NRA Water Quality ~~Reports~~ 85

NRA

# Water Quality Report - 1991



*National Rivers Authority*
*Anglian Region*

NRA WQR.



# Water Quality Report - 1991

## BACKGROUND

The National Rivers Authority (NRA) is charged with the duty of improving the quality of the Water Environment. The Authority is a public body which came into being in September, 1989.

The NRA operates through a Board and National Head Office. The Anglian Region is one of ten Regional Units.

This report describes trends in water quality and the key events which happened in 1991 in the Anglian Region.

This year we have continued to build on the organisation of the Region within the context of our new national identity and objectives. At the same time, we have maintained continuity with past activities and helped to develop and implement policies which will address our future tasks.

## EXECUTIVE SUMMARY

We report trends in the quality of rivers over the past eight years. About 5% less of river lengths complied with River Quality Objectives than in 1990. The main causes are dry weather and a switch in the emphasis of monitoring. The change appears not to have been caused by discharges of sewage effluent.

We discuss the 12-year trend in the biological quality of rivers. The underlying trend is one of improvement.

The trend in pollution incidents since 1974 is reported. The total number in 1991 was 2,141, an increase of 14% on 1990. More effective monitoring on our part and growing public awareness resulted in this increase. The number of incidents caused by oil pollution saw the greatest increase.

A few sites failed criteria for the Dangerous Substances Directive.

In common with 1990, water-based recreation was disrupted at some lakes and reservoirs by Blue-green Algae.

We report trends in the quality of Bathing Waters since 1987. In 1991 the number of failed waters was 4 out of a total of 33 identified under the Bathing Waters Directive.

We provide trends in the performance of discharges since 1982. The proportion of sewage treatment works operated by Anglian Water Services, which complied with their Consents in 1991 is 94% - an improvement of over 2% since 1990.

The number of enquiries of the Water Act Register has increased steadily since it opened in 1985. There were over 480 in 1991, an increase of 30% since 1990.

In 1991, we took over 36,000 samples for chemical analysis for routine audit purposes. Most of these were taken from rivers and effluents. We used River Quality Indices and the Laboratory Information Management System to ensure efficient use of this resource.

In preparation for calculating the measures needed for achieving Water Quality Objectives we have completed further mathematical models of rivers, estuaries and coastal waters.

Contents...


Part 1: INTRODUCTION

1.1 National Aims
1.2 Duties
1.3 The Environmental Protection Act
1.4 Water Quality 2000
1.5 Tasks

Part 2: RIVERS & GROUNDWATERS

2.1 Chemical Monitoring
2.2 River Quality Classification
2.3 River Quality Objectives
2.4 The 1990 Survey
2.5 Statutory Quality Objectives
2.6 River Quality Indices
2.7 Biological Monitoring
2.8 EC Directives
2.9 Pollution Incidents
2.10 Prosecutions
2.11 Groundwater
2.12 Nitrate
2.13 Blue-Green Algae
2.14 The Norfolk Broads
2.15 Pesticides
2.16 Catchment Management Plans
2.17 Mathematical Modelling

Part 3: ESTUARIES & COASTAL WATERS

3.1 Monitoring
3.2 Classification of Estuaries
3.3 EC Directives
3.4 Red List/Annex 1A
3.5 North Sea
3.6 JoNuS Programme
3.7 Paris Commission
3.8 Coastal Survey Vessel
3.9 Mathematical Modelling

Part 4: DISCHARGES

4.1 Utility Discharges
4.2 Non-Utility Discharges

| | | |
|---|---|---|
| | 4.3 | Priority Lists and the Index of Discharge Impact |
| | 4.4 | Targeting and Tripartite Sampling |
| | 4.5 | Progress on Consent Conditions |
| | 4.6 | Charging for Discharges |
| | 4.7 | Integrated Pollution Control |
| Part 5: | | WATER ACT REGISTER |
| Part 6: | | CAPITAL DEVELOPMENT PROGRAMME |
| Part 7: | | RESEARCH AND DEVELOPMENT |
| Part 8: | | CHEMICAL LABORATORY SERVICES |
| Part 9: | | INFORMATION STRATEGY |
| APPENDIX I: | | BIOLOGICAL SAMPLING IN 1991 |
| APPENDIX II: | | PROSECUTIONS BROUGHT TO COURT |
| APPENDIX III: | | FORMAL CAUTIONS ISSUED |
| | | Glossary |

# Part 1. INTRODUCTION

## 1.1 National Aims

The Authority's responsibility for the quality of the water environment extends to all Controlled Waters. Controlled Waters include rivers, lakes, groundwaters, estuaries and coastal waters.

The Authority has stated that it will protect and improve the Water Environment. The NRA aims to:

- achieve a continuing improvement in the quality of Controlled Waters, through the control of pollution;
- maintain and improve the quality of environmental waters for all those who use them;
- ensure that dischargers pay the costs of the consequences of their discharges and, as far as possible, to recover the costs of improving the water environment from those who benefit;
- assess performance towards achieving Environmental Quality Objectives and identify overall trends in water quality.

## 1.2 Duties

Legislation concerning the NRA was consolidated into the Water Resources Act in December 1991. Under this Act the NRA has statutory duties and responsibilities relating to the quality of the aquatic environment.

The prime duties of the NRA include:

- to achieve Water Quality Objectives in all Controlled Waters;
- to monitor the extent of pollution in Controlled Waters;
- to conserve and enhance the amenity of inland and coastal waters, and of land associated with such waters;
- to determine and issue Consents for discharge of wastes into Controlled Waters;
- to maintain Public Registers of Water Quality Objectives, Applications for Consents, Certificates and sampling data;
- to keep maps of Controlled Waters for public inspection;
- to advise and assist the Department of the Environment on matters

of water pollution;

- to exchange information with water undertakers on pollution matters.

The NRA has declared that it will operate openly in discharging its duties and balance the interests of all who benefit from and make use of Controlled Waters.

## 1.3 The Environmental Protection Act

The Environmental Protection Act 1990 introduced the concept of Integrated Pollution Control for processes which manufacture or use the most dangerous substances. (See Part 4.7) These will be authorised by Her Majesty's Inspectorate of Pollution. The NRA is a statutory consultee, and has considerable influence on authorisations where water quality is affected.

Under the Environmental Protection Act 1990, the maximum fine allowed for a pollution offence was increased from £2,000 to £20,000 for cases heard in a Magistrates Court. This took effect from 1 January 1991. An unlimited fine could be imposed in the Crown Court.

## 1.4 Water Quality 2000

An NRA national strategy for the water quality function, **Water Quality 2000**, has been introduced. The strategy addresses the goals we must achieve to bring about a continuing improvement in the waters under our control. Key issues include :

- the introduction of Statutory Water Quality Objectives for all waters for which we have responsibility;
- the set up and implementation of a system of catchment planning, to assist in the achievement of water quality standards;
- to determine the relative impact of all causes of poor water quality in each catchment;
- to set up systems for controlling these causes; and
- to develop economic incentives as a basis for pollution control.

## 1.5 Tasks

To achieve its aims for water quality, the NRA must excel in four areas:

- manage the resources available for monitoring;

- ensure that dischargers invest enough in the disposal of their wastes;
- ensure that changes in land use and other developments cause no damage to the water environment; and,
- minimise the risk of damage from accidents and pollution incidents.

During 1991, we have developed further our systems for the management of our monitoring programme. All information on routine sampling points and sampling obligations are held on computer. In the computer, this information is displayed as a menu and linked automatically to maps. The computer display allows us, or the public, to see all the monitoring done at any location, at a glance. The computer will extract results of chemical analyses into a special database. An example of this database is given in Figure 1.1. These sample results can then be displayed as graphs on the map. (See Figure 9.2)

The system covers all the chemical and biological analyses provided by our Laboratory Services. More than 115 sets of chemical analyses are needed to cover the requirements of the legislation and other duties. An example is given in Figure 1.2.

Three developments have helped us to manage the sampling programme. The first, the Laboratory Information Management System (LIMS), ensures efficient use of laboratory resources, minimises the risk of errors, and helps to ensure that all commitments for sampling and analysis are met (Part 8).

The second is the Sampling Information Management System (SIMS). This combines the monitoring requirements at each sampling site and then checks that LIMS is analysing for the requirements (Part 9).

The third development involves River Quality Indices. This is a system which checks the water quality information in our computer databanks to confirm that all data are logged correctly (Part 2.6).

We have continued the development of tools for assessing measures needed to improve water quality. The introduction of water quality models is giving us consistent and authoritative methods of setting Consents for discharges to Controlled Waters.

We have also developed further our systems for the audit of performance against water quality standards and extended their use to set priorities for action, using "Hit-lists" of the worst discharges derived from an Index of Discharge Impact (Part 4.3).

# FIGURE 1.1

| PTCODE | DETCODE | DATE | TIME | SAMPNO | REASONS | INDICATOR | METHOD | QUAL | RESULT |
|---|---|---|---|---|---|---|---|---|---|
| 710 | | 06/08/92 | | | L:S0002958.SPL | | | | |
| R01BFBR****** | | 01/01/91 | | 91000001 | CM: : : : | | | | |
| Type:** | | 31/12/91 | | 91999999 | Area:** | | | | Sub1:** |
| Sub2:** | | | | | DC:** PC:*** | | | | Zne:**** |
| Dept:** | | | | Lab:** | Who:*** Mth:* | | | | Ind:** |
| | ***** | | | | | | | | |
| R01BFBR01 | 00613 | 10/01/91 | 10:31 | 91000634 | CM:ED: : : | | S | | 7.92 |
| R01BFBR01 | 00613 | 07/02/91 | 09:35 | 91004004 | CM:ED: : : | | S | | 7.99 |
| R01BFBR01 | 00613 | 07/03/91 | 11:10 | 91007046 | CM:ED: : : | | S | | 7.94 |
| R01BFBR01 | 00613 | 11/04/91 | 08:30 | 91011132 | CM:ED: : : | | S | | 8.16 |
| R01BFBR01 | 00613 | 09/05/91 | 08:50 | 91014969 | CM:ED: : : | | S | | 8.02 |
| R01BFBR01 | 00613 | 06/06/91 | 08:30 | 91019436 | CM:ED: : : | | S | | 7.85 |
| R01BFBR01 | 00613 | 04/07/91 | 08:50 | 91023796 | CM:ED: : : | | S | | 7.95 |
| R01BFBR01 | 00613 | 01/08/91 | 08:30 | 91028327 | CM:ED: : : | | S | | 7.71 |
| R01BFBR01 | 00613 | 29/08/91 | 08:50 | 91032562 | CM:ED: : : | | S | | 8.05 |
| R01BFBR01 | 00613 | 03/10/91 | 08:40 | 91037426 | CM:ED: : : | | S | | 7.88 |
| R01BFBR01 | 00613 | 31/10/91 | 08:50 | 91042059 | CM:ED: : : | | S | | 7.74 |
| R01BFBR01 | 00613 | 28/11/91 | 08:30 | 91046484 | CM:ED: : : | | S | | 7.91 |
| R01BFBR01 | 00683 | 10/01/91 | 10:31 | 91000634 | CM:ED: : : | | S | > | 19.0 |
| R01BFBR01 | 00683 | 07/02/91 | 09:35 | 91004004 | CM:ED: : : | | S | | 4.04 |
| R01BFBR01 | 00683 | 07/03/91 | 11:10 | 91007046 | CM:ED: : : | | S | | 10.0 |
| R01BFBR01 | 00683 | 11/04/91 | 08:30 | 91011132 | CM:ED: : : | | S | | 5.12 |
| R01BFBR01 | 00683 | 09/05/91 | 08:50 | 91014969 | CM:ED: : : | | S | | 6.45 |
| R01BFBR01 | 00683 | 06/06/91 | 08:30 | 91019436 | CM:ED: : : | | S | | 8.48 |
| R01BFBR01 | 00683 | 04/07/91 | 08:50 | 91023796 | CM:ED: : : | | S | | 4.43 |
| R01BFBR01 | 00683 | 01/08/91 | 08:30 | 91028327 | CM:ED: : : | | S | | 11.7 |
| R01BFBR01 | 00683 | 29/08/91 | 08:50 | 91032562 | CM:ED: : : | | S | | 6.27 |
| R01BFBR01 | 00683 | 03/10/91 | 08:40 | 91037426 | CM:ED: : : | | S | | 2.87 |
| R01BFBR01 | 00683 | 31/10/91 | 08:50 | 91042059 | CM:ED: : : | | S | | 8.85 |
| R01BFBR01 | 00683 | 28/11/91 | 08:30 | 91046484 | CM:ED: : : | | S | | 8.37 |

# FIGURE 1.2

## ANALYSIS SUITES

RJ - SURFACE WATER DIRECTIVE ANNUALLY

| CODE | DETERMINAND NAME | UNITS |
|---|---|---|
| 00613 | PH | PH UNITS |
| 00683 | TURBIDITY (FTU) | FTU |
| 00721 | COLOUR FILTERED(0.45UM MEMBRANE)HAZEN | HAZEN |
| 00761 | TEMPERATURE C (FIELD TEST) | CEL |
| 00772 | CONDUCTIVITY AT 25 DEG C | USIE/CM |
| 00812 | OXYGEN DISSOLVED % SATN | % SATN |
| 00822 | OXYGEN DISSOLVED MG/L AS O | MG/L O |
| 00851 | BOD 5 ATU TOTAL | MG/L O |
| 00994 | CARBON ORGANIC TOTAL (ACID SPARGED) | MG/L C |
| 01113 | AMMONIA AS NITROGEN | MG/L N |
| 01165 | NITROGEN TOTAL OXIDISED AS NITROGEN | MG/L N |
| 01351 | SOLIDS PARTICULATE (105 C) (SUSPENDED) | MG/L |
| 01581 | HARDNESS TOTAL AS CACO3 | MG/L CACO3 |
| 01592 | CARBON DIOXIDE - FREE | MG/L CO2 |
| 01622 | ALKALINITY TOTAL AS CACO3 | MG/L CACO3 |
| 01724 | CHLORIDE | MG/L CL |
| 01751 | CYANIDE TOTAL | MG/L CN |
| 01771 | FLUORIDE | MG/L F |
| 01806 | PHOSPHATE ORTHO AS PHOSPHOROUS | MG/L P |
| 01823 | SILICATE REACTIVE DISSOLVED AS SI02 | MG/L SI02 |
| 01833 | SULFATE | MG/L SO4 |
| 02073 | SODIUM | MG/L NA |
| 02113 | POTASSIUM | MG/L K |
| 02830 | BORON TOTAL | MG/L B |
| 04035 | MANGANESE TOTAL | MG/L MN |
| 04197 | IRON 0.45UM MEMBRANE FILTERED | MG/L FE |
| 04611 | DETERGENTS ANIONIC AS MANOXOL OT | MG/L M.OT |
| 05032 | CHLORFENVINPHOS | UG/L |
| 05072 | DICHLORVOS | UG/L |
| 05352 | MALATHION | UG/L |
| 05432 | PARATHION UG/L | UG/L |
| 07142 | BENZO (GHI) PERYLENE TOTAL | UG/L |
| 07182 | BENZO (A) PYRENE TOTAL | UG/L |
| 07232 | DIAZINON | UG/L |
| 07291 | CHLOROPHYLL A UG/L | UG/L |
| 07312 | BENZO (B) FLUORANTHENE TOTAL | UG/L |
| 07332 | BENZO (K) FLUORANTHENE | UG/L |
| 07362 | FLUORANTHENE TOTAL | UG/L |
| 07421 | POLYNUCLEAR AROMATIC HYDROCARBONS-SUM 6 | UG/L |
| 07462 | INDENO (1,2,3-CD) PYRENE TOTAL | UG/L |
| 07494 | PHENOLS DISTILLED (MONOHYDRIC) AS PHENO | MG/L |
| 23460 | STREPTOCOCCI FAECAL PRES. (MICROBIO TEST | NO/100ML |
| 25490 | E COLI PRESUMPTIVE (MICROBIOLOGY TEST) | NO/100ML |
| 70422 | CHLORPYRIPHOS-METHYL UG/L | UG/L |
| 70741 | MEVINPHOS (UG/L) | UG/L |
| 70771 | TRIETAZINE (UG/L) | UG/L |
| 73261 | VANADIUM TOTAL | UG/L |

Continued...

