. (This is a corruption of the test for BOD, the oxygen demand is not exerted in the river, although the amount of algae may be linked to the nutrients discharged in effluents).

## 2.3 Method of Calculation

- 2.3.1 We use the standard **Parametric Method** to estimate percentiles.
- 2.3.2 We compare the estimates of the percentiles with the standards and assign Grade according to the worst determinand.

- 2.3.3 We keep records of the Mean, Standard Deviation and Number of Samples used to assign Class. These data are used to compute the Risk of Mis-grading using CONF-GQA (Appendix B).

## 2.4 Estimation of Percentiles

- 2.4.1 Water quality varies. This is why we often choose as standards, summary statistics which respond to this variability.
- 2.4.2 The **standard deviation** is the common measure of variability, but it states the spread about the average quality without defining this average. A weighted sum of the mean and standard deviation combines the properties of both measures. Such weighted sums are **percentiles**:

$$\text{Percentile} = \text{mean} + \text{weight} * \text{standard deviation}$$

- 2.4.3 The results on the Registers are used to calculate the mean and standard deviation each determinand. For a set of  $n$  results,  $x_1, x_2, \dots, x_n$ , the mean,  $m$ , is:

$$m = \frac{\sum_{i=1}^n x_i}{n} \quad \dots \quad [1]$$

The standard deviation,  $s$ , is:

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - m)^2}{(n-1)}} \quad \dots \quad [2]$$

## 2.5 Normal Distributions

- 2.5.1 For Dissolved Oxygen, the calculation of percentiles can be interpreted as if we assumed a **Normal Distribution**. (The effect of this is small compared with the errors from chance in sampling).

- 2.5.2 Given the mean,  $m$ , and the standard deviation,  $s$ , the required **Face-value estimate** of the 10-percentile required for Dissolved Oxygen is  $q$  in:

$$q = m - 1.2816s \quad \dots \quad [3]$$

## 2.6 Log-normal Distributions

- 2.6.1 For the **Biochemical Oxygen Demand** and **Total Ammonia**, the calculations can be interpreted as assuming a **Log-normal Distribution**. The values of  $m$  and  $s$  are converted to the values for the logarithms of the data using the **Method of Moments**:

$$S = \sqrt{\ln\left(1 + \frac{s^2}{m^2}\right)} \quad \dots \quad [4]$$

$$M = \ln\left[\frac{m}{\sqrt{1 + \frac{s^2}{m^2}}}\right] \quad \dots \quad [5]$$

- 2.6.2  $M$  and  $S$  stand for estimates of the mean and standard deviation of the logarithms of the data. The characters,  $\ln$ , denote the natural logarithm. The 90-percentile required for BOD and Total Ammonia is estimated as the exponential of  $(M + 1.2816 S)$ :

$$q = \exp(M + 1.2816S) \quad \dots \quad [6]$$

## 3 CONTROLLING THE ERRORS

### 3.2 Sampling and Sampling Error

- 3.2.1 Water quality can be highly variable and only a limited number of samples can be taken at each site. This produces a risk that we shall sometimes fail to notice that river quality is bad. This arises if the bad quality occurs, through chance, at times when no sample was taken.

This effect of chance is substantial, but the risk of error is aggravated if there is any tendency for poor quality to occur at night or weekends, and if sampling is restricted to normal working hours.

The effect of these loopholes is minimised because sampling staff inspect the river for evidence of pollution and we also monitor the quality of discharges and other sources of pollution. Also, biological sampling provides an indicator of recent pollution because the river life, once damaged, takes time to recover. Finally, critical sites are monitored continuously for a few key indicators of water quality, and the NRA takes a proportion of samples outside normal working hours.

- 3.2.2 It is also inevitable that we obtain, for reasons of chance, an occasional set of samples in which river quality tended to be bad at a site **only** when sampled. This can produce the appearance of non-compliance in a river which truly achieved its 90-percentile standard (by failing no more than 10% of the time).
- 3.2.3 The risk of drawing a wrong conclusion from sampling is calculated using the science of Statistics.
- 3.2.4 For a start, data are never 100% accurate because of errors in chemical analysis. A more serious doubt lies in the element of luck introduced by the use of sampling itself. The uncertainty that stems from a limited number of samples is called **Sampling Error**. It is quantified by calculating **Confidence Limits**.

### 3.3 Confidence Limits

- 3.3.1 Suppose 36 samples collected at a site give a 90-percentile of 2.04 mg/l (Appendix A). This is a precise result from the 36 samples. It is not, however, a precise estimate of the true 90-percentile at the site - it is only approximate. The true 90-percentile requires continuous accurate monitoring. Had a further 36 samples been taken on different dates over the same period of time, it is improbable that the 90-percentile calculated from these would also have been 2.04 mg/l.
- 3.3.2 The range of these possible estimates of the percentile defines the error in the particular value obtained from any one set of 36 samples. The error is estimated by calculating Confidence Limits. In addition to the estimate, say 2.04, a pair of confidence limits is calculated, say 1.03 and 3.13, which spans the range within which the true 90-percentile is expected to lie<sup>1,2</sup>.
- 3.3.3 It is common to calculate 95% confidence limits. To persist with the above example, 1.03 and 3.13 are 95% confidence limits on the estimate of the 90-percentile, 2.04. There was a chance of only 5% (one-in-20) that the true 90-percentile was less than 1.03 but that, through luck, the samples gave a value as high as 2.04. Similarly there is a chance of only 5% that the true 90-percentile was greater than 3.13 but that, through luck, the samples gave a value as low as 2.04.
- 3.3.4 If high concentrations are bad, the lower confidence limit is the **Optimistic Confidence Limit**. The upper limit is then the **Pessimistic Confidence Limit**. A pair of 95% confidence limits is said to give the 90% **Confidence Interval**: there is a chance of 10% that the true 90-percentile lies outside this range.

### 3.3.5 It follows that:

- if the standard is bigger than the Pessimistic Confidence Limit there is more than 95 % confidence that the standard was met;
- if the standard is less than the Optimistic Confidence Limit there is more than 95 % confidence that the river failed the standard;
- where the standard lies between the Confidence Limits it is impossible to declare Compliance or Failure with at least 95 % confidence. If decisions are made in these circumstances there is an unavoidable risk of between 5 % and 50 % that they will be wrong.

3.3.6 The gap between the Confidence Limits widens if sampling is decreased<sup>1,2</sup>. When the number of samples is small, the gap may be so wide as to preclude any sensible assessment of Grade.

## 3.4 Calculation of Confidence Limits

3.4.1 Taking Dissolved Oxygen and the 10-percentile as an example, a best, or **Face-value**, estimate of the 10-percentile was given in §2.5.2 as:

$$q = m - 1.2816s \quad \dots \quad [3]$$

where m is the mean and s the standard deviation.