## ANALYSIS SUITES

RJ - SURFACE WATER DIRECTIVE ANNUALLY contd.

| CODE | DETERMINAND NAME | UNITS | |
|---|---|---|---|
| 73602 | PROPAZINE | UG/L | |
| 74252 | COBALT TOTAL UG/L | UG/L | CO |
| 74401 | AZINPHOS-ETHYL | UG/L | |
| 74411 | FENTHION | UG/L | |
| 74421 | PARATHION-METHYL | UG/L | |
| 75051 | DESMETRYN UG/L | UG/L | |
| 75061 | PROMETRYN UG/L | UG/L | |
| 75091 | CLOPYRALID | UG/L | |
| 75101 | TRICLOPYR | UG/L | |
| 90381 | PHOSPHORUS TOTAL (ORTH + COND + ORG) | MG/L | P |
| 90675 | CHLOROFORM | UG/L | |
| 90685 | BROMODICHLOROMETHANE | UG/L | |
| 90695 | DIBROMOCHLOROMETHANE | UG/L | |
| 90705 | BROMOFORM | UG/L | |
| 91135 | DICHLOROMETHANE | UG/L | |
| 91155 | CARBON TETRACHLORIDE | UG/L | |
| 91195 | TRICHLOROETHYLENE | UG/L | |
| 91215 | TETRACHLOROETHYLENE | UG/L | |
| 91234 | CHLOROBENZENE | UG/L | |
| 91265 | 1,1,2,2-TETRACHLOROETHANE | UG/L | |
| 91275 | 1,1,1,2-TETRACHLOROETHANE | UG/L | |
| 91295 | PENTACHLOROETHANE | UG/L | |
| 91930 | COLIFORMS TOTAL PRES.(MICROBIOLOGY TEST) | NO/100ML | |
| 91983 | SILVER TOTAL UG/L | UG/L | |
| 91992 | BERYLLIUM TOTAL UG/L | UG/L | |
| 92004 | ANTIMONY TOTAL UG/L | UG/L | SB |
| 92017 | BARIUM TOTAL UG/L | UG/L | |
| 92521 | IOXYNIL UG/L | UG/L | |
| 92581 | BROMOXYNIL | UG/L | |
| 92611 | ARSENIC TOTAL UG/L | UG/L | AS |
| 92655 | CADMIUM TOTAL UG/L | UG/L | CD |
| 92692 | MERCURY TOTAL UG/L | UG/L | HG |
| 97031 | TERBUTRYN | UG/L | |
| 97251 | SELENIUM | UG/L | SE |
| 97271 | HYDROCARBONS DISSOLVED AND EMULSIFIED | UG/L | |
| 97326 | 1,1-DICHLOROETHYLENE | UG/L | |
| 97336 | 1,2-DICHLOROETHANE | UG/L | |
| 97345 | 1,1,1-TRICHLOROETHANE | UG/L | |
| 97355 | 1,1,2-TRICHLOROETHANE | UG/L | |
| 97364 | 1,2-DICHLOROBENZENE | UG/L | |
| 97374 | 1,3-DICHLOROBENZENE | UG/L | |
| 97384 | 1,4-DICHLOROBENZENE | UG/L | |
| 97462 | CHLORPYRIPHOS | UG/L | |
| 97472 | DIMETHOATE | UG/L | |
| 97482 | PYRIMIPHOS-METHYL | UG/L | |
| 97492 | CARBOPHENOTHION | UG/L | |
| 97502 | FENITROTHION | UG/L | |

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## ANALYSIS SUITES

RJ - SURFACE WATER DIRECTIVE ANNUALLY contd.

| CODE | DETERMINAND NAME | UNITS |
|---|---|---|
| 97512 | AZINPHOS-METHYL | UG/L |
| 98641 | ATRAZINE UG/L | UG/L |
| 98651 | SIMAZINE UG/L | UG/L |
| 98800 | SALMONELLAE CONF.PRES/ABS (MICROBIO.TEST | LITRE |
| 98874 | CHROMIUM TOTAL UG/L | UG/L CR |
| 98894 | COPPER TOTAL UG/L | UG/L CU |
| 98914 | LEAD TOTAL UG/L | UG/L PB |
| 98934 | NICKEL TOTAL UG/L | UG/L NI |
| 98954 | ZINC TOTAL UG/L | UG/L ZN |

## Part 2: RIVERS & GROUNDWATERS

### 2.1 Chemical Monitoring

#### 2.1.1 Routine sampling

Many of our systems for auditing water quality depend on good data on river chemistry. The programme for chemical monitoring of rivers for 1991 covered:

TABLE 2.1

Routine Freshwater Monitoring Frequencies.

| Sample Type / Frequency p.a. | BA | BF | BG | BH | CD | Total by Frequency band. |
|---|---|---|---|---|---|---|
| <=4 | 0 | 118 | 0 | 15 | 0 | 133 |
| 5 - 12 | 6 | 939 | 7 | 14 | 5 | 971 |
| 13 - 24 | 2 | 21 | 0 | 15 | 4 | 42 |
| 25 - 48 | 5 | 18 | 0 | 0 | 0 | 23 |
| Total by Type. | 13 | 1096 | 7 | 44 | 9 | 1169 |

Sample type key :
BA = Reservoir water,
BF = River / stream water,
BG = Canal water,
BH = Lake / broad / pond water,
CD = Raw supply water from impoundment.

The total length of freshwaters characterised by this sampling is 4,669 km. The total number of samples is 12,500 and the total number of sites is 1,126 (see also Table 8.1).

Samples of river sediments were collected at over 70 sites, mainly for purposes linked to the Dangerous Substances Directive. The frequencies ranged from one to four per year.

Our routine groundwater programme covered over 400 sites and involved the collection of more than 1,600 samples. Sampling frequencies ranged from fortnightly to one per year, depending on the type of survey and the variability of water quality at the site (see Part 2.11).

National guidelines have been drawn up for monitoring freshwaters. They should not impose a requirement for a great deal of extra resource, on our Region.

### 2.1.2 Continuous Monitoring

We maintain a network of Automatic Water Quality Monitoring Stations, which provide continuous measurements of water quality. Most are placed on rivers directly above intakes for potable supply or at other strategic river locations.

It is part of NRA policy to extend the network to include other sensitive waters, as well as requiring them on more of the important sewage and industrial effluents, for example:-

- at or above potable supply abstractions;
- at water transfer scheme abstractions or outfalls;
- downstream of large effluent discharges;
- on the lower reaches of a major watercourse;
- downstream of major conurbations;
- at subcatchment confluences;
- at estuarine or coastal sites affected by discharges.

In the last two years, many have been refurbished and the number of new stations in the region is increasing. About 25 are now linked by telemetry networks in the region.

Most monitor and record results for a range of parameters from temperature, pH, dissolved oxygen, conductivity, and ammonia. Generally, instrumentation is housed in a secure structure on the river bank, and water is pumped from the stream, passed probes, then returned to the stream. Results are logged on a small local microcomputer outstation and then telemetred periodically to processors in the Areas and at Regional Head Office at Peterborough. If any of the parameters exceed predetermined levels the stations automatically notify Regional Control Centre staff who will instigate an investigation into the cause of the exceedence.

## 2.2 River Quality Classification

The reporting of river water quality has been based on the River Classes introduced by the National Water Council (NWC).

River stretches are placed in one of the following classes:

Class 1a - Good Quality
Class 1b - Good Quality
Class 2 - Fair Quality
Class 3 - Poor Quality
Class 4 - Bad Quality

The Class for a particular stretch is determined mainly by the concentrations of Dissolved Oxygen, Biochemical Oxygen Demand (BOD) and Ammonia found from routine monitoring. The following table gives the river quality standards for these determinands and the associated Classes. The concentrations are 95-percentiles - they must be met for 95 percent of the time.

TABLE 2.2

| Class | River Quality Criteria | | |
|---|---|---|---|
| | Dissolved Oxygen | Biochemical Oxygen Demand | Ammonia |
| | (% saturation) | (mg/l) | (mg/l) |
| 1A | 80 | 3 | 0.3■ |
| 1B | 60 | 5 | 0.7■ |
| 2 | 40 | 9 | - ■ |
| 3 | 10 | 17 | - |
| 4 | Inferior to Class 3, anaerobic at times | | |

■ The water must be non-toxic to fish in European Inland Fisheries Advisory Commission (EIFAC) terms.

The chemical classification of rivers for 1991 is shown in one of the maps enclosed with this report. There is some change from 1990. About 9% of river lengths were downgraded, while 4% were upgraded. Overall, 91 % of rivers fall into the Classes defined as Good to Fair quality.

These statistics represent shifts in Class of around 570 km since the last report. Shifts occurred across all classes although most were between classes 1b and 2, and classes 2 and 3. There was a net downgrade of 226 km since the last report.

In 1991, it is believed that over 80% of river length downgraded was because of drought-related causes. Despite greatly-improved effluent qualities from many sewage treatment works, reduced flows in certain

catchments, provided less dilution for ammonia and BOD in effluents, and several stretches were also affected by heavy algal growth (see also Part 2.3 on RQO's).

Among the reductions, about thirteen km of the River Granta and nine km of the Stringside Stream dropped from Class 1A to 2 due to drought related causes. Downgradings from Class 1A to 1B included lengths of the rivers Wissey, Babingley, Heacham, Bucklesham Mill River, and about twenty-five km of the River Nar. Several lengths were re-classified from 1B to 2, notably parts of the Great Eau, Wendling Beck, Claydon Brook, Clipston Brook, Broughton Brook, Alconbury Brook and Ellington Brook. Downgradings from Class 1B to Class 3 included lengths of the River Kym, Watton Brook and Stowlangtoft Stream. About seven km of the Bourn Brook deteriorated from Class 2 to Class 3. Most of these changes were due to drought-related causes.

During 1991, 26% of the river length which was upgraded improved because of better effluent from Utility sewage treatment works (STWs). This included a 10 km stretch of the River Bure re-classified from Class 1B to 1A. Around nine km of the River Ouse and 5 km of the River Ore improved from Class 2 to 1B, and about five km of the Spiketts Brook improved from Class 4 to 3.

Notable improvements due to reductions in urban run-off or agricultural pollution lead to a change from Class 1B to 1A for a 10 km length of the Culford Stream, while about 13 km of a tributary of the River Blyth was re-classified from 2 to 1B.

There were no changes in the classification of canals.

## 2.3 River Quality Objectives

River Classes provide an absolute measure of river water. A river in a good Class will generally be a good fishery and suitable for other uses like the supply of drinking water, but this cannot be guaranteed because a use can be affected by pollutants which are not in the classification system.

River Quality Objectives (RQOs) are used to ensure that river quality is checked more directly against all the quality standards needed to support those uses. Improvements to river quality, for example by expenditure on effluent treatment, would then be targeted so as to ensure that River Quality Objectives were met and maintained.

The River Quality Objectives defined for the purposes of water quality management are:

- Abstraction for Public Water Supply;
- Salmonid Fishery (supporting a breeding population of trout or grayling);

- Cyprinid Fishery (supporting a breeding population of coarse fish);
- Amenity and Conservation (subdivided into three categories - high, moderate and low);
- Abstraction for Industrial Water Supply;
- Spray Irrigation of Field Crops;
- Livestock Watering;

Each of these requires that a set of water quality standards is met. We have assigned River Quality Objectives to 1,350 individual stretches of river, totalling 7,843 km.

Each river stretch has a group of uses which were assigned to it after full public consultation. The amalgamation of the standards for all these uses gives a complete set of standards for that part of the river. Water quality is then managed to achieve this set of standards.

In some rivers where the current river quality is very good the achievement of River Quality Objectives could, in theory, permit a deterioration in river water quality. To prevent this, a policy of *No Deterioration* is superimposed on the River Quality Objectives (see Part 2.5).

### 2.3.1 Compliance

The determinands most often involved in decision-making are Dissolved Oxygen, Biochemical Oxygen Demand, and Ammonia. The impact of other substances, for example metals and pesticides, is also assessed against the standards set down in the River Quality Objectives. These substances feature also in the Directives issued by the European Community.

River quality is highly variable and the use of sampling means that there is always a risk that we report wrongly that water quality has changed, or failed to meet with a standard, or complied with a standard. This risk, which is largest at low rates of sampling, is controlled by using statistically sound methods of assessing compliance and change.

River quality is also affected by whether the year is wet, dry, hot or cold. In order to smooth out these effects, and to increase our ability to detect small changes in quality, we use three years' data to report performance.

Every three months, we audit and report the chemical quality of over 4,500 km of our rivers against the River Quality Objectives, using results from around 880 sampling points. (In 1991, most of the remaining 3,300 km were monitored biologically - see Part 2.7). The trend in performance against the standards for Dissolved Oxygen, Biochemical Oxygen

Demand and Ammonia is shown in Figure 2.1. This shows results for the average percent of time for which rivers complied and the percent of total river length which met standards. These statistics, particularly the former, are stable and efficient measures which can be used to suggest trend.

For the three-year period ending in December 1991, the percent of time spent within the required limits was 86.7%, compared to 87.6% for the three-years ending in December, 1990.

For the three years ending in December 1991, 65.9% (2,990 km) of river lengths were of the required quality. This compares with the 70.7% (3,200 km) for the three years ending in December, 1990. This suggests that river quality in 1991 was worse than in 1988. Figure 2.1 shows that changes of this magnitude have been seen before, for example from 1983 to 1984 and from 1989 to 1990.

In Anglian Region, the growth of algae is encouraged by the nutrient-rich, slow-moving nature of many of the rivers. This leads to algal activity in the laboratory test for BOD, and to spurious, elevated results. Consequently, the performance figures for river quality are pessimistic because they are distorted by the effect of algae on the measurement of this test.

If the effects of algae on the measurement of the BOD are ignored, the total length meeting standards in 1989/91 would increase from 65.9 to 78.1 percent. This supports the case for much of the poorer quality being drought-related.

***Why did this reported change in quality occur?***

We can investigate this by looking at median values of water quality. Median values are those which fall exactly in the middle of the range of values. They will not be affected by extreme outlying results. Any shifts in median values can be expected to reflect real overall shifts in qualities. Thus, for assessing trends, the use of median values has several advantages:

- it offers a stable estimate of trend;
- it is relatively insensitive to changes in sampling rate; and thus,
- it is a good way of comparing water qualities between sites, rivers and years.

Results from analyses of median values for the parameters most often used decision making, are shown in Table 2.3.

# FIGURE 2.1

## PERFORMANCE OF RIVERS AGAINST RIVER QUALITY STANDARDS

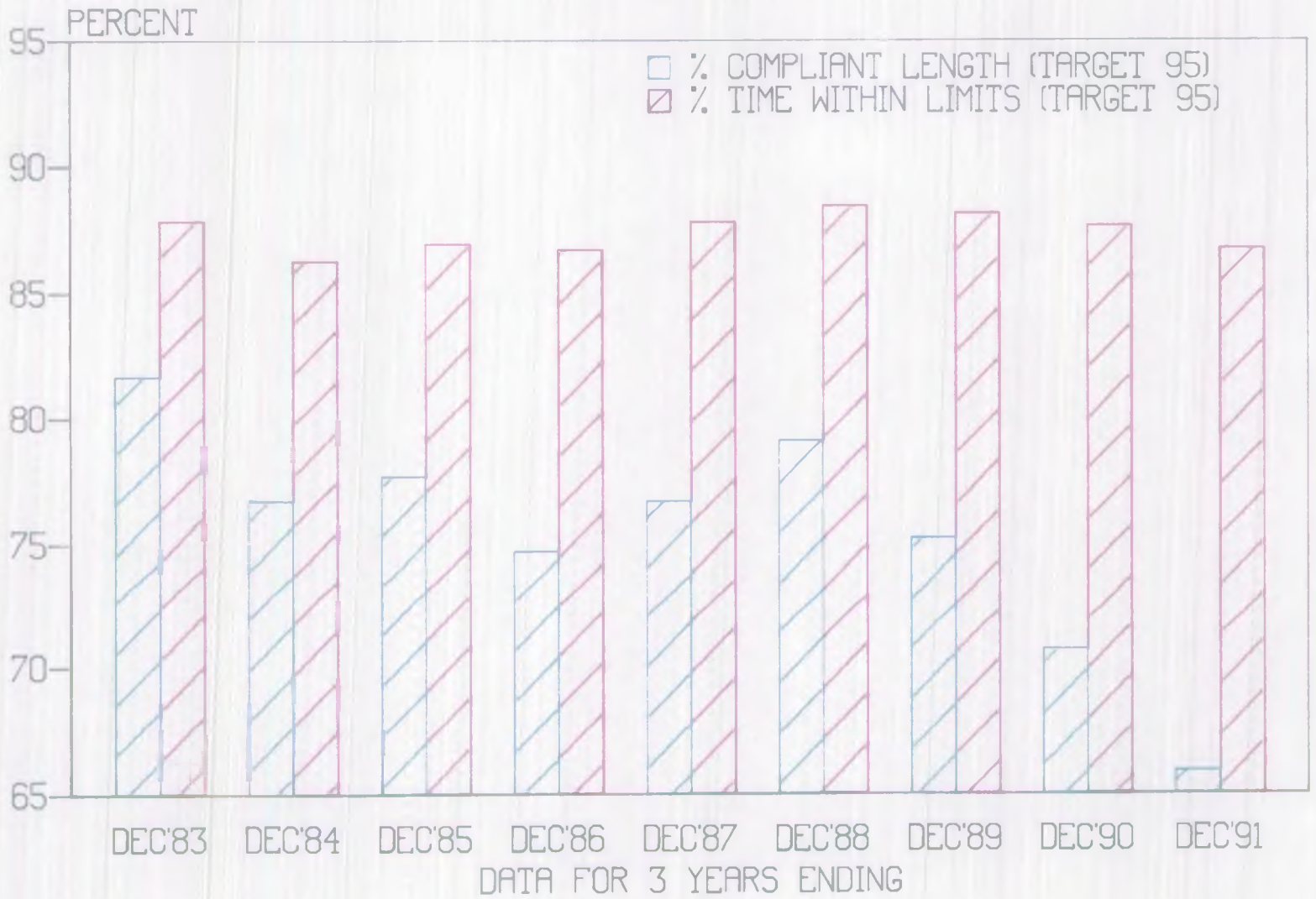


TABLE 2.3

Median Values For Each Determinand

| Determinand | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BOD mg/l | 2.2 | 2.4 | 2.3 | 2.5 | 2.5 | 2.5 | 2.4 | 2.4 | 2.1 | 2.1 | 2.1 |
| Total Ammonia mg/l | 0.09 | 0.14 | 0.15 | 0.14 | 0.16 | 0.16 | 0.16 | 0.15 | 0.13 | 0.10 | 0.08 |
| D.O mg/l | 10.0 | 10.2 | 10.2 | 10.1 | 10.1 | 10.1 | 9.8 | 9.8 | 9.5 | 9.4 | 9.4 |
| D.O % Saturation | 94.8 | 94.8 | 93.4 | 95.8 | 94.3 | 92.2 | 90.5 | 89.4 | 87.8 | 88.7 | 86.5 |

Dense growths of algae may have contributed to some local increases in BOD, but, since the mid-1980's an improvement in overall concentrations can be seen in the statistics for BOD and ammonia. These are the principal parameters to be affected if effluent qualities deteriorate, yet they have improved. Conversely values for dissolved oxygen have deteriorated. Regionally, concentrations of dissolved oxygen in the rivers, were depressed by the drought and low flows, particularly in the upper reaches.

The figures in Table 2.3 suggest that the apparent decline in compliance with River Quality Objectives is not caused directly by sewage treatment works.

A further reason for the apparent decline in the compliant length lies in the harmonisation of the sampling programme introduced over the past four years. This has led to increased sampling rates for rivers in the north and centre of our Region. About five percent more samples were collected during the period 1989/91 than in the period 1988/1990. The programme has largely settled down now and these shifts in emphasis will not occur again. These new rates mean that we can now pick up as significant, smaller violations of the river quality standards. Hitherto we have missed these.

## 2.4 The 1990 Survey

The chemical and biological quality of rivers and estuaries has been reported nationally every five years. The most recent survey was performed in 1990.

Anglian Region took on the role of collating chemical and biological data from all the regions.
It was essential that the results for 1990 could be compared sensibly with the NWC Survey for 1985, at the same time as preparing the way for Statutory River Quality Objectives (Part 2.5).

To achieve this, the 1990 Survey aimed for:

- continuity with 1985;

at the same time as achieving:

- full objectivity and national consistency.

These are conflicting requirements which were only achievable by reporting two sets of results:

[a] those obtained from a Survey based on similar procedures to those used for 1985;

[b] a Survey based on the universal use of a fixed set of procedures, the *NRA Survey*.

The subjectivity of past Surveys is unacceptable for quality standards which are to have statutory force. But the removal of this judgement will give a high risk of error in classification. The NRA plans three developments to reduce this risk:

- the assessment will be based on three years' data;
- biological data will be used to improve precision;
- the 1990 NRA Survey will establish a baseline - a sound statement of river quality in 1990. After 1990, using this baseline, we shall look for statistically significant changes in Class.

The high level of audit and reporting that have been developed in this Region allow us to adapt readily to such requirements.

The Report of the 1990 NWC Survey entitled "The Quality of Rivers, Canals and Estuaries in England and Wales" was published in December 1991. The NRA survey report will be published in due course.

## 2.5 Statutory Quality Objectives.

Following the 1990 NRA Survey, the Government will introduce *Water Quality Objectives* which will be statutory. The results from the 1990 NRA Survey will be used as a basis for these.

The group has produced a report entitled "Proposals for Statutory Water Quality Objectives", which includes a series of recommendations and provides a basis for consultation on the implementation of Statutory Quality Objectives, for all controlled waters.

Basic recommendations are:-

*The Statutory Quality Objective for a stretch of Controlled Water should be in three parts:*

- *a Target Class, based on a classification system which is expected to remain unchanged in the future;*
- *a set of Use-related Objectives which can be allowed to develop as new standards and new Uses are introduced; and,*
- *a requirement to comply with the Directives issued by the European Commission.*
- *in addition to the achievement of Statutory Quality Objectives, the NRA should plan for No Deterioration from the existing quality of Controlled Waters.*

The Statutory Water Quality Objectives will be used to plan the measures needed to secure the aims of the NRA.

## 2.6 River Quality Indices

At many sites we need to assess compliance with the standards for over 40 different determinands. The management of this large and complex workload is aided by a system of River Quality Indices.

The Indices are scores which summarise water quality and measure performance in managing resources for environmental monitoring (see Part 1.5).

Data are compressed into a simple number which discriminates between good and bad quality, thus reducing the effort needed to:

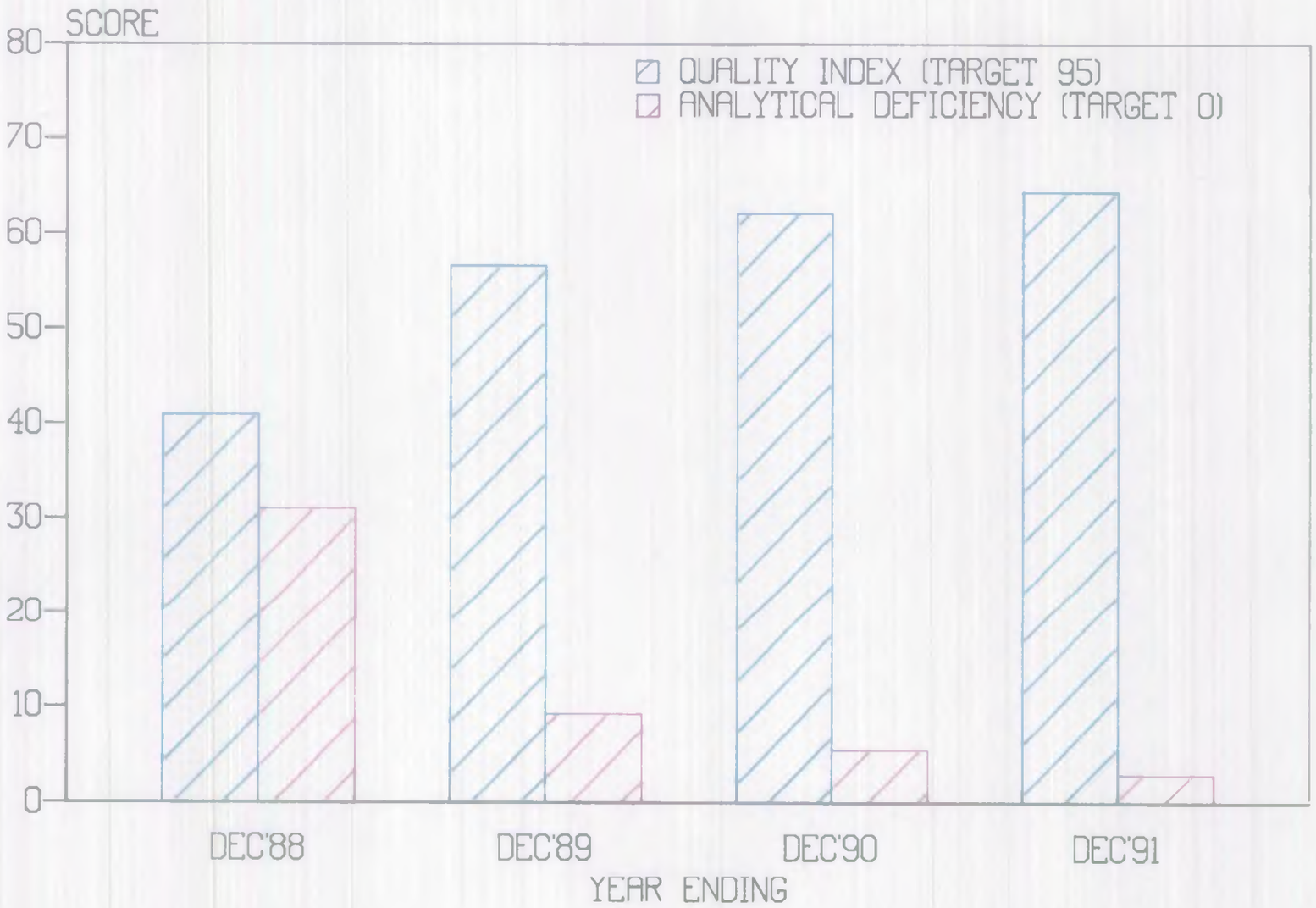
- maintain an awareness of water quality;
- set targets;
- identify areas of poor quality;
- direct resources to areas of poor quality; and,
- audit sampling and analytical resources

The Indices are used to summarise information at a site, within a District or an Area, or over the whole Region. They are used by managers to direct resources to areas of concern and to ensure that the Sampling Programme covers all our obligations.

Figure 2.2 shows changes in the Regional River Quality Index over the four years since December 1988. A perfect result is a score of 100 for each river, District, Area and the Region. The target for the Region is to see the Index rise progressively towards 100.

# FIGURE 2.2

## REGIONAL RIVER QUALITY INDEX



The figure also shows improvements in our ability to achieve our sampling programme (in the reducing scores for the Analytical Deficiency).

## 2.7 Biological Monitoring

The role of the biology function is to understand and measure aquatic life in order to help the NRA protect and manage Controlled Waters.

The number of biological samples taken from rivers and lakes throughout the region has increased steadily since 1988 as illustrated in table 2.4 below. These surveys examine the plants and animals found in both flowing and still-waters.

TABLE 2.4

THE NUMBER OF BIOLOGICAL SAMPLES TAKEN

| Year | No. of Samples |
|---|---|
| 1988 | 1,684 |
| 1989 | 3,400 |
| 1990 | 7,474 |
| 1991 | 8,899 |

### 2.7.1 Monitoring River Quality

Animals collected from the rivers are identified and the biological quality of that site assessed on the invertebrates detected. Some invertebrates are indicators of high biological quality as they are sensitive to a deterioration in the quality of their habitat. These invertebrates would score highly in the BMWP (Biological Monitoring Working Party) scoring system. This system is used to summarise biological data and ranges from 0 to >150 as illustrated in table 2.5.

TABLE 2.5

THE BMWP SCORE SYSTEM

| BMWP Score | Quality |
|---|---|
| > 150 | Excellent |
| 101 - 150 | Very Good |
| 51 - 100 | Good |
| 26 - 50 | Moderate |
| 0 - 25 | Poor |

Changes in variety of invertebrates found throughout the year indicate not only the natural variation and life cycles of the animals, but also changes in the water quality of a river.

Chemical analysis by the NRA includes the major environmental parameters that indicate changes in water quality. However there are many potential pollutants that are not assessed. Various invertebrates are sensitive to these pollutants and are therefore important indicators of specific pollution problems. Without biological monitoring some pollution incidents or long term changes in water quality could go undetected.

### 2.7.2 National Reporting Sites

For the past 12 years comparisons have been made of the biological quality of 240 sites original sampled in the 1980 National River Quality Survey. These are referred to as National Reporting Sites. The results are shown in Figure 2.3. The 1991 data shows a similar quality to that in 1990, and the underlying trend is one of improvement since 1982.

### 2.7.3 The 1991 Biological Quality Survey

In 1991 a comprehensive study of biological river quality was undertaken. Apart from some stretches that were assigned Low Amenity River Quality Objectives (Part 2.3), all lengths were sampled in three seasons - spring (defined as March to the end of May), Summer (June to the end of August) and Autumn (September to the end of November). A total of approximately 3,300 biological samples was taken.

A standard, nationally-agreed sampling technique was used to maximise comparability, replicability and the number of invertebrate taxa collected from each site. The regions were assisted in Analytical Quality Control by the Institute of Freshwater Ecology (IFE). A random selection of samples were re-examined by IFE and the results sent back to each Senior Biologist in the Region. From this independent audit of the results the errors associated with each sorter were quantified and problem areas identified and then resolved.

The results of the 1991 Biological Survey using the National Classification system (See section 2.7.6.) are shown in table 2.6. The survey suggested that over 52% (3212 km) of the river length in the Anglian Region is of Class A quality. The total length of river sampled biologically has increased since 1990 and the percentage of river length in each Class in 1991 is similar to that in 1990.

# FIGURE 2.3

## BIOLOGICAL QUALITY OF RIVERS (BMWP SCORE)

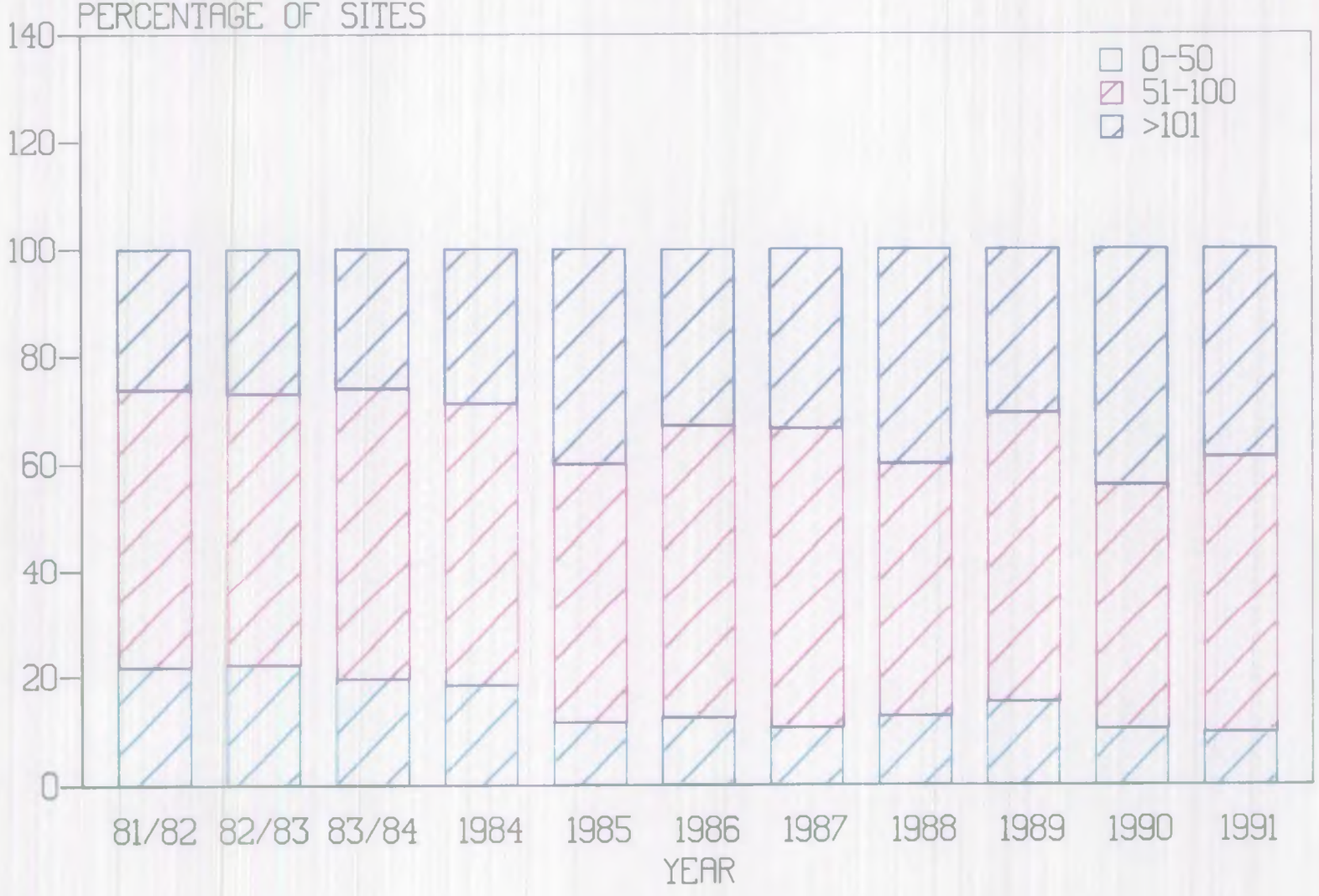


TABLE 2.5

THE 1991 BIOLOGICAL SURVEY

| | 1990 survey km | % | 1991 survey km | % |
|---|---|---|---|---|
| Class A | 2983 | 51.7 | 3212 | 52.8 |
| Class B | 1917 | 33.2 | 1954 | 32.1 |
| Class C | 696 | 12.1 | 782 | 12.8 |
| Class D | 178 | 3.1 | 139 | 2.3 |
| Total | 5774 | | 6087 | |

In order to classify the rivers using the data from the 1991 Biological Survey a computer model called Rivpacs has been used.

The biological classification of rivers in Anglian Region is shown in one of the maps enclosed with this report.

2.7.4 RIVPACS

RIVPACS (River Invertebrate Prediction and Classification System) is a computer package, developed by the Institute of Freshwater Ecology. It has two main aims:-

- classification of the rivers in Great Britain, according to the invertebrates found; and,
- the prediction of the invertebrates that should be found given a set of environmental variables.

Within RIVPACS is an existing river classification system based on 438 unpolluted reference sites using biological and environmental data. The environmental data includes, for example, the depth and width of each river. Data can then be compared with this classification system enabling the rivers throughout Britain to be classified.

When the environmental variables of a site are fed into RIVPACS, it is able to predict the variety of invertebrates that should be found and the BMWP score. These predictions assume the site of sampling is unpolluted. If the BMWP predicted by RIVPACS is lower than the observed value, the results suggest that some form of pollution may have occurred.

The range of applications of RIVPACS includes:-

- Invertebrate predictions for sites which are polluted can be used

as a baseline against which an assessment of improvements in water quality may be made.

- If a previously unsampled site suffers from a pollution incident, RIVPACS can predict the taxa which may have been eliminated.
- RIVPACS can be used in the formulation of conservation strategies by cataloguing site invertebrates.
- The interpretation of national and local river quality survey results can be enhanced by using RIVPACS to predict BMWP statistics in the absence of pollution.
- Invertebrate predictions for sites that may have been affected by, for example, land drainage operations or water transfer schemes, will enable an ecological assessment of the affected rivers to be made.

### 2.7.5 National Biological Classification System

RIVPACS has been used to develop a banding or classification system of the rivers of Great Britain, based on the results from the 1990 Biological Survey.

For each site a BMWP score, ASPT and number of BMWP taxa were determined. These observed values were then compared to the predicted values produced from RIVPACS. The ratio of the observed and predicted values produced an Ecological Quality Index (EQI) for each of the three variables.

$$EQI = \frac{\text{Observed value}}{\text{Predicted value from RIVPACS}}$$

Therefore, for each site sampled, three EQI values were determined.

EQI (BMWP Score) )
EQI (ASPT) ) EQI variables
EQI (No. Taxa) )

An EQI value of 1 for each determinand would indicate that the site was not polluted or suffering from stress of any kind. An EQI value of 0 indicates that the site is grossly polluted and sustains little or no aquatic life. The EQI variables provide a useful management tool. Given a set of environmental variables, the environmental stress of a particular site can be quantified.

The EQI's determined for each site enabled a banding system to be established to classify Britain's rivers.

The biological classes, or bands, A to D, are based on all three of the

EQI variables. The statistical 10-percentile is used for EQI (BMWP Score) and EQI (No. Taxa) and 5-percentile for EQI (ASPT). This statistical bias was incorporated because of the greater statistical confidence in the ASPT score. The ASPT is independent of both an increase in diversity of the macroinvertebrates found at a site and sample size.