3.4.2 The **Optimistic Confidence Limit** on the estimate of the percentile is obtained when we replace the factor of 1.2816 with a smaller value which depends on the sampling rate (Appendix A).

3.4.3 For 36 samples and the 90-percentile, the factor is 0.9540. This value ensures that the value calculated for the Optimistic Confidence Limit is worse than the 90-percentile standard only when there is confidence of at least 95 % that the Grade Boundary has truly been failed. (There is a risk of only 5 % that the failure is not real, and caused by an unlucky set of samples).

3.4.4 Values of the factor for other sample numbers are given in Appendix A.

3.4.5 The process is the similar for the other determinands. We replace 1.218 with the factors given in Appendix A.

3.4.6 Appendix A gives factors for 95-percent confidence limits on the estimates of 90-percentiles. Appendix A also gives factors for the calculation of Pessimistic Confidence Limits.

## 3.5 Errors in Assigning Grade



- 3.5.1 The above procedures indicate the following average level of uncertainty in using 36 samples to estimate percentiles:

Determined	90% Confidence Interval
BOD	- 16% to + 28%
Ammonia	- 27% to + 53%
Dissolved Oxygen	- 6% to + 9%

- 3.5.2 A site with an estimated 90-percentile BOD of 3.3 mg/l appears to be Grade B because 3.3 lies between the grade limits of 2.5 and 4 mg/l (Table 1). However, such a site will generally have, with 36 samples, a **Confidence Interval** which is wider than the boundaries of Grade B. This means that it is uncertain that the river is really in Grade B. Ignoring small probabilities that the river is placed in Grade A or D, such a site might really turn out to have the following probabilities of being graded:

Grade B: 70% and Grade C: 30%

These probabilities are calculated by checking where the Confidence Intervals cross the grade limits<sup>2</sup>.

- 3.5.3 The potential error is even larger when assessing whether a site has changed grade. In a first period, the percentile might suggest Grade B but, as above, the confidence limits could show:

Confidence of Grade B = 70%  
Confidence of Grade C = 30%

which is recorded as Grade B. In the next period, the data could show:

Confidence of Grade B = 40%  
Confidence of Grade C = 60%

which is registered as Grade C. Over the two periods this looks like a slip from Grade B to Grade C but the range of possibilities is:

From Grade B to Grade C = 42%  
From Grade B to Grade B = 28%  
From Grade C to Grade C = 18%  
From Grade C to Grade B = 12%

3.5.5 So there is a strong possibility, 58%, that the reported deterioration from B to C did not really happen. There is a small chance, 12%, that quality actually improved (but was recorded as a deterioration).

3.5.6 The calculation of these **Risks of Mis-grading** for a particular site, using a set of chemical data for that site, is done using a computer program, CROM<sup>3</sup> (Calculate the Risk of Mis-grading). CROM is discussed in Appendix B.

3.5.7 The practical consequence of these effects is that the reported grade can change back and forth randomly, every year or so. The effect on a large number of sites is calculated by the **Grade Allocation Model**, GRAM<sup>4</sup>.

### 3.6 Grade Allocation Model

3.6.1 Table 2 shows the results of GRAM in terms of the risk of placing a river in the wrong Chemical Grade. Two sets of figures are given side-by-side, one for the numbers of sites and a second for the percentages.

3.6.2 In a system with no error, Table 2 would show non-zero values only on the leading diagonal. The off-diagonal elements show the errors.

Table 2: Risk of Error in Chemical Grading

		Assigned Grades (%)						Assigned Grades								
True Grade	A	B	C	D	E	F	% Sites put in True Grade	A	B	C	D	E	F	Total Sites in True Grade		
A	13.3	3.0	.0	.0	.0	.0	16.3	1027	228	0	0	0	0	1255		
B	3.1	23.5	3.9	.1	.0	.0	30.6	241	1808	302	9	0	0	2360		
C	.1	3.2	15.8	2.9	.2	.0	22.1	6	243	1217	225	16	0	1707		
D	.0	.1	2.7	7.9	2.7	.0	13.3	0	7	205	609	205	0	1026		
E	.0	.0	.2	2.0	12.1	.6	14.9	0	0	12	151	934	48	1145		
F	.0	.0	.0	.0	.5	2.3	2.8	0	0	1	0	37	175	213		
Total	16.5	29.7	22.5	12.9	15.5	2.9	100.0	1274	2286	1737	994	1192	223	7706		
	% sites in Assigned Grades							Total sites in Assigned Grades								

% Risk of Mis-grading = 25.1 (up 11.7; down 13.4)

3.6.3 Table 2 shows, for example, that of the 2286 sites placed in Grade B, 228 were really in Grade A and 243 were really in Grade C. A tiny number, 7 sites, were really in Grade D, two grades from the true quality, Grade B.

- 3.6.4 Looked at another way, the results show that of 2360 sites truly in Grade B, 241 would be placed wrongly in Grade A by the grading procedure and 302 would be put wrongly into Grade C.
- 3.6.5 A handful of sites, equivalent to 4 in every 1000, is placed wrongly two grades outside the true grade. This suggests that the scheme is accurate to:

**$\pm$  one Grade**

- 3.6.6 The risk that a river is placed in a wrong Grade is an average of 25%. This is split evenly between the risk of placing the river in a grade which is better than the true grade (12%) and the risk of putting the river in a grade which is worse than the true grade (13%).

**3.7 Error in Assessing Change of Grade**

- 3.7.1 Table 2 has shown that the grading process can put rivers in the wrong Chemical Grade. In reality, the true grade is never known (except for sites given continuous error-free monitoring) and the procedure looks for a change in the **reported** grade from one survey to the next. The estimates in each survey are imprecise, and this amplifies the risk of error in deciding whether the grade has really changed.
- 3.7.2 Table 4 shows the results from GRAM for the risk of declaring wrongly that a site has changed its Chemical Grade. These refer to the case in which no site experiences any change in the true water quality.
- 3.7.3 As before, in a system with no error, Table 4 would show non-zero values only on leading diagonal. The off-diagonal elements show the errors.
- 3.7.4 Table 4 shows an average risk of 34% in reporting wrongly that grade has changed. Again, this is split evenly between the risk of declaring wrongly that the grade has improved (17%) and the risk of asserting wrongly that a river had moved into a worse grade (17%).
- 3.7.5 A few sites, 24 in every 1000, are declared wrongly to have jumped two grades. This suggests that sites which jump by two or more grades can be said with 97.6% confidence to have changed Grade.
- 3.7.6 The calculation of these errors is important because the errors will lead to wrong decisions on the measures needed to improve water quality.