The banding criteria are described below:-

| Biological Class | EQI(ASPT) | EQI(TAXA) | EQI(BMWP) |
|---|---|---|---|
| A | >0.89 | >0.79 | >0.75 |
| B | 0.77-0.88 | 0.58-0.78 | 0.50-0.74 |
| C | 0.66-0.76 | 0.37-0.57 | 0.25-0.49 |
| D | <0.65 | <0.36 | <0.24 |

A class is determined for each variable and the overall class of the site is the median of the 3 results. For example, B, B, C, results in class B; B, A, C, results in class B. However, if the lowest EQI is that for ASPT, then this will be the final class, eg. C (ASPT), B (TAXA), B (BMWP), then the overall class will be C.

Each site will represent a stretch of river, so that the class of the site sampled truly reflects that of the allocated stretch. In this way the river lengths of the Region can be classified according to their biological quality.

### 2.7.5 Other Biological Samples

The work carried out in 1991 is summarised in Appendix I. This indicates the wide range of sample types collected.

## 2.8 EC Directives

The management of river water quality is affected directly by several of the European Community Directives. The Directives contain a variety of requirements with respect to monitoring, reporting, consenting and other water quality control measures. They have a major impact on the planning of our monitoring programme. Their role as a basis for justification of improvements, e.g. through the regulation of discharges, is becoming increasingly prominent.

Some Directives have been in force for many years, the most important being those relating to:

- Dangerous Substances in Surface Waters;
- Dangerous Substances in Groundwater;

- Surface Water Abstracted for Drinking Water;
- Freshwater Fisheries.

During 1990 and 1991, new Directives of significance to water quality matters were adopted and their requirements will come into force progressively over the next few years. These were directives relating to:

- Urban Waste Water Treatment;
- Pollution of waters by nitrates from agriculture;
- Harmonisation of reporting on environmental Directives;
- Freedom of access to information on the environment.

These new Directives are relevant to estuarine/coastal waters as well as rivers/groundwaters but are described in detail here.

### 2.8.1 Dangerous Substances in Surface Waters

The Dangerous Substances Directive contains two lists of pollutants and outlines the approach to be adopted in controlling discharges containing the substances in each. List I includes materials which are particularly toxic, persistent, and which accumulate in the environment. List II covers pollutants with less serious potential effects. The objective is to eliminate pollution from List I substances and to reduce pollution from List II substances.

#### 2.8.1.1 List 1 Substances

Environmental standards have currently been set for lindane, cadmium, mercury, the drins (dieldrin, aldrin, endrin, isodrin), pentachlorophenol, DDT, carbon tetrachloride, chloroform, hexachlorobenzene, hexachlorobutadiene, trichloroethylene, trichlorobenzene, tetrachloroethylene, and 1,2 dichloroethane.

The Directive applies to discharges to both fresh and saline surface waters. We have to provide lists of significant discharges, monitor the receiving waters, and report annually to the Government (DoE) (which then reports to the Commission). We also have to control, through issuing and reviewing consents, all significant discharges of listed substances.

In addition to monitoring for List I substances at discharge-related sites, background monitoring known as National Network monitoring was carried out as required by the DoE. This is undertaken mainly at the tidal limits of major rivers. In mid-1990, the DoE extended the National Network monitoring to cover all List I substances (although the Direc-

tive specifies only cadmium and lindane). Our sampling regime was extended to accommodate this change.

With regard to the discharge-related receiving water sites:

[a] There were no failures to meet the Directive quality criteria in any of the 5 freshwater sites designated under the Mercury Directive, nor the 22 sites for the Cadmium Directive.

[b] Of the four freshwater sites designated under the Lindane Directive, two failed the quality standard. Both sampling sites are in small dykes affected by drainage from the premises of Calders and Grandidge near Boston which suffers from historic contamination by timber treatment chemicals. We are maintaining close contact with the company who are to commit major capital investment to tackling the problem. One boundary of the site has now been sealed. A treatment plant is being considered to treat the collected site drainage and greatly reduce concentrations entering the small dyke. There have been no problems detected in the Witham Haven downstream.

[c] The single freshwater site designated under the Carbon Tetrachloride Directive passed the standard.

[d] There are no freshwater sites in this region designated under the Pentachlorophenol and DDT Directive.

[e] Under the Drins Directive, four freshwater discharge-related sites were monitored against the water quality standards. Two of these sites exceeded the criteria, these being in the two small dykes related to the Calders and Grandidge premises where problems are being addressed as described in [b] above. There were no problems at sampling sites further downstream.

The remaining substances in the Drins Directive are Hexachlorobenzene (HCB), Hexachlorobutadiene (HCBD) and Chloroform. For these, 1991 was the last of two years extra background monitoring agreed with DoE. This monitoring was undertaken at our Harmonised Monitoring sites. No industrial discharges, either direct to river or to sewer have been identified as containing HCB or HCBD. For chloroform, two consents were issued in late 1991 and the receiving waters will be monitored during 1992.

The environmental standards for the chlorinated solvents (trichloroethylene, trichlorobenzene, tetrachloroethylene, and 1,2 dichloroethane) are not yet in force. The Commission will require the first monitoring data in 1994. We will be undertaking investigational monitoring during 1992 to identify whether there are any discharges of these substances in our Region.

2.8.1.2 List II Substances

During 1991 there were around 70 discharges to freshwaters which contained List II substances. Monitoring of the receiving waters was undertaken as required and the following sites exceeded (or nearly exceeded) their national quality standards:

[a] The Willow Brook at Corby failed for zinc. A work programme has been agreed with the industrialist responsible for the discharge. A new consent will be issued upon completion of the control measures.

[b] The Hog Dyke was a borderline pass for copper. This receives the discharge from Raunds STW and a review of the consent is being undertaken.

No failures of the national freshwater quality standards were detected with respect to any other List II substances.

2.8.2 Groundwater Directive

This Directive relates to the protection of groundwater against pollution caused by certain dangerous substances. It effectively prohibits the discharge of List I (the most dangerous) substances to groundwaters and limits the discharge of List II (less dangerous) substances. The lists of substances differ somewhat from those for discharges to surface waters. No annual reports have yet been requested by DoE for this Directive (but see 2.8.7).

In October 1990, the DoE issued two documents relating to the Directive, these being:

[a] DoE Circular 20/90 which gave guidance and information on the classification of listed substances for the purposes of the Directive. A stricter approach to the control of substances emanating from waste disposal sites was prescribed.

[b] A DoE consultation paper on Government proposals for a national classification scheme for listed substances with respect to the Directive. This contained more specific rules than circular 20/90, and it was proposed that the NRA should carry out the classification of substances.

A seminar on groundwater protection, involving the Community Environment Ministers, was held at The Hague in November 1991. A Declaration was issued after the conference. The Ministers recognised the vital importance of groundwater as a resource. They noted the wide range of threats to those resources and that Community legislation was inadequate for providing the necessary protection. They agreed that an action programme was required to prevent deterioration of groundwater quality, restore quality where appropriate, prevent over-exploitation, and replenish the

system where necessary. The need for an integrated approach was stressed, requiring management of surface and groundwater quality as a whole. Further to the seminar, the Council issued a Resolution asking the Commission to draw up an action programme by mid-1993, and to progress amendment of the Groundwater Directive to incorporate it within a general freshwater management/protection policy.

Groundwater protection is apparently moving up the agenda of the Community environmental programme. The proposals will considerably extend Community legislation in this field.

### 2.8.3 Surface Water Directive

Under this Directive, surface water abstracted for public water supply has to comply with water quality standards which depend upon the type of water treatment provided. So far, the DoE has not asked us to report on this Directive, but this will change when the new Harmonisation of Reporting Directive (see 2.8.7) comes into force. We run audits throughout the year to check on compliance with the water quality and sampling requirements, and periodic internal reports are produced.

During 1991, we contributed to an ongoing national exercise to provide DoE with information on abstraction points. The DoE will use this information in deciding which points to designate for the purposes of Statutory Water Quality Objectives in relation to this Directive (see 2.5).

### 2.8.4 Freshwater Fisheries

This Directive specifies water quality standards for the protection of game and coarse fisheries. In Anglian Region, 400 km of game fishery and 950 km coarse fishery have been designated under the Directive.

We did not have to report to Doe on this Directive in 1991, but periodic internal audits were carried out. There were a few exceedences of the standards, with dissolved oxygen levels causing most failures.

### 2.8.5 Urban Waste Water Treatment

This Directive, adopted in May 1991, requires the construction of sewerage systems and sewage treatment facilities, and the achievement of minimum effluent standards. The stringency of the requirements for specific discharges relates to the size of the population served by a given treatment works, and also to the type and sensitivity of the receiving waters. Nutrient removal treatment will be required in cases where discharges are considered to contribute to eutrophication of the receiving waters, or to elevated levels of nitrates in waters abstracted for drinking. Implications for the Water Services companies and the NRA are considerable. This Directive will affect discharges to all surface

waters (fresh and saline). A considerable degree of interpretation and ongoing development is needed for aspects of this Directive. Anglian Region has made a significant contribution to this development work.

### 2.8.6 Pollution of waters by nitrates from agriculture

This Directive concerns the protection of surface and groundwaters from pollution by nitrates from agricultural sources. It was adopted in December 1991. The requirements come into force over the next few years.

The Directive requires Member States to identify (by December 1993) waters affected by nitrogen pollution. These are surface waters with elevated nitrate levels which are abstracted for drinking water, groundwaters with elevated nitrate, and waters which are eutrophic due to high nitrate levels. The NRA is undertaking the monitoring required for this procedure in accordance with a Direction from the Secretary of State. Ongoing monitoring will be required to allow a review of affected waters every four years.

Once the "polluted" waters have been identified, Vulnerable Zones will be designated (also by December 1993). These are areas of land draining to the affected waters. Action programmes must then be established and implemented within Vulnerable Zones within six years of zone designation. This will comprise measures to reduce water pollution by restricting agricultural activities. Such restrictions will be mandatory. In addition, a voluntary code of good agricultural practice must be introduced. This will apply to all farmland, not just land within zones, and will be aimed at achieving a general level of protection for all waters.

Reports must be submitted to the Commission every four years, on implementation of this Directive, including a summary of the water quality monitoring results.

### 2.8.7 Harmonisation of Reporting on Environmental Directives

This Directive was adopted in December 1991. It will standardise the format of reports, and the timescales for reporting on the environmental Directives. The full details and implications are not yet clear as the Commission is still negotiating with Member States over the precise requirements for each Directive. It seems certain, however, that reports will be needed more frequently than in the past, and that the required content of some reports will be considerably more onerous than under the current arrangements. The implementation of this Directive will result in a higher profile for monitoring in respect of certain Directives eg the Surface Water Abstraction Directive and the Groundwater Directive. The first "standardised" reports will cover the period 1993 to 1995.

### 2.8.8 Freedom of Access to Information on the Environment

The objective of this Directive, adopted in June 1990, is to ensure freedom of access to, and dissemination of, information on the environment held by public bodies. It sets out the basic terms and conditions on which such information should be made available. The Directive covers information on all environmental waters and must be implemented by 1993. The Government is currently undertaking a consultation exercise on proposals to implement the Directive.

### 2.8.9 Proposed Directives

The following proposed environmental Directives are currently undergoing consideration and development:

- Ecological Quality of Surface Water;
- Landfill of Waste;
- Hazardous Waste;
- Conservation of habitats and wild flora/fauna (adopted May 1992).

Progress on these Directives will depend mainly upon the political will of the Member State which holds the presidency of the Commission (for the second half of 1992 this will be the UK).

## 2.9 Pollution Incidents

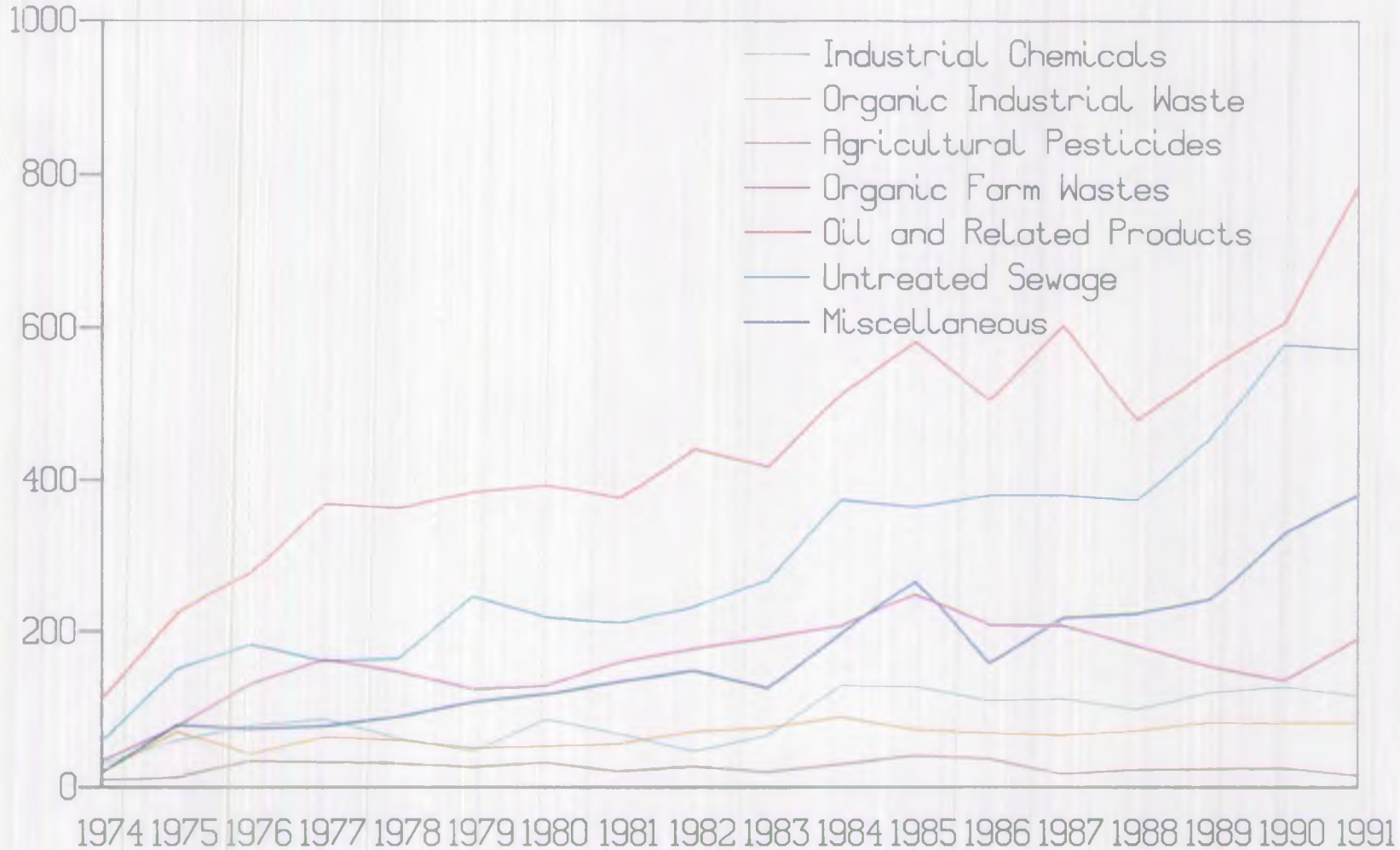
The reporting of incidents which result in pollution commenced in 1974. In 1991 a new, computer based, system of recording pollution incidents was introduced in this region. The system, called **POLLEASE**, enables district field staff to enter details of an incident onto computer as they investigate it. At regular intervals details of all completed investigations are copied to a computer at Regional Headquarters to enable regionwide statistics to be compiled.

A certain number of incidents which are reported to the NRA turn out, upon detailed investigation, to be due to factors other than pollution. For example natural, temperature induced changes in river conditions, may have been the cause of the reported incident. In April a new category, "no pollution", was introduced to take account of these incidents.

The total number of reported pollution incidents in 1991, including those where no pollution was found, was 3,004. When those incidents in the "no pollution" category are excluded the figure is 2,141, an increase of 14% on 1990's figures. Figure 2.4 shows the number of pollution incidents reported annually since 1974.

# FIGURE 2.4

## NUMBERS OF POLLUTION INCIDENTS



Amongst the biggest pollution incidents during the year were:-

- *A spillage of timber preservative contaminated a stretch of the River Flit from Flitwick Moor to Clophill. A biological survey showed that there had been a major impact on invertebrates both in the stream across the moor, and in the river. Successful prosecution.*

- *The Pike Drain in Lincoln was contaminated by a discharge of 200 litres of turbine cleaner. Several thousand fish were killed including eels, dace, roach, and gudgeon, as well as small fry and sticklebacks. Successful prosecution.*

- *About 1,000 fish (mostly pike, roach, chubb, eels and carp) died due to extremely high levels of ammonia in polluted effluent from a bakery supplies manufacturer. The effluent, from a site at Needham Market, affected 3km of the River Gipping. Not prosecuted.*

- *A public water supply borehole at East Harling was taken out of service by Anglian Water Services Ltd because of high levels of herbicides in the water. The source of the pollution was unclear. Prosecution inappropriate.*

- *Liquid fertiliser from a local farm contaminated a 100m stretch of the River Kym at Kimbolton. About 150 fish, mainly roach, bream, and gudgeon were killed. Successful prosecution.*

- *High concentrations of ammonia in the River Ancholme at Cadney lead to the closure of the Cadney intake. The contamination was possibly caused by the draining of a pond upstream of the intake. Prosecution inappropriate.*

The total number of reported incidents was higher in 1991 than in 1990, despite the mainly dry conditions. Dry weather tends to reduce incidents associated with storm discharges and run-off. The definition of accurate trends in pollution incidents within regions, and explanation of differences between regions is a difficult, perhaps invalid, exercise because of the volatility of the statistics.