**Table 4: Risk of Error in Assessing Change of Grade**

Grade	A	B	C	D	E	F	Sites in Grades Survey 2 (%)
A	12.4	4.0	.1	.0	.0	.0	16.5
B	4.4	20.5	4.5	.2	.1	.0	29.7
C	.2	4.9	13.3	3.7	.5	.0	22.5
D	.0	.4	3.2	6.4	2.8	.1	12.9
E	.0	.1	.6	2.6	11.4	.8	15.5
F	.0	.0	.0	.0	.8	2.1	2.9
	16.9	29.8	21.6	13.1	15.6	2.9	100.0
	% sites in Grades in Survey 1						

% Risk of declaring change where none has occurred = 33.9) (up 17.0; down 16.9)

### 3.8 Confidence of Assigning the Correct Grade

- 3.8.1 To control error, we could use statistical techniques for assessing whether a reported change of grade is significant<sup>1,2</sup>. GRAM was used to test the case where rivers were re-graded only if there was 95 % confidence that the change could not be ascribed to chance.
- 3.8.2 The results showed that there was an average risk of 5% that a river will be reported with a change of grade when no change has truly occurred. This is split evenly between the risk of wrongly upgrading and a risk of wrongly downgrading. There is almost zero risk of wrongly regrading by two grades.
- 3.8.3 The difficulty with this approach is that there is no way of avoiding the high risk of wrong grading which will occur in the first Survey. The GRAM Model shows that a river placed in a wrong grade in 1990 will tend to remain locked in this grade because the data for later years will be unable to show with sufficient confidence that the grade has changed.
- 3.8.4 For this reason it is best to live with the risk (an average of 34%) that river is declared wrongly to have changed grade. The following simple rule will avoid the biggest errors:

**A change of two or more Grades is significant**

This rule will indicate that the true quality has changed by one Grade.

- 3.8.5 This rule will be sharpened by calculating for each site the numeric value of the risk that any reported change of Grade is not be a true change but one caused by the effect of chance in sampling. The details are described below, but the finished results will be presented in the form of ranked lists of sites showing where there is most confidence that the quality has truly improved or deteriorated.
- 3.8.6 The sort of list which will be produced for the 1995 Survey is illustrated in Table 4. In this Table, for example, the hypothetical Stretch AAA is the one site in England and Wales which is most improved. The Table can continue though a ranking of all stretches in England and Wales finishing with, for example, with Stretch ZZZ, the site showing the worst deterioration of all sites in England and Wales.
- 3.8.7 These lists will help decide where action is needed to improve water quality. They will also act as a guard against premature celebrations that quality has improved.

Table 4: Presentation of Changes from 1990 to 1995

Site	Confidence of Improvement by at least .....			No change	Confidence of deterioration by at least ....		
	3 Grades	2 Grades	1 Grade		1 Grade	2 Grades	3 Grades
Stretch AAA	20	40	99	1	0	0	0
Stretch AAB	18	44	97	3	0	0	0
etc ... (for 8000 stretches)							
Stretch XZZ	0	0	0	9	91	33	12
Stretch ZZZ	0	0	0	6	94	55	22

- 3.8.8 A particular line in Table 4 will be constructed in the following way using program CROM<sup>3</sup> (Appendix B). A set of results for 1990 might show that for a particular site there was 65% confidence that the river was Grade B but 30% and 5% confidence that the true Grade was C or A respectively:

1990	A	B	C	D	E	F
	5	65	30	0	0	0

A result for 1995 might suggest a slip to Grade C:

1995	A	B	C	D	E	F
	2	30	68	0	0	0

- 3.8.9 These results for 1990 and 1995 are put together in Table 5. There is confidence of 44% (65% times 68%) that the river has truly declined from Grade B to C. This is the most likely history though the sum of the diagonal entries (20% for Grade B and 20% for Grade C) shows that there is a confidence of 40% that no change of Grade (B or C) occurred.
- 3.8.10 The off-diagonal elements show a confidence of 11% (9% + 1% + 1%) that the grade improved, and 49% (44% + 2% + 3%) that the grade changed for the worse.
- 3.8.11 For this particular site the NRA could choose action to correct the downgrading bearing in mind that there was a risk of 51% that no downgrading had really occurred. Other sites, where a deterioration was reported with greater confidence, would attract more serious action.

Table 5: Error in Assessing a Change of Grade

Confidence of Change of Grade (%)							
Grade in 1990	Grade in 1995						
	A	B	C	D	E	F	
A	-	2	3	-	-	-	5
B	1	20	<b>44</b>	-	-	-	<b>65</b>
C	1	9	20	-	-	-	30
D	-	-	-	-	-	-	0
E	-	-	-	-	-	-	0
F	-	-	-	-	-	-	0
	2	30	<b>68</b>	0	0	0	100

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## APPENDIX A: Factors for the Calculation of Confidence Limits

B.1 The values given in the table below are calculated as  $t_0$  in:

$$2t_0 = \frac{\delta + \lambda \sqrt{1 + \frac{\delta^2}{2f} - \frac{\lambda^2}{2f}}}{\sqrt{n} \{1 - \frac{\lambda^2}{2f}\}} \quad \dots \quad [B.1]$$

where  $f$  is the number of degrees of freedom, in this case  $n-1$ , where  $n$  is the number of samples<sup>5,6</sup>.

B.2 In Equation [B.1]:

$$\delta = z\sqrt{n} \quad \dots \quad [B.2]$$

and  $z$  is the Standard Normal Deviate: 1.6445 for the 95-percentile and 1.218 for the 90-percentile.

B.3 The value of  $\lambda$  approximates to the Standard Normal Deviate for the confidence limit used to define the Optimistic Confidence Limit. For 95% confidence,  $\lambda$  approximates to 1.6445. The true value of  $\lambda$  is calculated more precisely as a function of  $f$  and  $z$ .