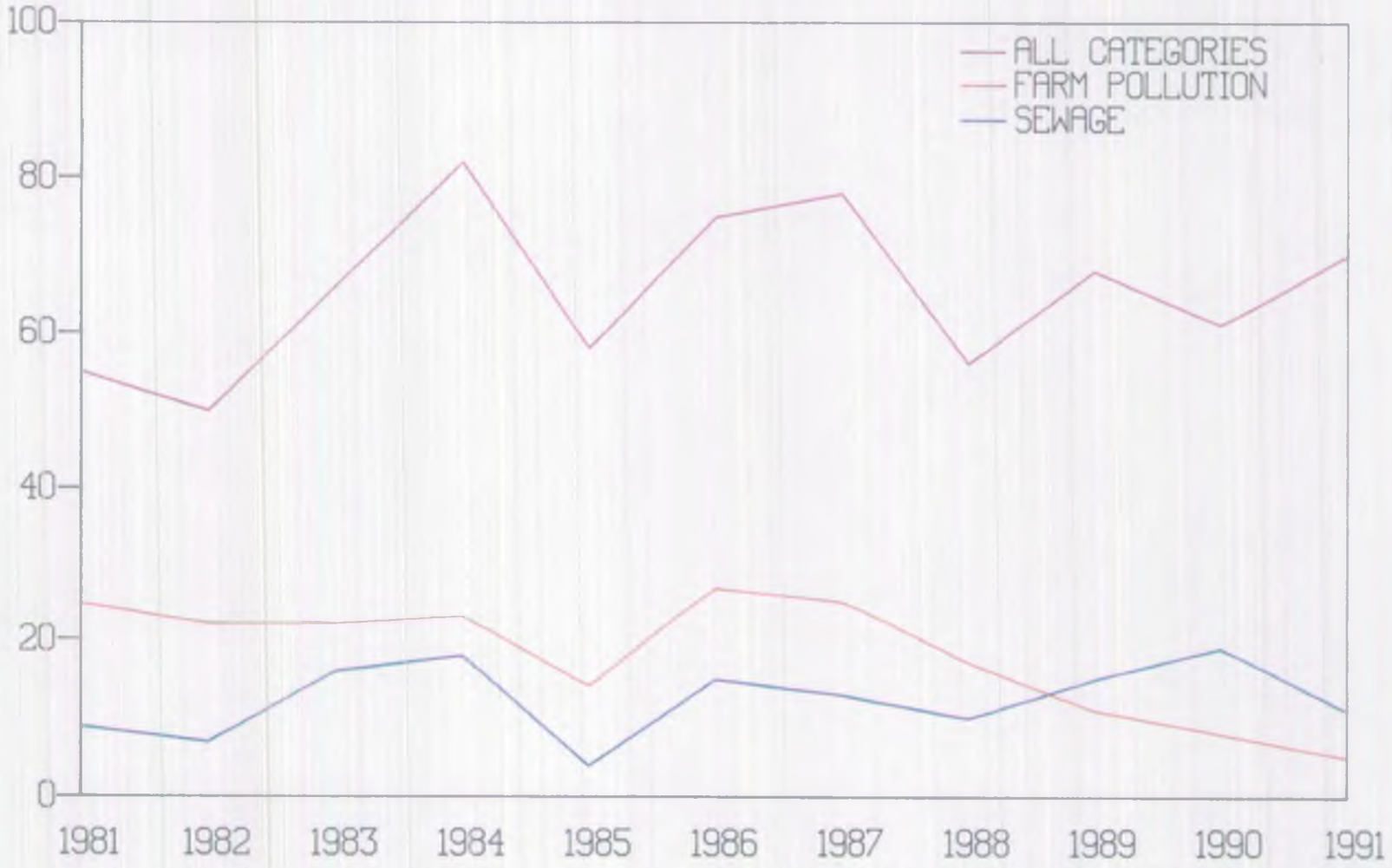
Better legislative powers and our growing effectiveness at pollution prevention will tend to reduce incidents and their impacts. However, as our monitoring becomes even more effective, and public awareness continues to grow, so we may see greater numbers of incidents being reported. We would expect these to be in categories of less significance.

We also expect to find more evidence of historic and on-going chronic pollution, such as that in the Helpston/Etton area (see 2.13), because we are now looking harder for it.

Figure 2.5 gives a breakdown of incidents resulting in fish mortalities. Despite the relatively hot, dry summer, with low flows, numbers were not

# FIGURE 2.5

## NUMBER OF POLLUTION INCIDENTS RESULTING IN FISH MORTALITIES



exceptionally high; although there is a slight increase compared with 1990.

## 2.10 Prosecutions

Under Section 85 of the Water Resources Act (1991) it is an offence to *"cause or knowingly permit any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters"*. Prosecutions are normally brought only where serious pollution has occurred or some negligence or deliberate act was involved and where sufficient evidence can be accumulated to mount a successful case.

This means that the number of prosecutions is a small fraction of the total number of pollution incidents. The cases brought to court in 1991 are listed at Appendix II and the trend in the number of prosecutions each year is shown in Figure 2.6. In 1991 45 prosecutions were undertaken, the highest number in any year, and all categories showed an increase in prosecution when compared with 1990.

Biological data is often prepared for use as evidence in court. It provides evidence on the nature and toxicity of the pollutant, and the source and extent of the waterway affected, together with the recovery rate of the biota.

In addition to prosecutions, the NRA is able to issue a Formal Caution. These are issued in respect of pollution incidents where it is inappropriate to prosecute but it is clear that an offence has been committed. Such a caution, whilst not leading to court action, does require the alleged offender to acknowledge their guilt. A list of formal cautions issued in 1991 is produced in Appendix III.

## 2.11 Groundwater

Half of the drinking water supplied in the region is taken from groundwaters, which in most cases require treatment only by disinfection. In addition there are thousands of abstractions for agricultural and industrial water supplies and many wells are used for private supplies of drinking water.

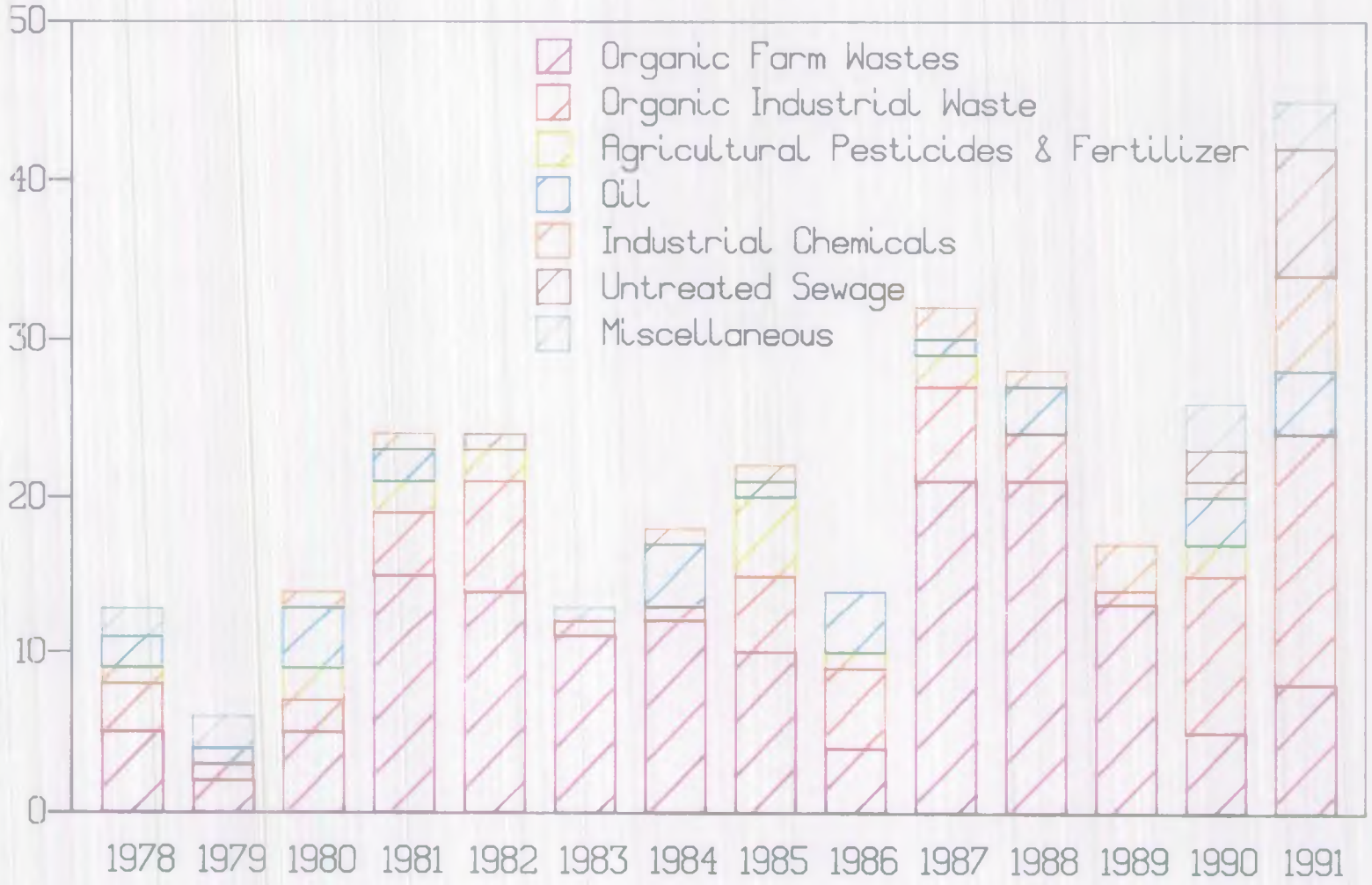
Protecting the quality of groundwaters is of great importance, particularly because groundwater pollution is very difficult to remedy once it has occurred. In areas where the aquifer is overlain with clay or other impermeable strata, pollution spilling onto land poses greater immediate risks to rivers than to groundwaters.

### 2.11.1 Monitoring

Many of the boreholes which gave us water quality data for groundwaters are now owned by Anglian Water Services. Work is continuing on the definition of the NRA Monitoring Network.

# FIGURE 2.6

## NUMBERS OF PROSECUTIONS FOR POLLUTION INCIDENTS



About 500 points are routinely monitored to provide information on groundwaters. Analytical sets range from those for the chlorinity and overall ionic strength of the water, to complex lists including metals, pesticides and microbes.

National guidelines are being drawn up for monitoring groundwaters. If implemented as policy, they will require extra resources for our Region.

### 2.11.2 Protection

Policies on Aquifer Protection will give priority to protecting areas where the aquifer is exposed directly to the land surface. A regional policy was produced in 1989 and is referred to in dealings with planning authorities. A draft national policy was offered for public consultation in December 1991. The responses are being considered for incorporation into the final document.

Through the waste disposal site licensing authorities (County Councils), we are increasing the pressure on site operators to prevent leachate reaching Controlled Waters. For example, major remedial works at waste disposal sites have been completed around Foxhall, and are underway at Kesgrave, both near Ipswich and work is about to commence at Wangford, south of Lowestoft.

Our staff are working very closely with County Councils to investigate and improve the situations around a number of contaminated sources. We have investigated a number of reports of groundwater contamination, for example at boreholes at East Harling (herbicides), Rendlesham (herbicide), and Trowse Newton (chlorinated solvents).

Further investigations have been conducted of polluted groundwater around a public water supply borehole at Etton, near Peterborough. One pollutant, a herbicide, has been traced back to a series of landfill sites which lie to the south west of the borehole. Although the pollutant is adequately removed from the groundwater at the site of the borehole using Granular Activated Carbon, we intend to pursue options to prevent further pollution occurring, and to clean up the existing contamination.

In respect of chlorinated solvent pollution of groundwater at Sawston, Cambridge Water Company lost their civil action against those responsible. They are appealing against the decision.

Following contamination of the Public Water Supply borehole at Beck Row a groundwater scavenging system was installed by the Property Services Agency. The groundwater is treated by air-stripping, and then discharged to sewer.

## 2.12 Nitrate

### 2.12.1 Nitrate in Rivers

Concentrations of nitrate in rivers vary with site and season. Figure 2.7 illustrates this variability and shows trends at four major surface water abstraction sites in the region.

The technique known as Multiple Regression has been used to identify trends, and to relate nitrate concentrations to river flows. The method has been used to predict future levels of nitrate in our rivers and reservoirs. The results indicate that average concentrations of nitrate in surface waters may continue to rise by 1 mg $NO_3$ per litre per year. However, Figure 2.7 suggests that since 1976 the upward trend appears to have levelled off.

### 2.12.2 Nitrate Sensitive Areas

The Water Resources Act allows for the designation of Nitrate Sensitive Areas (NSAs) in which it is desirable to reduce the leaching of nitrate in ground and surface waters. In 1990, following notification by the NRA of candidate areas and consultations with farmers, the Ministry of Agriculture, Fisheries and Food (MAFF) established 10 NSAs of which 2 are in Anglian Region. These are at Sleaford and Branston Booths, near Lincoln. Nine further areas were identified as nitrate advisory areas (NAAs), of which 5 are in the Anglian Region.

In conjunction with the water companies (whose borehole sources are being protected by the NSAs and NAAs), we are monitoring nitrate concentrations within the NSAs and at abstraction boreholes. Results of this monitoring are sent to DoE and, through MAFF, to the farmers involved. (See Figure 2.8)

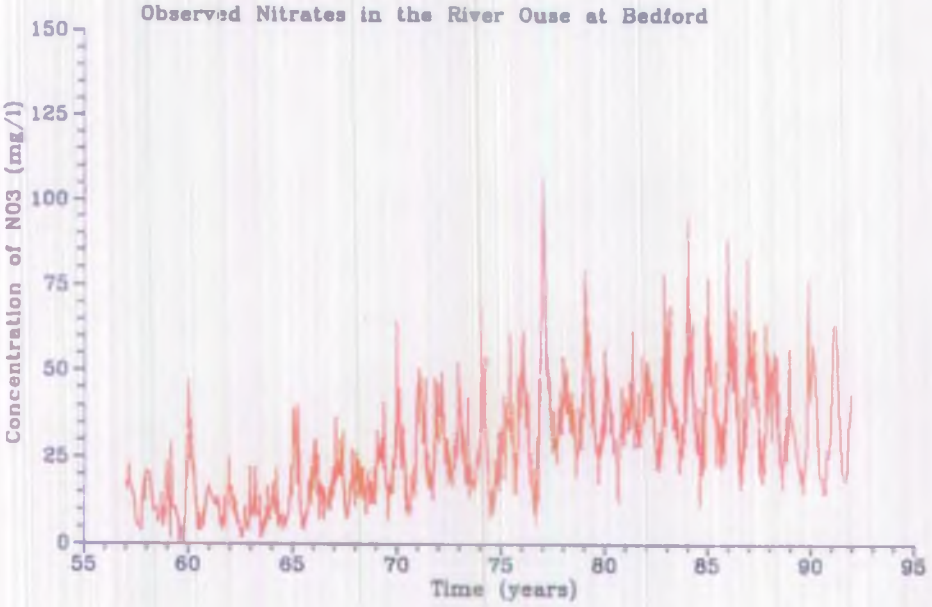
The scheme is voluntary and runs for five years from 1990. Farmers are given small compensatory payments for the relatively modest changes in farming practice in the "basic scheme". Larger payments are given for major land use change in the "premium scheme". Virtually 100% of land in the Branston and Sleaford NSAs is included in the "basic scheme". In addition, 13% and 33% respectively is also in the "premium scheme".

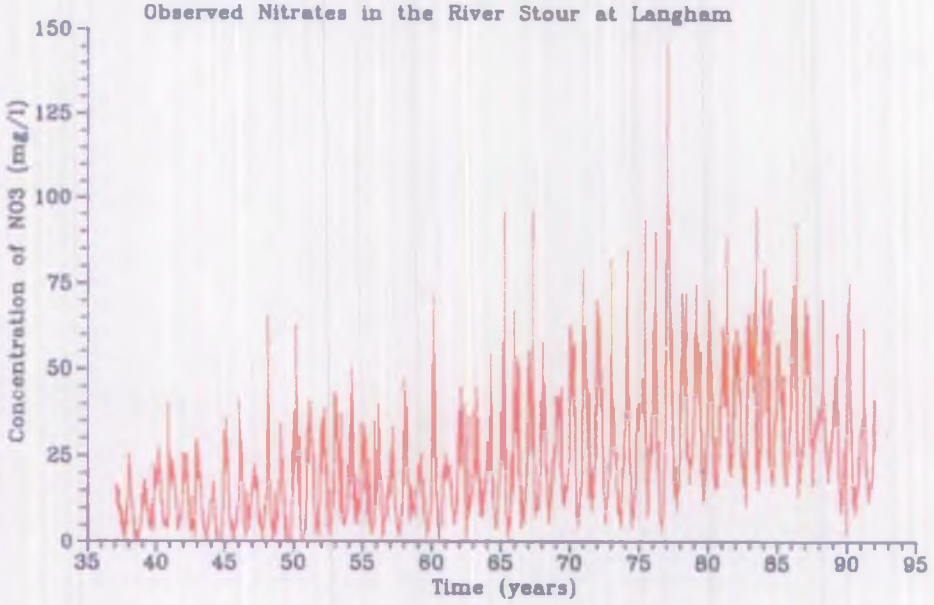
Due to the very dry winters in 1990 and 1991 it has not been possible to get a true estimate of the effectiveness of the NSA measures. The decline in nitrate since 1988 is believed to be due to the effects of the drought causing less nitrate to be leached from the soil.

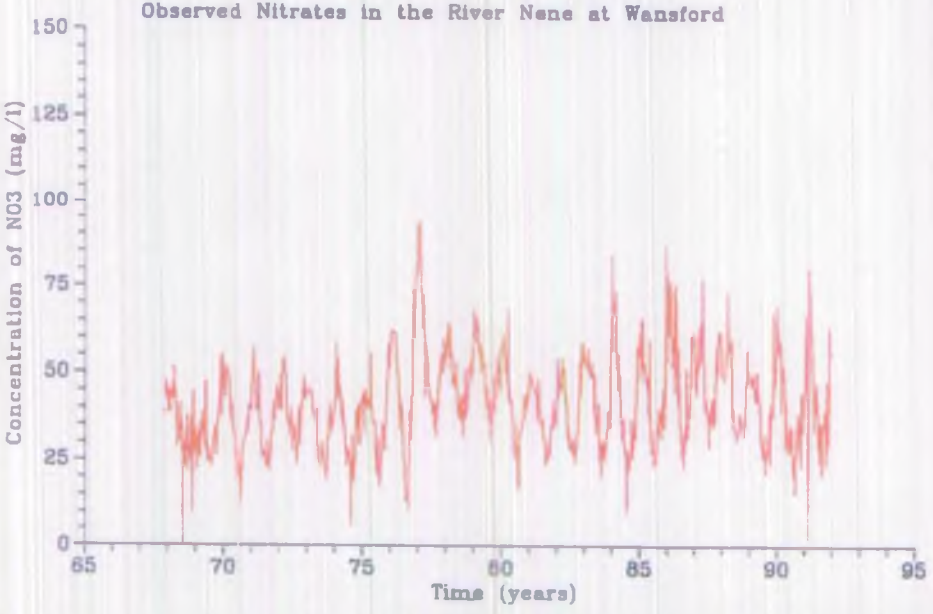
## 2.13 Blue-Green Algae

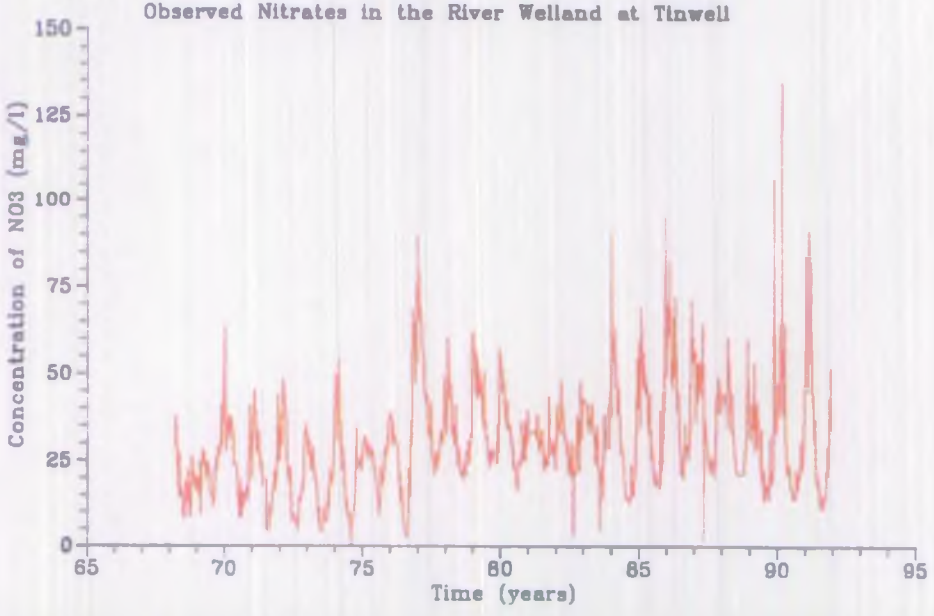
Routine monitoring programmes were established during 1989 and 1990 to

# FIGURE 2.7


Observed Nitrates in the River Ouse at Bedford
Concentration of NO3 (mg/l)
Time (years)

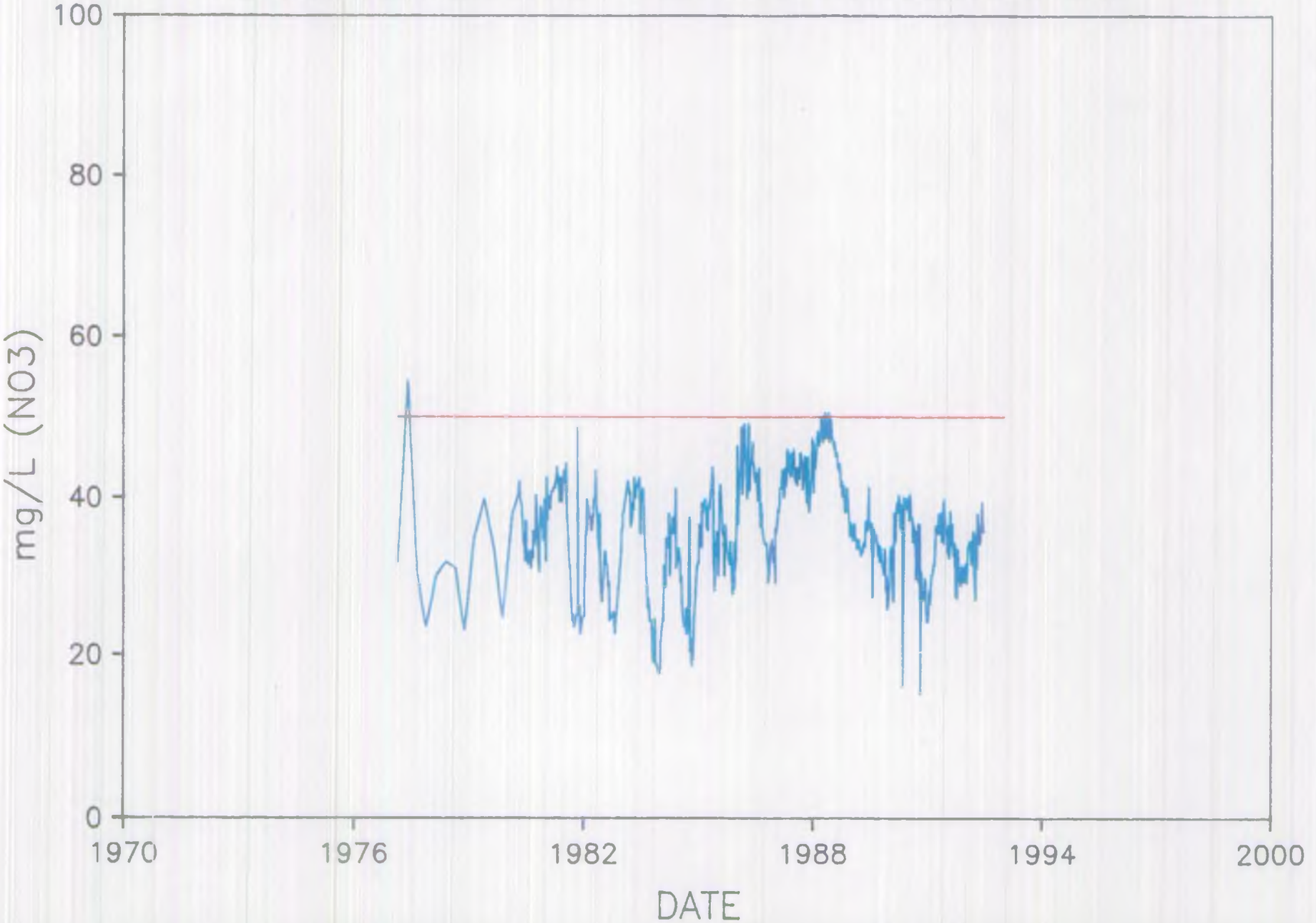

Observed Nitrates in the River Stour at Langham
Concentration of NO3 (mg/l)
Time (years)


Observed Nitrates in the River Nene at Wansford
Concentration of NO3 (mg/l)
Time (years)


Observed Nitrates in the River Welland at Tinwell
Concentration of NO3 (mg/l)
Time (years)

# FIGURE 2.8

## BRANSTON BOOTHS – NITRATE CONCENTRATIONS



assess the occurrence of blooms of potentially toxic blue-green algae. In 1991 a different sampling strategy was adopted which was aimed at reducing the extensive routine monitoring programmes and concentrating efforts on resolving the problems.

The 1989 and 1990 programmes had effectively identified a large number of high priority waters that are most likely to develop blue-green algal problems in later years. Since lake ecology does not change greatly from year to year and fluctuations in algal populations are largely weather dependent, the Toxic Algae Task Group, set up during the summer of 1989, considered it unnecessary to repeat extensive routine monitoring programmes each year. Instead it was considered that algal problems are likely to re-occur each year and that owners should take the necessary precautions to prevent recreational and amenity users from coming into contact with blooms and scums and to contact the NRA when they do arise.

The 1991 programme was designed so that reactive sampling of waters that were not sampled, or did not contain "abundant" populations of blue-green algae, during the routine monitoring programmes of 1989 and 1990, was carried out. This meant that resources could be channelled to developing methods and recommendations for resolving the blue-green algal problems and preventing further incidents. The Task Group is currently working on guidelines for the development and implementation of "Action Plans". These plans aim to provide information for control options and work necessary to enable more effective management actions to be taken for specific water bodies of high priority.

Media coverage in the region was extensive, testimony to the fact that toxic blue-green algae are still a key issue. Clearly there is still a need to maintain detailed records of the incidence of blue-green algal problems and the events of toxicity.

In Anglian Region 28 waters were sampled for the first time on a reactive basis during 1991. Of these 12 contained populations of potentially toxic species at levels sufficiently high to warn owners that blooms of blue-green algae could occur. Fourteen waters contained scums and/or blooms.

Anglian Water Services have continued to dose 11 reservoirs with ferric sulphate to reduce phosphorus levels and problems with blue-green algae. The NRA has monitored the effects of ferric sulphate dosing on the benthos and plankton of Rutland Water, Pitsford Reservoir, Covenham Reservoir, Grafham Water and Foxcote Reservoir.

In order to underpin Action Plan development an extensive research programme has been progressed which includes the following:

- development of a model to determine factors responsible for algal growth;
- production of a "field kit" to test whether or not a bloom or scum is toxic;

- establishment of a library of toxins in British freshwaters;
- identification of factors that control the production and release of toxins;
- provision of information on what happens to toxins in the environment and whether they are taken up in the food chain.

Research and development projects are progressing well and a field test kit for detecting microcystin-LR toxicity should be ready for testing in 1992. Microcystin is the most commonly occurring blue-green algal toxin. A one year study to develop an analytical method for the detection of Microcystin will be completed in 1992.

## 2.14 The Norfolk Broads

The NRA is continuing to work with the Broads Authority and English Nature, to restore the water quality of the Norfolk Broads by reducing eutrophication. Like many other shallow lakes in Europe, the Broads have proved more resilient to change, following the successful reduction of phosphorous inputs, than had been expected. The reasons for this are being investigated by a research programme jointly funded by the NRA and the above organisations. Two factors have been identified as important, the release of phosphorous from the sediment and a complex series of biological interactions which tend to stabilise the lake community in its present, algal dominated state.

The results of this research are being used to carry out a range of experimental management techniques designed to overcome these problems. Low doses of iron salts have been added to an area of one of the Broads to control the release of phosphorous from sediments, and a number of large scale temporary fish removal experiments have been established. Similar work is being carried out on a number of other lakes in mainland Europe. Contacts with the organisations responsible for this work have been established to ensure the exchange of information and ideas. During the year a new initiative to examine the role of nitrogen in eutrophication of these lakes has also been initiated.

By collaborating with other agencies and combining a carefully planned monitoring programme with specific laboratory and whole lake experiments the NRA has been able to make significant advances in understanding the management of shallow eutrophic lakes. This information is being used to develop a restoration strategy that will progressively improve the water quality of the area and continue to further our understanding of the complex processes that influence it.

## 2.15 Pesticides

Pesticides are used to control insects, weeds, fungi, and so on, in both

agricultural and non-agricultural situations. Their use results in low concentrations of unwanted chemicals in surface and groundwaters.

In some cases Water Companies have notified us that pesticide concentrations have exceeded the standard specified in the EC Drinking Water Directive. Most of these exceedences were caused by two persistent herbicides predominantly used for amenity weed control on roads and paths. The major users of these herbicides, such as local authorities, were approached. When the pollution problem was brought to their attention many agreed to change to less persistent alternatives.

We have made contributions to a number of national guidance documents for pesticide users. These are aimed at ensuring correct storage, use and disposal of pesticides whilst minimising the risk of water pollution. This is in line with the general principle of Best Environmental Practice.
Spillages of pesticides can result in significant pollution incidents, even in small quantities (see 2.9) and disposal can give rise to significant contamination of water supplies.

## 2.16 Catchment Management Plans

A river catchment is the geographical area from which the river system derives its flow and water quality. It includes associated groundwater, coastal and estuarine waters. The size may vary between 500 and 5,000 square kilometres.

The river is influenced by climate, land-use, geology, soil-type, vegetation, and the density and economic activity of the population within its catchment. These factors determine the rates of input and loss of water, and the input and removal of both dissolved and suspended loads.

The interplay of forces and processes determine the quality of a particular length of river, and, to a great extent, the uses to which it may be put. These uses are recognised as Environmental Quality Objectives (See 2.3).

The concept of Integrated Catchment Management attempts to balance the sometimes conflicting demands on a river system, such as drinking water supply and waste disposal, water abstraction and amenity usage. The objective is to oversee activities which impinge on the use of water and to intervene where necessary to balance interests.

To put the concept into practice, all interested parties contribute to a process of review of both the existing state of the catchment, and of anticipated future changes.

This consultation process is being effected by the NRA by the production of *Catchment Management Plans*. These identify present and future uses of water and associated land, land drainage and flood defence activities.

Standards are defined for each, with particular attention to the NRA's statutory duties. Areas of conflict are identified and an action plan formulated to meet the various objectives. Consultation is made as wide as possible, with specific reference being made to local authorities, sewerage and water undertakers, conservation groups and trade organisations. Statutory committees (Regional Rivers Advisory Committees) are consulted first and help to identify conflicting needs.

Priority is being given to catchments :

- where conflict exists between users of the water within the catchment;
- where present objectives are not being met; and,
- where significant development is being planned which could have a major impact on the water environment.

In 1991, the process was initiated with the publication of a draft plan for the catchment of the River Cam. A plan was also prepared for the coastal catchment surrounding Louth in Lincolnshire which covers the Rivers Long Eau, Great Eau, Waithe Beck, Louth Canal, Steeping and Lymm.

After the draft plans have been commented upon and revised, definitive plans will be published which will form the basis for NRA management decisions. It is envisaged that the plans will look forward at least 10 years and be reviewed at five yearly intervals.

## 2.17 Mathematical Modelling

SIMCAT, our river water quality model, describes the quality of river water throughout a catchment. SIMCAT is used to help to plan the measures needed to improve water quality. SIMCAT has special features which enable it to produce results quickly whilst controlling the effect on decision-making of the statistical uncertainties associated with water quality data.

Data files have been produced for the following rivers:

Blackwater, Chelmer, Gipping, Great Ouse, Ivel, Little Ouse, Mardyke, Nene, Stour, Thet, Waveney, Welland, Wensum, Wid and Witham.

The WRC nitrate model for the Central Lincolnshire Limestone has been used to examine the impact of changed land-use with the two Nitrate Sensitive Areas (See part 2.12). Predictions have been run forward for 50 years.

The results suggest that the land-use changes which have been implemented will have little effect on levels of nitrate within the aquifer. Further work is planned to check assumptions made and mechanisms used in the model.

## Part 3: ESTUARIES & COASTAL WATERS

There were no significant changes in estuary water quality during 1991. Most lengths of estuary are of good quality although there are localised areas of pollution around some outfalls. All estuaries support fish life and allow the passage of migratory fish, principally eels.

The coastal waters of the Anglian Region have some of the strongest tides in the whole of the North Sea. In some areas the tidal range (the difference in height between low water and high water) can be as much as 7 metres.

These tides ensure that discharges are rapidly diluted and dispersed. Also, there are relatively few discharges of industrial or sewage effluent to coastal waters compared to rivers and estuaries. As a result the quality of coastal waters is good.

### 3.1 Monitoring

Routine sampling for water quality in estuaries and coastal waters was performed at over 100 sites during 1991, including monitoring at the 33 identified Bathing Waters. A further 150 sites were sampled for special surveys. The total number of samples collected was in excess of 3,000.

The frequency of sampling ranged from annually to weekly.

Samples of sediments were mainly collected for investigations of discharges which might contain Dangerous Substances, and as part of the Humber monitoring programme. The frequencies ranged from one to four per year.

Samples of shellfish were collected from several sites in the Wash to monitor the bacteriological impact of sewage effluents on the fishery and to gather information for the Shellfish Hygiene Directive.

Biological monitoring was performed on all of our major estuaries and at several sites on the coastline. The numbers of samples are given in Appendix I.

### 3.2 Classification of Estuaries

Estuaries are classified on the basis of quality, according to the system devised by the Department of the Environment and the National Water Council. This is called the Classification of Estuaries Working Party (CEWP) System after the working party which set it up. The CEWP System is highly subjective and is being re-evaluated by a national working group.

A summary of the results for 1991 is given in Figure 3.1 with data for previous years for comparison. Most lengths of estuary are in Class A with 25% of Class B and 7.5% of Class C. There is one small length of Class D (in the Orwell).

## 3.3 EC Directives

The principal long-standing Directives affecting saline waters are those relating to:

- Dangerous Substances in Surface Waters;
- Shellfish Waters;
- Titanium Dioxide;
- Bathing Waters.

During 1990 and 1991, new Directives of significance to water quality matters were adopted and their requirements will come into force progressively over the next few years. These were directives relating to:

- Urban Waste Water Treatment;
- Shellfish Hygiene;
- Pollution of waters by nitrates from agriculture;
- Harmonisation of reporting on environmental Directives;
- Freedom of access to information on the environment.