B.4 The table gives figures only for sampling rates up to 72. The following equations may be used to calculate factors for these or other sampling rates. In all cases  $t_0$  is the factor and  $n$  is the number of samples:

**Optimistic Limit on the 90-percentile:**

$$t_0 = 1.2681 - \frac{1.9292}{\sqrt{(n+2)}}$$

Square of Correlation Coefficient = 0.9999; Error of estimate:  $\pm 0.01\%$

**Optimistic Limit on the 95-percentile:**

$$t_0 = 1.6240 - \frac{2.1123}{\sqrt{(n+2)}}$$

Square of Correlation Coefficient = 0.9999; Error of estimate:  $\pm 0.01\%$



**Pessimistic Limit on the 90-percentile:**

$$t_0 = 1.2561 + \frac{2.6610}{\sqrt{(n-4)}}$$

Square of Correlation Coefficient = 0.9996; Error of estimate:  $\pm 0.04\%$

**Pessimistic Limit on the 95-percentile:**

$$t_0 = 1.6090 + \frac{3.1205}{\sqrt{(n-4)}}$$

Square of Correlation Coefficient = 0.9995; Error of estimate:  $\pm 0.04\%$

### Factors for the Estimation of Confidence Limits

Number of Samples	For 90-percentiles		For 95-percentiles	
	Optimistic	Pessimistic	Optimistic	Pessimistic
4	.4428	4.1591	.7434	5.1442
5	.5177	3.4040	.8179	4.2031
6	.5737	3.0039	.8748	3.7081
7	.6180	2.7533	.9204	3.3998
8	.6541	2.5798	.9581	3.1876
9	.6845	2.4517	.9900	3.0315
10	.7105	2.3527	1.0174	2.9112
11	.7330	2.2729	1.0413	2.8146
12	.7529	2.2076	1.0625	2.7357
13	.7706	2.1530	1.0815	2.6699
14	.7866	2.1064	1.0985	2.6140
15	.8011	2.0662	1.1140	2.5657
16	.8143	2.0311	1.1282	2.5236
17	.8264	2.0000	1.1412	2.4864
18	.8375	1.9720	1.1532	2.4530
19	.8477	1.9468	1.1643	2.4230
20	.8573	1.9241	1.1747	2.3959
21	.8662	1.9034	1.1843	2.3713
22	.8745	1.8845	1.1934	2.3488
23	.8824	1.8671	1.2019	2.3281
24	.8897	1.8511	1.2099	2.3091
25	.8967	1.8362	1.2175	2.2915
26	.9033	1.8224	1.2247	2.2752
27	.9095	1.8096	1.2315	2.2599
28	.9154	1.7975	1.2379	2.2457
29	.9210	1.7862	1.2441	2.2324

# Factors for the Estimation of Confidence Limits (continued)

Number of Samples	For 90-percentiles		For 95-percentiles	
	Optimistic	Pessimistic	Optimistic	Pessimistic
30	.9264	1.7756	1.2499	2.2198
31	.9315	1.7656	1.2555	2.2080
32	.9364	1.7562	1.2609	2.1969
33	.9411	1.7472	1.2660	2.1863
34	.9456	1.7387	1.2709	2.1763
35	.9499	1.7307	1.2756	2.1668
36	.9540	1.7230	1.2802	2.1578
37	.9580	1.7157	1.2846	2.1492
38	.9618	1.7087	1.2888	2.1410
39	.9655	1.7020	1.2928	2.1331
40	.9691	1.6956	1.2967	2.1256
41	.9725	1.6895	1.3005	2.1184
42	.9758	1.6836	1.3041	2.1115
43	.9790	1.6780	1.3077	2.1049
44	.9821	1.6726	1.3111	2.0985
45	.9851	1.6674	1.3144	2.0924
46	.9881	1.6624	1.3176	2.0866
47	.9909	1.6575	1.3207	2.0809
48	.9936	1.6529	1.3237	2.0754
49	.9963	1.6484	1.3267	2.0701
50	.9989	1.6440	1.3295	2.0651
51	1.0014	1.6398	1.3323	2.0601
52	1.0038	1.6357	1.3350	2.0554
53	1.0062	1.6318	1.3376	2.0508
54	1.0085	1.6280	1.3402	2.0463
55	1.0108	1.6243	1.3427	2.0420

**Factors for the Estimation of Confidence Limits (continued)**

Number of Samples	For 90-percentiles		For 95-percentiles	
	Optimistic	Pessimistic	Optimistic	Pessimistic
56	1.0130	1.6207	1.3451	2.0378
57	1.0151	1.6172	1.3475	2.0337
58	1.0172	1.6139	1.3498	2.0298
59	1.0192	1.6106	1.3521	2.0259
60	1.0212	1.6074	1.3543	2.0222
61	1.0232	1.6043	1.3564	2.0186
62	1.0251	1.6013	1.3585	2.0151
63	1.0269	1.5983	1.3606	2.0116
64	1.0288	1.5955	1.3626	2.0083
65	1.0305	1.5927	1.3646	2.0050
66	1.0323	1.5899	1.3665	2.0019
67	1.0340	1.5873	1.3684	1.9988
68	1.0356	1.5847	1.3702	1.9958
69	1.0373	1.5822	1.3720	1.9928
70	1.0389	1.5797	1.3738	1.9899
71	1.0404	1.5773	1.3755	1.9871
72	1.0420	1.5750	1.3772	1.9844

## APPENDIX B: Assessment of Risk of Mis-grading

- B.1 The computer program, CONF-GQA, provides these assessments of confidence. CONF-GQA is in the Public Domain.
- B.2 The output from CONF-GQA is a statement of the statistical confidence that a site is in each or any of the Grades. This also gives the Risk of Mis-grading - the confidence that the True Grade is really not that reported as the Face-value Grade.
- B.3 CONF-GQA also gives the confidence that the True Grade is **at least as good as the Face-value Grade** or the confidence that it is **worse than the Face-value Grade**.
- B.4 An example of the output from CONF-GQA is shown below. In this example, the Face-value Grade is Class C. This is determined by the level of BOD.

REGION RIVER STRETCH	Severn Trent Trent River Soar to Nottingham STW				Confidence of Chemical Grade (%)					
	MEAN	STANDARD DEVIATION	NUMBER OF SAMPLE S	90%TILE	GRADE					
					A	B	C	D	E	F
BOD	3.80	1.58	62	5.85			62	38		
AMMONIA	.30	.25	64	.58		57	43			
DISS. OXYGEN	95.80	9.63	64	83.34	97	3				
ALL DETERMINANDS ...							62	38		0

- B.5 There is 62% confidence that Class C is the True Grade. The Risk of Mis-grading is therefore 38%.
- B.6 The confidence for each of the Grades A to F are zero, zero, 62, 38, zero and zero% respectively. These values could be shown as a pie-chart on our maps of Face-value Grade.
- B.7 For Grades A and B, the Confidence of Grade is zero (less than 5%). We can state that the river is significantly worse than Grades A and B.
- B.8 Similarly we are 38% confident that the True Grade is worse than C, zero % confident that it is worse than D, and zero % confident that Grade is better than C.
- B.9 CONF-GQA requires as input, the mean, standard deviation and number of samples for each determinand. A stand-alone version is available and a version has been built into Barry Milford's software (which runs on AARDVARK datafiles).

## APPENDIX C: Combining Summary Statistics

C.1 For a Mean,  $M_1$ , Standard Deviation,  $S_1$  and Number of Samples,  $N_1$ , for Year 1 and a parallel set of statistics for Year 2, calculate the summary statistics for the two combined years, 1 and 2, without having to go back to the raw data.