The situation for 1991 is summarised below:

### 3.3.1 Dangerous Substances in Surface Waters

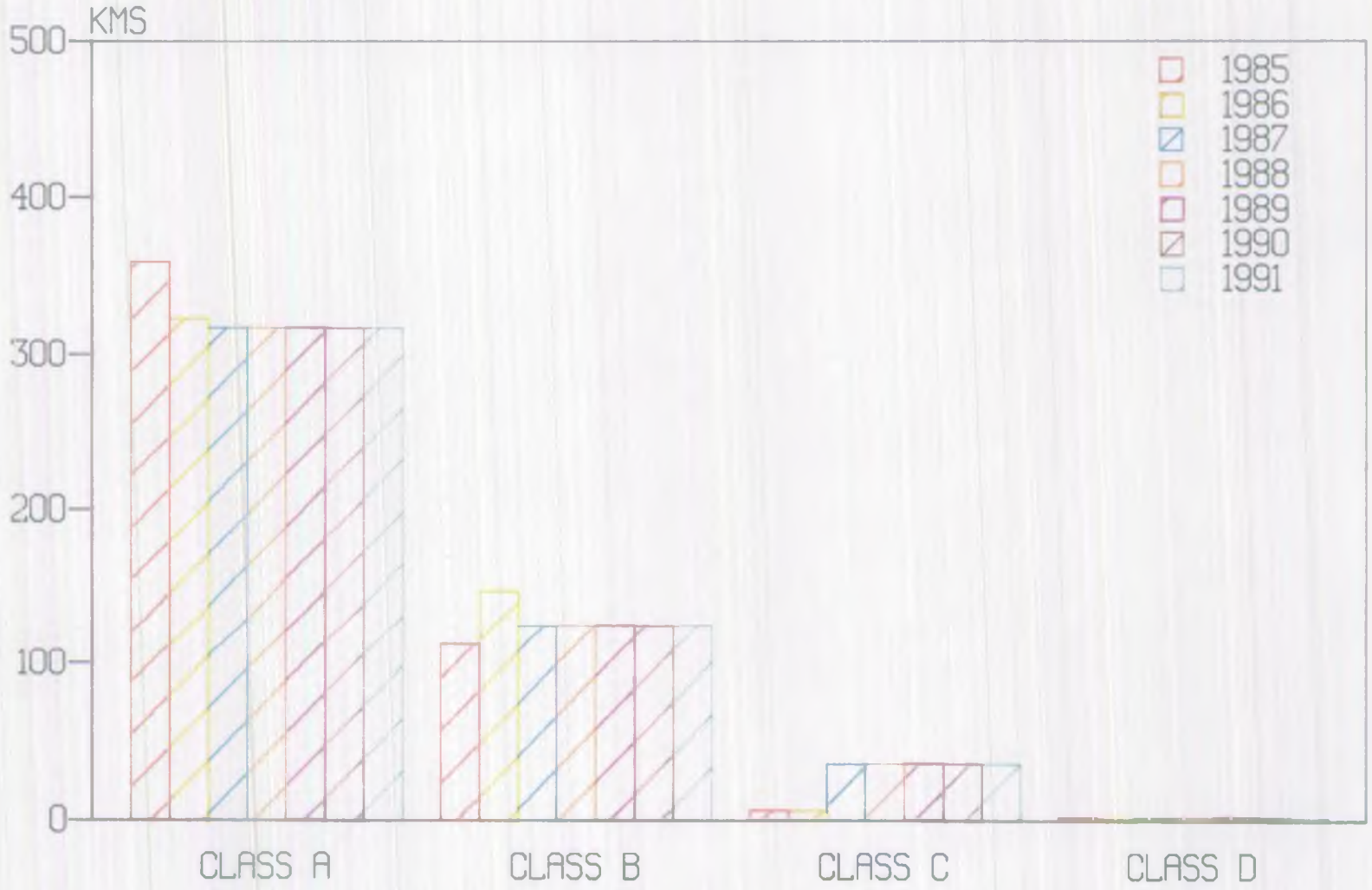
The scope and objectives of this Directive are outlined in 2.8.1.

All the discharge-related saline water monitoring sites passed the Directive List I quality standards. There were four sites for Lindane, four for Mercury, five for Cadmium, one for Pentachlorophenol, and one for the Drins (Aldrin, Dieldrin, Endrin, and Isodrin). We also undertook background monitoring for List I substances, as required by the DoE.

Downstream monitoring of saline waters in relation to 15 discharges containing List II substances was undertaken. Five sites exceeded the relevant national quality standards, these being:

# FIGURE 3.1

## ESTUARIAL WATER QUALITY



- The Blackwater estuary at Fullbridge for zinc;
- The Orwell estuary at Woolverstone Marina for zinc and copper;
- The Humber Estuary at South Killingholme for copper; and,
- Fenn Creek (R. Crouch estuary) south of Eyotts Farm for copper.

No obvious cause for the zinc exceedences has been identified but the use of dissolving zinc anodes on pleasure craft is a suspected source. The copper failures in the Humber resulted from inputs to the river system which are upstream of the Anglian Region. Work by WRC has shown that this copper is bound up with organic matter and has low toxicity. The failure in the Orwell is thought to relate to Cliff Quay sewage treatment works and investigations have been instigated. No specific cause for the failure in Fenn Creek has been identified. The upstream STW (Woodham Ferrers) is being investigated as a possible source.

### 3.3.2 Shellfish Waters

This Directive lays down quality standards for waters designated as shellfisheries, the objective being to ensure a suitable environment for shellfish growth. It is not a direct public health measure (in contrast to the Shellfish Hygiene Directive - see 3.3.6). There are currently six designated shellfish waters in our region. Monitoring of the waters at specified minimum frequencies is required for a range of parameters.

The relevant waters were monitored during 1991 as required under the Directive. The data were reported to the DoE and will be submitted to the Commission. There were few exceedences of the mandatory standards. Individual dissolved oxygen results of less than the minimum standard were experienced but these are not considered to have harmed the shellfish colonies. There was a single significant result for DDT at one site (Hamford Water) and an investigation is being undertaken. Four sites experienced exceedences of the DoE guideline standard for zinc:

- River Blackwater off Marconi Sailing Club, Stansgate;
- Hamford Water, The Twizzle off Titchmarsh;
- River Roach, Monkton Quay, Foulness; and,
- River Roach, East End, Paglesham.

Dissolving zinc anodes on yachts are a possible cause. There was a single copper failure at one site which may be affected by an industrial discharge whose consent is to be reviewed.

The number of designated shellfish waters is likely to increase significantly over the next few years as a consequence of the recent Shellfish Hygiene Directive.

### 3.3.3 Titanium Dioxide

Waste from the Titanium Dioxide industry is harmful to the environment, mainly because of its high acid and iron content.

The Directives on Titanium Dioxide require that factories discharging such waste should reduce pollution caused by their discharges, within a specified timescale. There are three factories in the UK. The two largest, Tioxide UK Ltd and SCM, are located on the south bank of the Humber and discharge their effluent to the estuary.

In 1988, the outfalls from both factories were relocated to deeper water where dilution and dispersion would be much greater. A major survey in 1989 confirmed that the re-siting of the outfalls produced a substantial reduction in the size of the affected area.

Chemical and biological monitoring of the receiving waters in 1991 was carried out as required by the Directives and reported to DoE.

This was the third full year of monitoring since the two discharges were moved into deeper water. The significant reduction in iron concentrations in the receiving waters, evident since the relocation of the two outfalls, has been maintained. The biological monitoring results indicate that there has been some deterioration in status since 1988, particularly around the Tioxide outfall. It seems likely that this decline relates to the discharge, although further investigation is in hand which will clarify the situation.

During 1991, the DoE had been in the process of drafting Directions to the NRA under the Water Act 1989, to enshrine within UK law, one of the Titanium Dioxide Directives. The Directive laid down the timescales within which reduction and elimination of pollution from these discharges must be achieved. In mid-1991, the Directive was annulled following an action by the Commission (over the legal basis of the legislation) in the European Court of Justice. The DoE has advised us that national policy is to proceed in enforcing the standards of the former Directive and that UK legislation will be progressed under the Environmental Protection Act. The Directive will be resurrected by the Commission but with a different legal basis.

### 3.3.4 Bathing Waters

The purpose of the Directive is to reduce pollution of bathing waters, prevent further deterioration, and thereby protect public health and the environment.

Of the 33 Anglian Region sites identified under the Directive for the 1991 bathing season, 29 passed the water quality standards as assessed by the DoE criteria. This compares with 27 out of 29 in 1990 (See Table 3.1). West Mersea, Gorleston Beach, Caister Point,and Hemsby were the

newly identified waters for 1991. The first two of these sites failed the directive together with Cleethorpes and Great Yarmouth South, which also failed in 1990.

The current "pass/fail" method of assessing compliance with the Directive has several drawbacks, based mainly on its statistical volatility. The large variation in bacterial numbers over a short period of time coupled with the relatively infrequent sampling rate required by the Directive may result in bathing waters failing for statistical reasons rather than those of poor water quality. Bearing in mind these drawbacks it is useful to look at the trend in bathing water quality from a different viewpoint, using the Median values of the Total and Faecal Coliform parameters for each bathing water over the bathing season (see also Part 2.3.1).

By ranking the median values of all bathing waters for each of several years and plotting them graphically, it is possible to see the trend in bathing water quality in the relative positions of the different year's graphical results. Thus Figure 3.2 plots the median Faecal Coliform values for each bathing water for each of the years 1987 to 1991 against the proportion of beaches with a median less than that particular value. Essentially the further the graphical plot is to the right for a particular year, then the better the bathing water quality for that year.

In general there would appear to have been a trend of steady improvement in water quality for the years 1987 to 1991. Approximately 89% of bathing waters had a median of less than 500 faecal coliforms per 100 ml in 1987. In 1991 this figure had risen to 100%, showing a significant improvement in bathing water quality. This is considered to be due to a combination of remedial capital expenditure schemes by the Utility companies, together with summers which have been particularly dry and sunny (causing increased bacterial die-off and reduced storm-water overflow operation).

During 1991, Regulations and Water Quality Objectives under the Water Act 1989 were expected from the DoE. These will put the requirements of the Bathing Water Directive into UK law. The NRA will have a duty to achieve compliance with the Objectives within a specified timescale and to monitor. The Regulations were issued in July 1991 and established a classification system for bathing waters based on the mandatory values in the EC Directive. As at the end of 1991 the classification had not been applied to any specific waters as the Quality Objectives were still awaited. (Subsequently issued on 5th May 1992. We must achieve compliance with the Objectives by 15th May 1992 ie. with almost immediate effect).

TABLE 3.1

BATHING WATER DIRECTIVE

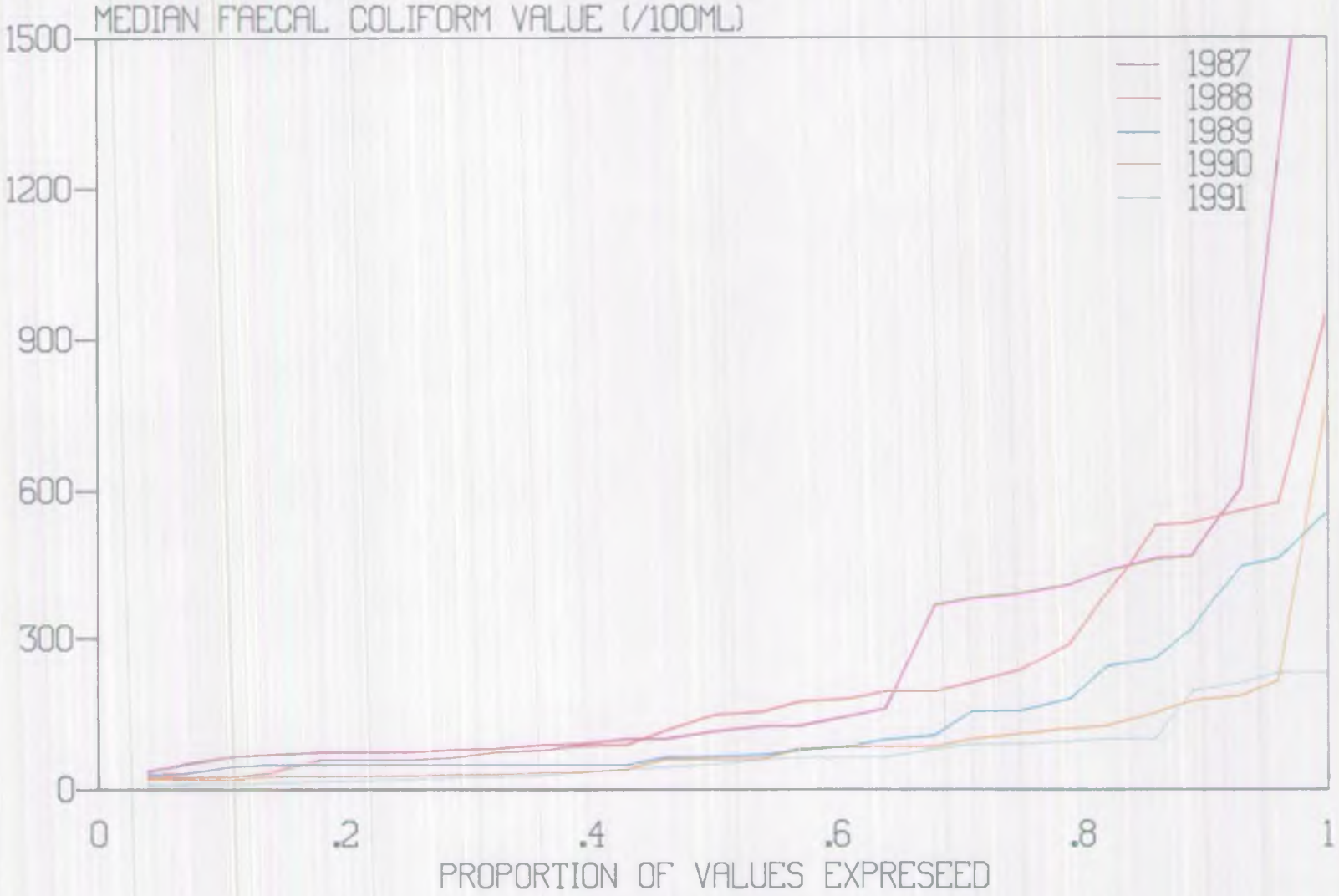
Compliance with Standards for Total and Faecal Coliforms

| BATHING WATER | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| Cleethorpes | Fail | Fail | Fail | Fail | Fail |
| Mablethorpe | Fail | Pass* | Fail | Pass* | Pass |
| Sutton on Sea | Fail | Fail | Pass | Pass* | Pass |
| Moggs Eye | Pass | Pass | Pass* | Pass | Pass |
| Anderby | Pass* | Pass | Pass* | Pass | Pass |
| Chapel St. Leonards | Fail | Pass | Pass | Pass* | Pass |
| Ingoldmells | Fail | Pass* | Pass* | Pass* | Pass |
| Skegness | Pass | Pass | Pass* | Pass* | Pass |
| Heacham | Pass | Fail | Pass | Pass* | Pass* |
| Hunstanton | Pass | Fail | Pass | Pass | Pass |
| Wells | Fail | Pass* | Pass* | Pass* | Pass |
| Sheringham | Fail | Fail | Fail | Pass | Pass |
| Cromer | Fail | Fail | Fail | Pass | Pass* |
| Mundesley | Pass | Pass* | Pass | Pass | Pass |
| Goreleston Beach | -- | -- | -- | -- | Fail |
| G.Yarmouth North | Fail | Pass | Pass | Pass | Pass |
| G.Yarmouth Pier | Fail | Fail | Pass* | Pass* | Pass* |
| G.Yarmouth South | Fail | Fail | Fail | Fail | Fail |
| Lowestoft North | Pass | Pass | Pass | Pass* | Pass* |
| Lowestoft South | Pass | Pass | Pass | Pass | Pass |
| Southwold The Denes | -- | -- | -- | Pass | Pass |
| Felixstowe North | Pass | Pass | Pass | Pass | Pass |
| Felixstowe South | Pass | Pass | Pass | Pass | Pass* |
| Dovercourt | Fail | Fail | Pass* | Pass* | Pass |
| Walton | Fail | Pass | Pass* | Pass | Pass |
| Frinton | Pass | Pass* | Pass | Pass | Pass |
| Holland | Fail | Pass | Pass | Pass | Pass |
| Clacton | Fail | Pass* | Pass | Pass | Pass |
| Jaywick | Pass | Pass | Pass | Pass* | Pass* |
| Brightlingsea | Fail | Pass* | Pass* | Pass* | Pass |
| West Mersea | -- | -- | -- | -- | Fail |

* These sites have had at least one failing sample.

# FIGURE 3.2

## BATHING WATER QUALITY



### 3.3.5 Urban Waste Water Treatment

This Directive has significant implications for the UK water industry.( See part 2.8.5) Discharges to saline waters will be particularly affected, with full sewage treatment becoming the "norm" at many locations, in contrast to the best past practice of minimal treatment and discharge via a long sea outfall. In many instances, standards to be imposed are tighter than those which we have derived for the needs of the receiving waters.

### 3.3.6 Shellfish Hygiene Directive

This Directive, which was originally drafted as a directly binding EC Regulation, was formally adopted in July 1991.

The Directive lays down health conditions for the production and placing on the market of live bivalve molluscs which are intended for immediate human consumption, or for further processing before consumption. It covers the production, harvesting, transportation, relaying, purification, processing, handling, dispatch, storage, wrapping, and labelling of live bivalve molluscs, including public health measures and the monitoring of production areas.

The principal points of relevance to dischargers and regulators in the Water Industry, are the requirements relating to the harvesting areas and to the monitoring of those areas. Shellfish harvesting areas are classified into three groups, principally on the basis of the bacterial content of the shellfish flesh. Shellfish may only be marketed if they are taken from waters falling into these groups and, for two of the groups, only after relaying or purification. The new Directive will apply to all the main commercial shellfisheries and not just to those designated under the Shellfish Waters Directive.