C.2 Sum the sampling frequencies:

$$N_{12} = N_1 + N_2$$

C.3 Compute the sum of the combined data:

$$sm = N_1 M_1 + N_2 M_2$$

C.4 Compute the sums of the squares of the combined data:

$$sq = (N_1 - 1)S_1^2 + N_1 M_1^2 + (N_2 - 1)S_2^2 + N_2 M_2^2$$

C.5 Calculate the Mean,  $M_{12}$ , and Standard Deviation,  $S_{12}$ , for the combined years:

$$M_{12} = \frac{sm}{N_{12}}$$

$$S_{12} = \sqrt{\frac{(sq - \frac{sm^2}{N_{12}})}{(N_{12} - 1)}}$$

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**NRA PROGRAMME FOR THE MONITORING OF**

**WATER QUALITY**

**PART 3:**

**MANAGEMENT AND DESIGN OF REGIONAL OPERATIONAL**

**MONITORING PROGRAMMES**

## **1. APPROACH TO GUIDELINES FOR REGIONAL OPERATIONAL MONITORING**

There is a clear need to achieve greater consistency between Regions in their approach to the design of Regional Operational Monitoring programmes. However, it is not possible to be prescriptive about the sampling programme designs which should be adopted to address all specific local questions. Rather, this document sets out the basic principles which apply to all such sampling programmes and the different factors which should be considered in their design. In particular, business needs which are considered acceptable justifications for Regional Operational Monitoring are listed in Section 2. Guidance on the management of Regional Operational Monitoring is provided in Section 3, whilst guidance on programme design is provided in Section 4.

The guidance contained in this document is an amalgamation of two notes which Regions have already seen, namely the paper on the Management of Sampling Programmes presented to the Water Quality Monitoring Steering Group (with slight amendments, it now forms Section 3 of this document) and the paper on the design of permissive sampling programmes presented to EQC in December 1993.

The document should be read in conjunction with the Instrumentation, Biology and Groundwaters Monitoring Strategies. In addition, the Marine Monitoring Strategy (Ref: NRA 1994b) requires a review of marine Regional Operational Monitoring and this is to be undertaken according to these guidelines.

## **2. BUSINESS NEEDS**

### **2.1 Introduction**

Previous reviews of Regional Operational Monitoring found that the extent of Regional programmes varied widely. However, it is possible to categorize the range of sampling types into a smaller number of justifiable 'business needs' categories which have similar objectives and strategies.

The identified justifiable business need categories are:

- a) Discharge Impact Assessment, Pre-consenting Studies and Post Scheme Appraisal
- b) Development Impact Assessment
- c) Diffuse Source Impact Assessment
- d) Detection of Trends and General Water Quality Characterisation
- e) National R&D and Regional Operational Investigations
- f) Defensive Studies
- g) Post Pollution Incidents
- h) 'Real Time' Water Quality Management
- i) Model Development and Validation

The following sections describe in more detail the justifiable business needs. The categories and specific objectives of the business needs, with examples of sampling types, are shown in Table 1.

### **2.2 Justifiable Regional Operational Monitoring**

#### **2.2.1 Discharge Impact Assessment, Pre-consenting Studies and Post Scheme Appraisal**

This category covers monitoring investigations related to point source discharges and the assessment of their environmental impact. The objectives of this type of survey are to assess the likely environmental impact prior to issuing an NRA consent or an HMIP IPC authorisation in order to set appropriate limits and then review these conditions to ensure they are protecting the aquatic environment. This type of work is fundamental to the way the NRA operates to protect the aquatic environment.

### **2.2.2 Development Impact Assessment**

This category includes environmental impact assessments associated with developments in fresh and marine waters and covers, for example, opencast mining; industrial and urban developments and tidal barrages.

### **2.2.3 Diffuse Source Impact Assessment**

This category of sampling usually includes programmes to define the extent of diffuse pollutant problems such as acidification, eutrophication, leachates or pesticide pollution. These problems are not easily resolved but the results from surveys in this category can be used to target Pollution Prevention measures aimed at addressing these issues.

### **2.2.4 Detection of Trends and General Water Quality Characterisation**

This is the most significant component of many Regional Operational Monitoring Programmes and in many cases is not targeted at resolving water quality problems or issues. This category includes investigations to determine background water quality and changes in water quality over time. In order to be included in Regional Operational monitoring, sampling in this category must be justified in terms of solving or identifying a particular water quality problem or issue.

For freshwaters, it is expected that the number of instances when work of this type, above that required for the GQA, is undertaken by the Regions will be small, whilst for marine waters it is anticipated the implementation of the Estuarine GQA Scheme will subsume the majority of this type of monitoring. However, this type of monitoring will be required where the determinands of interest are outside the scope of statutory or surveillance monitoring programmes.

### **2.2.5 National R&D and Regional Operational Investigations**

This category covers the survey work undertaken by the Regions in support of National R&D initiatives and Regional investigative or development work.

Examples of National projects are the Development of National GQA schemes for controlled waters; improving instrumentation for water quality monitoring and investigating different treatment methodologies for minewater discharges. Regional projects will reflect particular local problems or issues.

### **2.2.6 Defensive Studies**

In some cases Regions may undertake sampling in connection with particular local issues which come to the fore and which may be championed by local pressure groups or attract media attention with the possibility of the NRA's position being challenged. This category involves the collection of information to allow the NRA to form an opinion and respond to the issue based on scientific data.

### **2.2.7 Post Pollution Incidents**

These guidelines are not intended to include Formal, or other, sampling which is undertaken as part of the initial response to a pollution incident.

The guidance is intended to cover the sampling that is undertaken after the incident is over and includes work to monitor the recovery of the controlled water and surveys to indicate the extent of remedial work required to assist in drawing up pollution prevention initiatives.

### **2.2.8 'Real time' Water Quality Management**

This guidance is restricted to the day-to-day management of rivers or estuaries through the use of continuous monitoring instruments, such as the system for the management of the Thames estuary and the future operation of barrages, eg: Tees; Tawe; and, Cardiff Bay barrages. Long-term management is achieved through catchment management planning and the consenting of discharges and is covered in Sections 2.2.1 and 2.2.2.

### **2.2.9 Model Development, Calibration and Validation**

This category covers monitoring undertaken in the development, calibration and validation of water quality models which will be used to assist management decisions for the protection of the aquatic environment. The output from models will be used to support other identified justifiable categories, notably discharge impact assessment and the detection of trends and general water quality characterisation (See Sections 2.2.1 and 2.2.4).

**Table 1 - Categorization of Regional Operational Monitoring**

Category	Specific Objectives <sup>1</sup>	Specific Examples
All categories	<ol style="list-style-type: none"> <li>1. Prioritisation of external agency investment, eg WSPLCs</li> <li>2. Consent review/Application/post consent review</li> <li>3. Catchment Management Plans</li> <li>4. Identification of pollution prevention measures</li> <li>5. Identification of remedial measures</li> <li>6. Calibration and validation of water quality models</li> </ol>	See specific examples below.
Discharge Impact Assessment Monitoring, Pre-consenting Studies & Post Scheme Appraisal	<ol style="list-style-type: none"> <li>1. Abstraction licence application</li> </ol>	STW Effluent Impact Trade Effluent Impact Farm Waste Waste Disposal Site Impact Mineral Extraction Impact CSO Impact Minewater Impact Surface Water Sewer Impact
Development Impact Assessment Monitoring	<ol style="list-style-type: none"> <li>1. Assessing impact of major works in controlled waters</li> </ol>	Pre- & post development monitoring Monitoring associated with barrage
Diffuse Source Impact Assessment	<ol style="list-style-type: none"> <li>1. Consultation with other bodies (MAFF, DoE)</li> </ol>	Surface Water Acidification Agricultural Pollution Pesticide Pollution Eutrophication (eg Phosphates in River Test, Nutrients in Broads) Waste Disposal Sites
Detection of Trends and General Water Quality Characterisation	<ol style="list-style-type: none"> <li>1. RQO failure downstream</li> <li>2. Biology indicates possible water quality problem and source confirmed by inspection</li> </ol>	Non-classified saline waters and/or local EQO Non-classified freshwaters Investigation of determinands not in GQA
National R&D and Regional Operational Investigations	<ol style="list-style-type: none"> <li>1. National requirements.</li> <li>2. Improvement to all aspects of WQ monitoring eg data management, sample analysis etc</li> </ol>	Specific Project Investigations
Defensive Studies	<ol style="list-style-type: none"> <li>1. Underpin NRA decisions</li> </ol>	Sensitive Regional Issue - General WQ issue - Discharge impact - Beach survey - Biological status - Conservation issue

**Table 1 - Categorization of Regional Operational Monitoring - Continued**

Category	Specific Objectives <sup>1</sup>	Specific Examples
Post Pollution Incidents	1. Evidence for legal action/recharge 2. Indicate extent of remedial works/post remedial assessment/recharge	Post Pollution Incidents
'Real Time' Water Quality Management	1. Operational control	Monitoring for Day to Day river/estuary management Barrage Operation Monitoring
Model Development, Calibration and Validation	1. Underpin NRA decisions	Calibration of water quality models

<sup>1</sup> Specific objectives relating to all justified categories of Regional Operational Monitoring are listed in Section 2.1.



### **3. MANAGEMENT OF REGIONAL OPERATIONAL MONITORING**

#### **3.1 Background**

During the assessment of sample workloads undertaken in 1992 to support the laboratory review, significant inter-Regional differences were found which are not explained by reference to numbers of discharges, total river length, etc. Various reasons for the discrepancies were identified in discussions with Regional contacts. One factor cited by some Regions is lack of national guidance on Regional Operational sampling, ie sampling which is not covered by Part 1 and Part 2 of this manual.

Guidance on the design of Regional Operational Monitoring is provided in Section 4. This may help to deal with inter-Regional differences, but a substantial degree of local judgement will still be needed. A pressing requirement is to establish formal arrangements to specify, authorise, control and review sampling programmes so that all sampling and analyses are undertaken for clearly defined purposes and represent good value for money.

Most Regions have made adjustments to sampling programmes, but there has been a tendency to continue with inherited programmes of work. Reviews of sampling programmes are cumbersome in the absence of a suitable database or Sampling Programme Management System (SPMS).

#### **3.2 Sampling Programme Management System**

Within some Regions the data systems required for the effective management of sampling programmes do not exist. As a result, those Regions will not find it easy to quantify the sampling and analysis required for each particular purpose. Furthermore, sample programme reviews and variations are difficult.

The process of managing Regional Operational Monitoring programmes would be made much easier if all Regions had a suitable database - a sampling programme management system (SPMS) - on which details of the sampling requirements for each recognised purpose can be entered and manipulated. A project to develop an SPMS is at the Project Definition Stage and a copy of the Problem Definition Report has been circulated to the Regions for comment. A project to undertake a feasibility study and develop a prototype SPMS has recently been approved by the IS PAB and will be commencing in the near future. However, the need for Regions to begin using these guidelines is pressing and the lack of a computerised SPMS must not prevent Regions from undertaking the required reviews of their Regional Operational Monitoring programmes.

The establishment of a formal contractual relationship between clients and laboratories is focusing attention on the detailed specification of workload and on the cost. This will also help to secure better value for money from sampling.

### **3.3 Management Control of Sampling Programmes**

The following actions are recommended to improve management control:

- a) every sample and determination in sampling programmes must have a stated purpose and there must be a clearly defined use for the data. The purpose must fall within one of the justifiable business need categories set out in Section 2, or within the National Programme defined in Part 1 or Part 2 of this manual;
- b) the sampling for each purpose should have an identified customer;
- c) a member of each Regional Management Team should be given responsibility to ensure that the sampling programmes are reviewed annually, checked for compliance with guidelines, costed and submitted to an appropriate member of staff for approval;
- d) quarterly reports should be made to this member of staff, showing performance in each element of the sampling programme. Any sampling in excess of programme should be accounted for;
- e) any proposal to undertake unprogrammed sampling, or to modify the programme, except in an emergency, should be subject to a scheme of formal approvals based on cost. The quarterly report to this member of staff should include a summary of such expenditure;
- f) every proposed survey should have an end-date and sampling should be reviewed on that date and cease if the objectives of the monitoring have been achieved or the need for the work no longer exists. This is particularly important following each major pollution incident where there should be an early review of associated sampling, to ensure that excessive expenditure is not incurred on follow-up monitoring.

### **3.4 Review of Existing Sampling Programmes**

It is proposed that in each Region the existing sampling programme, covering chemical and biological sampling for all controlled waters, for each identified purpose should be reviewed and costed annually, and a list of required "projects" drawn up. Any proposed future variations to the programmes would be subject to the authorisation procedures set out in Section 3.3.

Once the Regional sampling programmes have been set up, summary information from each Region will be reviewed by the Water Quality Monitoring Steering Group (WQMSG) to ensure Regional sampling programmes are properly justified.

### **3.6 Size of Regional Operational Monitoring Programme**

It is difficult to issue guidance on the size of the Regional Operational Monitoring programmes as the need for monitoring depends on the different Regional Priorities. For instance it is not practical to issue a target figure for the number of STW impact assessments undertaken by a Region as the numbers needing assessment may vary from Region to Region. If the guidance issued here is followed, all Regional Operational Monitoring should be targeted at particular water quality problems and will only be undertaken when absolutely necessary. There is however an audit role to be undertaken by NRA Head Office to ensure there are not discrepancies in the sizes of the Regional Operational Programmes.

The most effective measure for controlling the amount of Regional Operational Monitoring is budgetary constraint. The Regions or Head Office should identify a budget for Regional Operational Monitoring and a bid system could be developed using the Regional Operational Monitoring Proposal forms (See Appendix 1). Each proposal would then be considered on its merit and only those programmes with the highest Regional or local priority will be undertaken.

Any significant monitoring proposals should be submitted in time for the corporate plan and could be considered as Operational Investigations.

## **4. DESIGN OF REGIONAL OPERATIONAL MONITORING PROGRAMMES**

### **4.1 Introduction**

The format of a Regional Operational Monitoring programme cannot be prescribed but when designing a sampling strategy a number of general principles can be applied. These principles are detailed below and must be considered when planning and designing sampling programmes.

### **4.2 Guidelines on the Design of Regional Operational Monitoring**

The general strategy to be followed when planning Regional Operational Monitoring is shown in Figure 1.

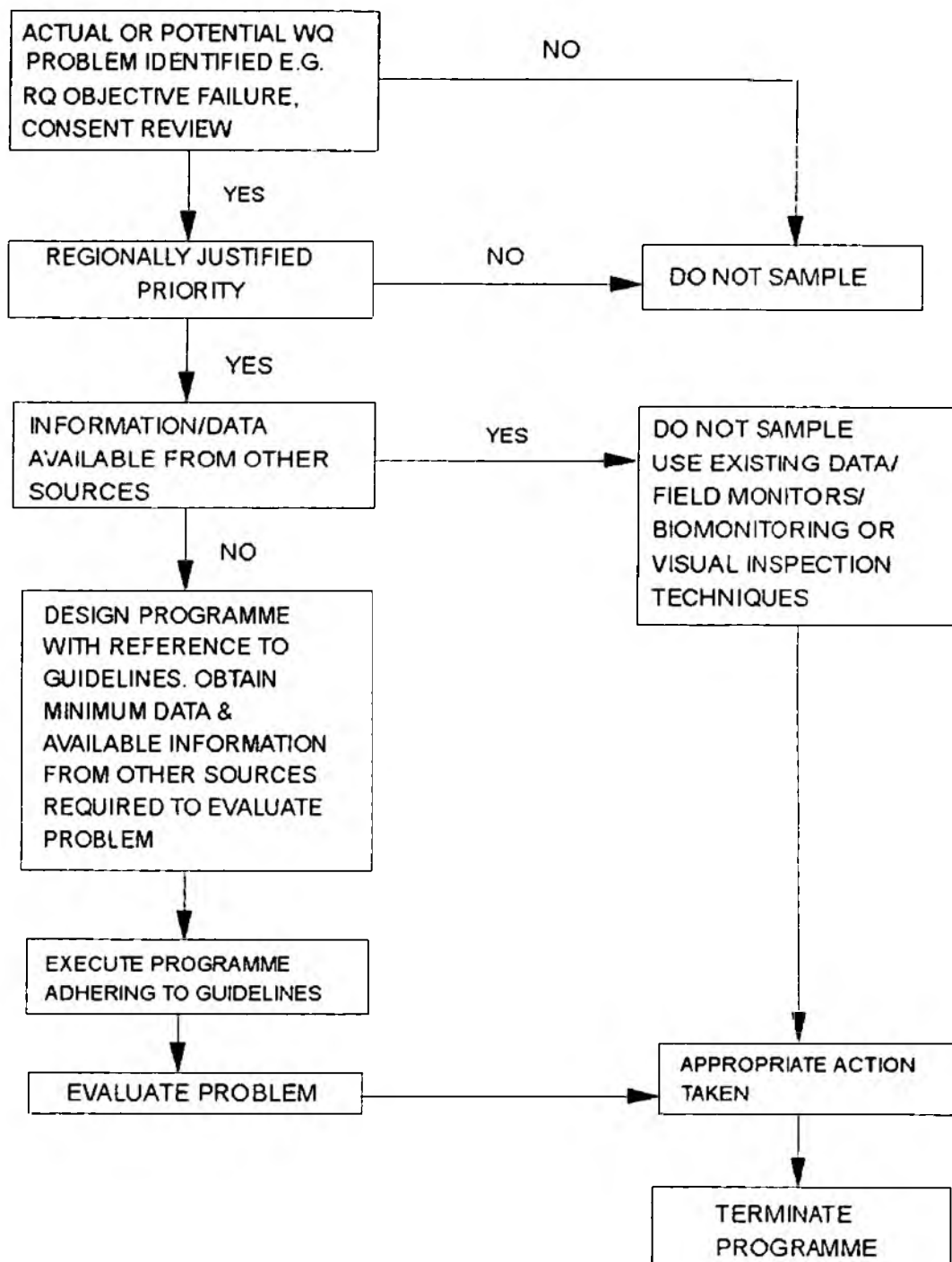
#### **4.2.1 Individual Survey Design**

- a) The objectives/purpose of the survey must be clearly defined and justified and be targeted to providing a definite output or solution.
- b) All historic data should be reviewed to ensure the required information is not already available.
- c) The survey should have a defined timescale and a defined end point at which time the objective should have been achieved. Sampling should cease, subject to review, at this point.
- d) All other possible sources of data, such as the statutory or surveillance programmes, should be examined to establish whether these could provide the information needed to satisfy the survey objectives.
- e) The survey design should consider all monitoring techniques such as biological monitoring, ecotoxicology, field monitors or visual inspection in order to target resources to minimise expenditure and ensure the selection of the most cost effective method of achieving the survey objective.
- f) The survey design should keep the number of sampling sites needed to a minimum, and these should utilize the existing statutory and surveillance network sites wherever possible.
- g) The survey should utilize the existing sampling programme but the sampling frequency should be sufficient to allow the survey objectives to be achieved with the appropriate degree of statistical certainty. In cases where this is not possible as it would result in prohibitively large numbers of samples being required, other forms of monitoring must be considered.
- h) Detailed guidance on monitoring programme design can be obtained from the Handbook on the Design and Interpretation of Monitoring Programmes (Ref: WRc 1989). The principles and main steps common to the design of all

sampling programmes are set out in the Handbook and this should be used as the NRA standard.

- i) Sampling should only be undertaken for those determinands needed to achieve the objective. Careful planning is needed to ensure that all required determinands are included, and also to ensure that no extra determinands are included.
- j) For each Regional Operational Monitoring/sampling proposal all survey details should be recorded on a Regional Operational Monitoring Proposal Form (reproduced in Annex 1) in order to check the need for the work and the size of resources including laboratory analysis and to allow the audit of programmes against the objectives.
- k) The sampling programmes must be regularly monitored and audited to ensure no unnecessary sampling is taking place and that the original objectives are being achieved.
- l) All surveys should be reported to the customer in order that the appropriate action can be taken to satisfy the original objectives. This is particularly important where the reporting of information is not automatic, as is the case, for example, with some types of biology data.

Figure 1 - Regional Operational Monitoring Strategy



N.B STRATEGY DOES NOT APPLY TO POLLUTION INCIDENT MONITORING

## **5. REGIONAL IMPLEMENTATION OF THE GUIDELINES**

The aim of these guidelines is to bring about a change in culture regarding the management, organisation and implementation of Regional Operational Monitoring programmes. Therefore, implementation of these guidelines will need to be an ongoing activity in all Regions, and should begin immediately.

It is recommended that a review of Regional Operational Monitoring programmes is undertaken annually in each Region. Regions should draw up a list of "projects", ie a brief description and justification which summarise all the Regional Operational Monitoring they propose to do, and also cost their proposals. It is recommended that Regions use the "bid" forms (an example of which is reproduced in Annex 1) to review and justify their sampling programmes.

It will be for the nominated Regional "clients" to oversee the review to ensure each sampling proposal meets the justifiable business needs and approve expenditure by signing-off the proposal.

An initial review should be completed by June 1995 and a list of proposed projects drawn up. Subsequent annual reviews will need to be drawn up in time for the Autumn corporate planning round.

There should be a continuing review of surveys as they reach their end-date and in this way there will be an on-going review of Regional Operational Monitoring.

It is recommended that all bid forms should be archived to provide Area staff with background knowledge of the sampling that has been undertaken in a particular catchment.









# **ANNEX 1**

## **REGIONAL OPERATIONAL MONITORING**

**Example of a Regional Operational Monitoring Proposal Form**

# Annex 1

## Example of a Regional Operational Monitoring Proposal Form

### Requests for Analytical Services

#### 1. Proposer's Details

Your name:	Date:	2 December 1994
Position:	Your ref:	
Location:	Area:	Dist:
	Our ref:	827/02/03/03

Is this request... a) An Alteration to the Routine Sampling Programme Go to Box 2  
or b) A Special Survey, Project or Investigation Go to Box 3

#### 2. Alteration to the Routine Monitoring Programme

Point code:	If Effluent, Consent no.
If effluent discharge name:	
If a <u>new</u> effluent, please attach the Sample Point Details Form.	
Action:	
Reasons for change:	
Route(s) Affected:	Suites/Dets: Freq/pa

#### 3. Special Survey, Project or Investigation

Title:  
Purpose:  
Impact of not proceeding:  
Constraints:  
Comments:

##### 3a. Details of Survey Analytical Requirements

No of Samples	Substrate (e.g. Estuary Water)	Analytical Suites and Determinands	Start Date	End Date

##### 3b. List of Point codes in survey

Please send to Barrie Harbott at RHQ

4. Assessment - BJH → RDH → JAM → CSP → GJA/PLB  
(LIMS) (Comp) (Cfd) → Update SIMS & BIDS and file.

Please initial and jot any notes overleaf.

## Requests for Analytical Services

### 1. Proposer's Details

Your name:	I Hill	Date:	2 December 1994
Position:	Pollution Prevention Officer	Your ref:	
Location:	Brampton	Area:	C
		Dist:	
		Our ref:	827/02/03/03

Is this request...      a) An Alteration to the Routine Sampling Programme      Go to Box 2  
                                  or      b) A Special Survey, Project or Investigation      Go to Box 3

### 2. Alteration to the Routine Monitoring Programme

Point code:	If Effluent, Consent no.
If effluent discharge name:	
If a <u>new</u> effluent, please attach the Sample Point Details Form.	
Action:	
Reasons for change:	
Route(s) Affected:	Suites/Dets:      Freq/pa

### 3. Special Survey, Project or Investigation

Title:	Sawston Groundwater Project
Purpose:	Obtain information regarding chlorinated solvent levels in groundwater.
Impact of not proceeding:	Will delay the 2nd Sawston borehole contract - Need to ensure that new boreholes are drilled in correct location
Constraints:	
Comments:	Part of Remediation Project

#### 3a. Details of Survey Analytical Requirements

No of Samples	Substrate (e.g. Estuary Water)	Analytical Suites and Determinands	Start Date	End Date
6	Groundwater	Chlorinated solvents	20/12/94	20/01/95

#### 3b. List of Point codes in survey

**Please send to Barrie Harbott at RHQ**

4. Assessment - BJH → RDH → JAM → CSP → GJA/PLB  
                                  (LIMS) (Comp) (CfD)      → Update SIMS & BIDS and file.

Please initial and jot any notes overleaf.





## **PUBLICATION OF RESULTS OF MONITORING PROGRAMMES**

The provision of information on water quality to all interested parties in a form which is clear and readily understandable is one of the NRA's key responsibilities. Comprehensive statements need to be made in published reports on the standards that are required to be met and the extent to which they are being complied with. In addition, the results of general environmental surveys should be reported at periodic intervals to provide assessments of water quality status and changes which occur over time.

Considerable progress has already been made by the NRA in publishing water quality information. On EC Directives, the NRA has reported the results of monitoring associated with the requirements of the Bathing Waters Directive in its reports on Bathing Water Quality (Refs: NRA 1991c, NRA 1992c, NRA 1993c and NRA 1994c). Reports have also been published on the Titanium Dioxide Directives (Ref: NRA 1993b), the Shellfish Waters Directive (Ref: NRA 1994d) and the Freshwater Fish Directive (Ref: NRA 1994e).

With regard to the NRA's surveillance activities, the NRA has published the results of the 1990 Survey of the quality of rivers, canals, and estuaries (Ref: NRA 1991d). A further report presents the chemical and biological information from the 1990 Survey according to the new GQA Scheme (Ref: NRA 1994a). This provides the baseline against which future changes in water quality can be assessed and reported. Similar reports are required with respect to the quality of coastal waters. This is being addressed through the development of a strategy for coastal water quality monitoring which involves the combined use of direct sampling from boats and aerial surveillance using multi-spectral scanning techniques. Surveys will be carried out at periodic intervals around the entire length of the English and Welsh coastline, covering the three mile coastal water strip for which the NRA is responsible. This will build up a library of information from which assessments of water quality status can be made and reported upon at regular intervals.

For the future, the NRA will also need to report on progress with WQOs. This will involve assessments of compliance with the standards and conditions set for the various EC Directives and the use-related Classes applying to individual stretches of water.



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