The classification of harvesting areas will be based upon sampling undertaken by local authorities and port health authorities during 1991/92. Around 75 Harvesting Areas have been identified to date. Regulations under the Food Safety Act 1990 (expected mid-1992) will be produced by 1993 to implement the Directive.

Many of the commercial UK shellfisheries will fall into the categories which will require relaying or purification of the molluscs prior to marketing. As a result of this, and with the introduction of SWQO, there will be pressure on the NRA to bring about improvements in the water quality (and thus the classification) of shellfisheries, and to initiate further designations of waters under the Shellfish Waters Directive. DoE have indicated that initial responsibility for such new designations lies with the NRA. All waters identified as harvesting areas under the new Directive should logically be also designated under the Shellfish Waters Directive. Improvements to (or elimination of) discharges adversely affecting these waters will be required.

There is likely to be considerable pressure upon the NRA to establish the impact of potentially polluting discharges on shellfish quality. This implies a substantial ongoing additional monitoring burden to establish ambient water quality over shellfish beds caught by the two Directives.

It seems likely that the NRA will principally monitor waters under the Shellfish Waters Directive (as at present) and local authorities/port health authorities will undertake the Shellfish Hygiene Directive monitoring (relating mainly to shellfish quality).

### 3.3.7 Pollution of Waters by Nitrates from Agriculture

The scope of this Directive is outlined in Section 2.8.6. Its relevance to saline waters is with respect to estuaries or coastal waters which are eutrophic. Vulnerable Zones will need to be designated in relation to any such areas.

## 3.4 Red List/Annex 1A

The second North Sea Conference (held in 1987) agreed to reduce by 1995 50% of the loads of certain dangerous substances which are discharged to the North Sea by 1995. The UK Government identified a list of 23 such substances: the Red List. The third North Sea Conference (held in 1990) identified a list of 36 such substances. This list (which includes all of the Red List except PCBs) is known as Annex 1A.

The NRA started Red List survey work in July 1990. Rivers, industrial effluents and sewage effluents were all sampled. This was extended to include the additional Annex 1A parameters in January 1991.

The objective of the surveys is to identify the sources of at least 90% of the load of the listed substances being discharged to Anglian Region's estuaries and coastal waters.

The results of the 1990 Red List survey work are now available and have been compared to loads discharged in other NRA regions to give nationally ranked positions. This ranking indicates that, from Anglian Region, there is only one substance, hexachlorobenzene, which makes a major contribution to the national load. The SCM discharge on the south Humber bank is identified as having 35% of the national load. Discussions are taking place with the industrialist concerned about why this is present in the effluent and what steps can be taken to reduce it. However the more major Anglian freshwater rivers (eg Great Ouse, Yare etc) do show up as carrying measurable loads of the agricultural pesticides and herbicides. This is not unexpected given the nature of the region and probably results from diffuse inputs such as runoff from farm land. The implications of such diffuse sources are being addressed by Central Government.

Annex 1A extends the range of dangerous substances being monitored by including the List II metals and increasing the number of organic solvents and organophosphorus pesticides that are looked for. It is unlikely that Anglian Region will feature high in the ranked lists for these additional substances with the exception of zinc where it is known there is a substantial source at Courtaulds on the south Humber bank and possibly chloroform where the 1991 monitoring has revealed significant amounts in the Dow Chemicals effluent at Kings Lynn.

## 3.5 North Sea

Following the second and third North Sea Conferences the North Sea Task Force agreed a Monitoring Master Plan. Within the UK this was incorporated into a national baseline monitoring programme overseen by the Marine Pollution Monitoring Management Group. Anglian Region have two estuaries, the Humber and the Wash, within the programme and baseline monitoring started on these two estuaries in 1991. Water quality in the estuaries is monitored four times per year and biological health and sediment quality once per year. The results for the Wash confirm the known high nutrient loading in the Great Ouse Estuary. In the Humber the results confirm that despite carrying a substantial effluent loading water quality in the main channel of the Humber is good.

Nutrients and eutrophication of estuaries and coastal waters were topics of particular concern to the North Sea Conferences. Anglian region has responded to this by increasing its monitoring of nutrients in marine waters and by significantly improving our ability to detect low levels of nutrients. We also contribute to the JoNuS research programme which was started by MAFF in May 1990 (described below).

## 3.6 JoNuS Programme

The JoNuS (Joint Nutrient Study) programme looks at the transport of nutrient loads through estuaries to the sea and is based on the Humber and the Wash.

In addition to providing nutrient data for the Humber, the Wash and the Wash estuaries, JoNuS will generate information concerning nutrient mobilisation mechanisms, leading to management guidance for nutrient-rich discharges. Initial results indicate that whilst the Wash estuaries have high nutrient loads and may be eutrophic a significant proportion of those loads are trapped within the estuary and do not escape to sea.

## 3.7 Paris Commission

In 1988 the Paris Commission decided to implement a comprehensive annual survey of selected pollutants to Convention waters. The first study was carried out in 1990. The objective of the survey is to monitor 90% of

the input of each selected pollutant.

In Anglian Region 17 rivers, 14 sewage effluents and eight industrial effluents are monitored. Rivers are monitored close to their tidal limit. Major industrial and sewage treatment works effluents downstream of these points are also monitored.

Figure 3.3 shows estimates of the contribution made by rivers, industrial and sewage effluents to the total load from the region.

## 3.8 Coastal Survey Vessel

In August 1991 Anglian Region took delivery of the purpose built coastal survey vessel, "Sea Vigil". The vessel is a 16.5m twin screw steel built boat with a 13m$^2$ laboratory/survey cabin for processing chemical, biological and bacteriological samples. Figure 3.4 gives details of the utilisation of "Sea Vigil" from August to the end of 1991.

Initial experience with the vessel has shown that it can operate successfully in all the major areas of the region. However, there were some difficulties. The Wash proved awkward due to limited access to and from the estuaries and dock facilities at many states of the tide. There were also constraints caused by the storage of the survey inflatable when not in use. The opportunity was taken at the end of the year to carry out some minor modifications to overcome these difficulties. On board sleeping accommodation has been increased reducing the need for overnight docking. A high level storage platform has been created for the inflatable giving improved stern end working arrangements.

## 3.9 Mathematical Modelling

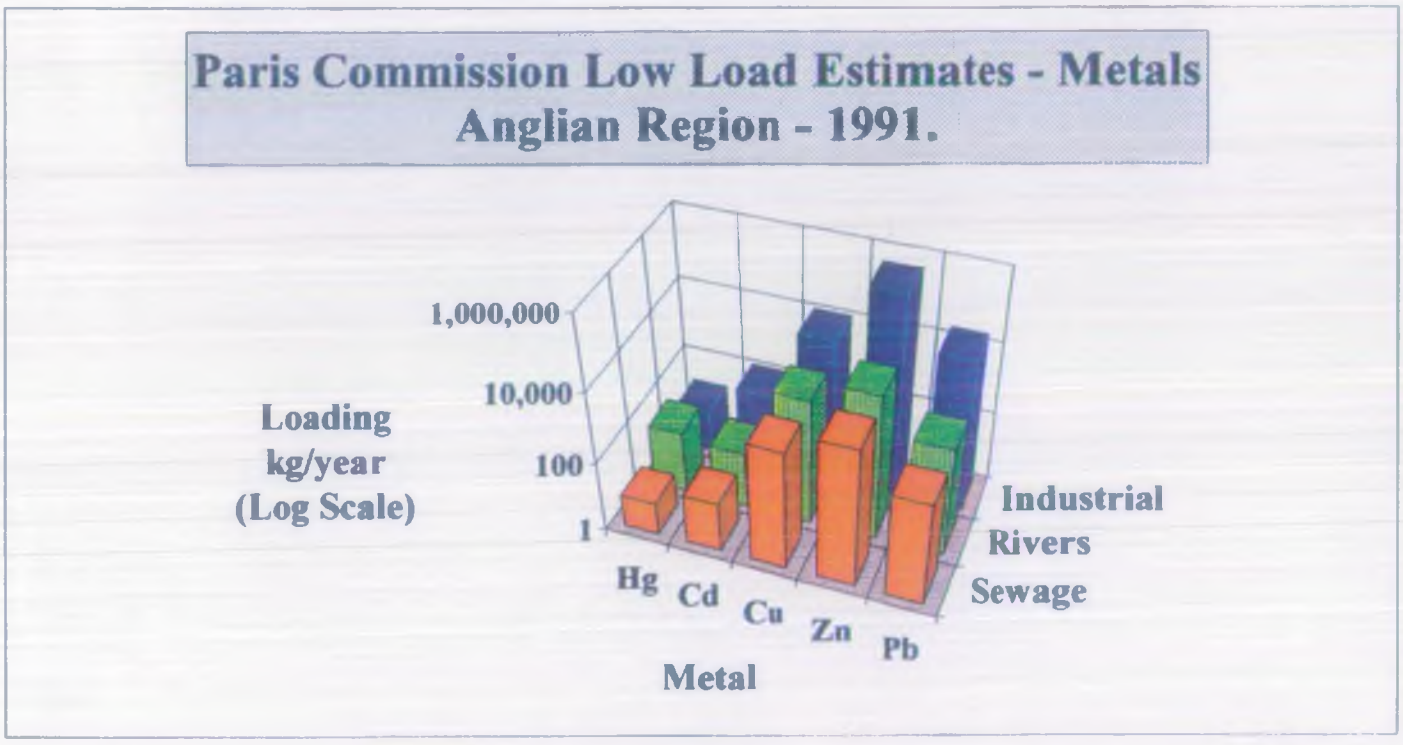
The aim of modelling work is to provide a suite of consistent techniques for calculating the measures needed to achieve our objectives for water quality.

### 3.9.1 Estuaries

Mathematical Models constructed by the Water Research Centre have been extended to include techniques for calculating effluent standards defined as 95-percentiles. This feature, and the inclusion of the option to model microbes and nutrients, illustrates the way in which we are able to adapt and up-date the models to meet increased demands.

The Crouch and Roach Estuary Model has been used to help determine future quality standards for discharges to the estuary so that water quality can be improved. A typical set of predicted water quality data is shown in Figure 3.5.

# FIGURE 3.3


Paris Commission Low Load Estimates - Metals
Anglian Region - 1991.
Loading
kg/year
(Log Scale)
1,000,000
10,000
100
1
Hg
Cd
Cu
Zn
Pb
Metal
Industrial
Rivers
Sewage

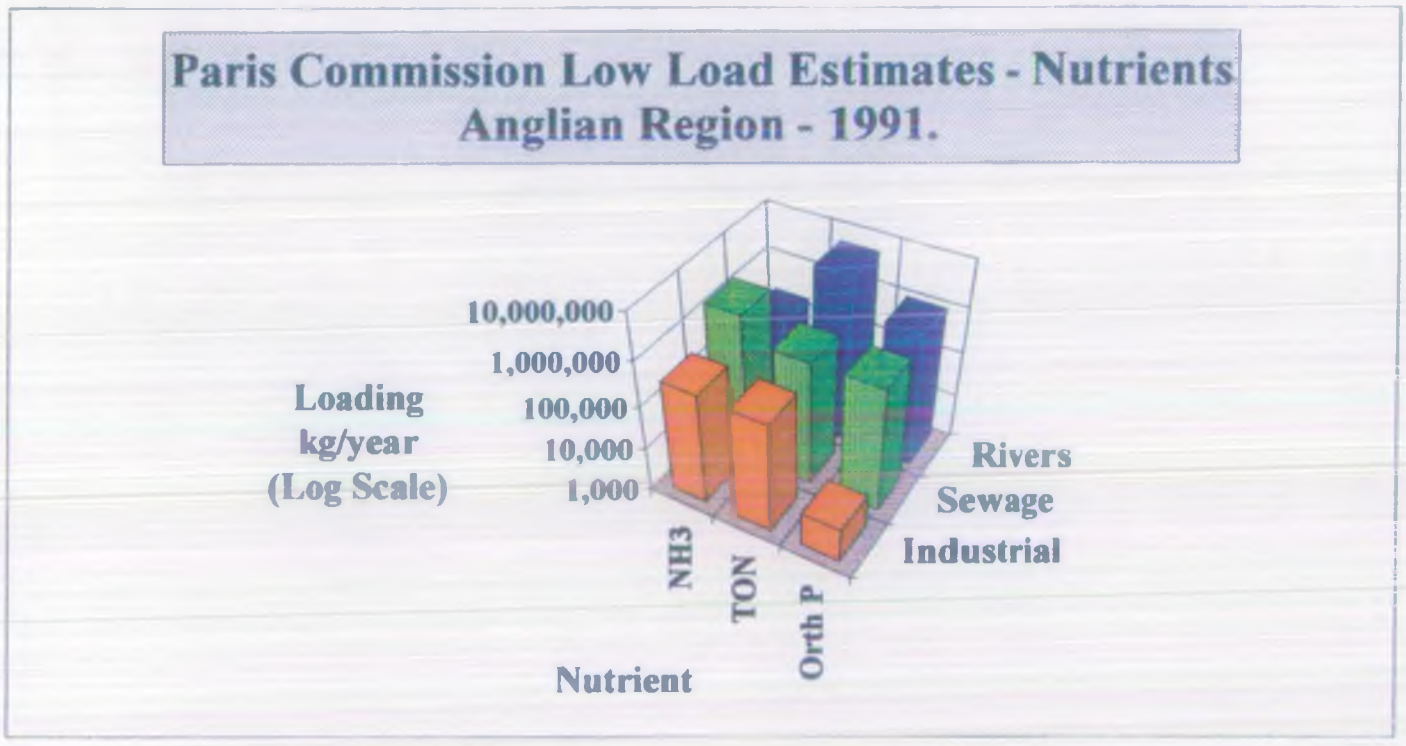
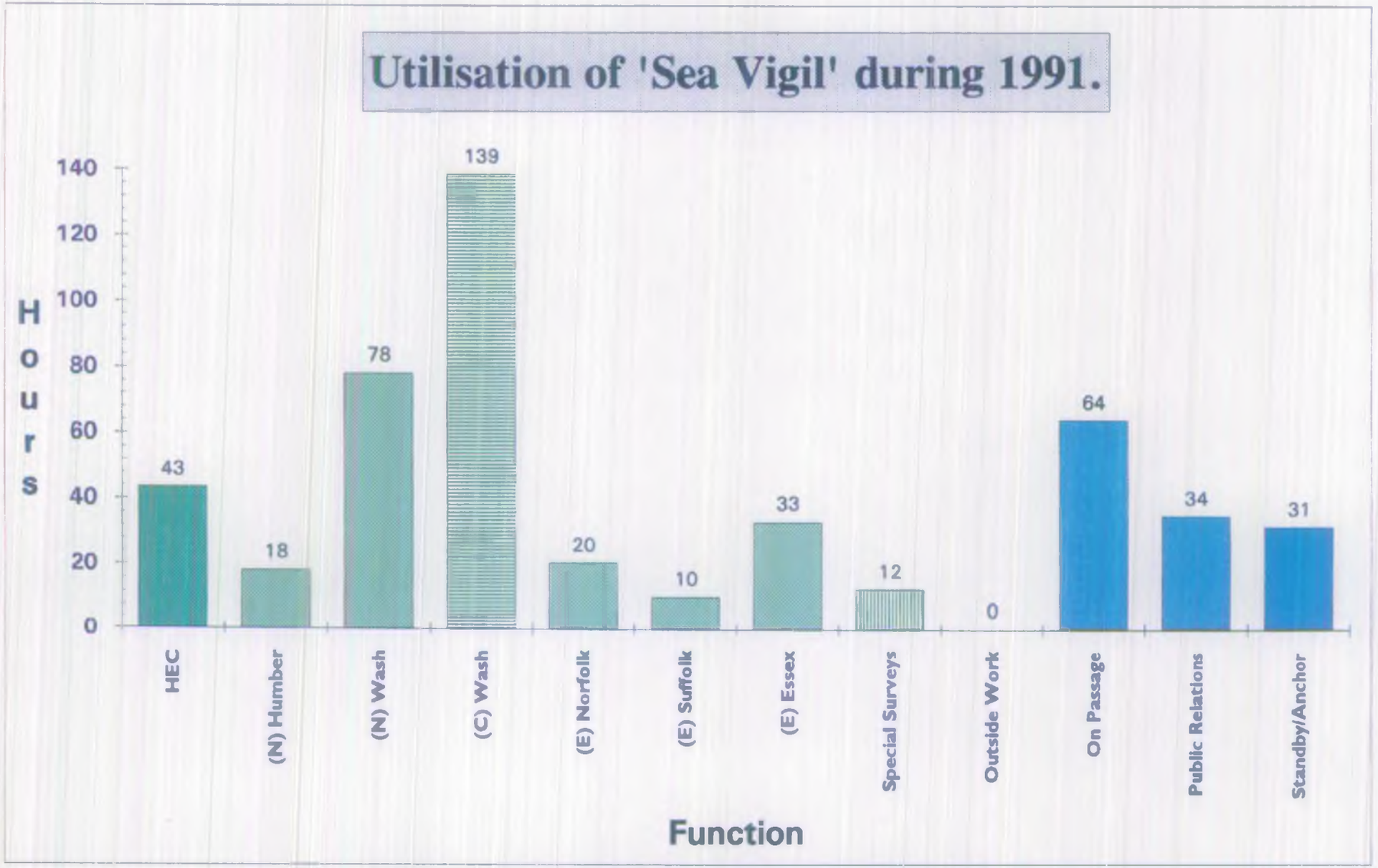

Paris Commission Low Load Estimates - Nutrients
Anglian Region - 1991.
Loading
kg/year
(Log Scale)
10,000,000
1,000,000
100,000
10,000
1,000
NH3
TON
Orth P
Nutrient
Rivers
Sewage
Industrial

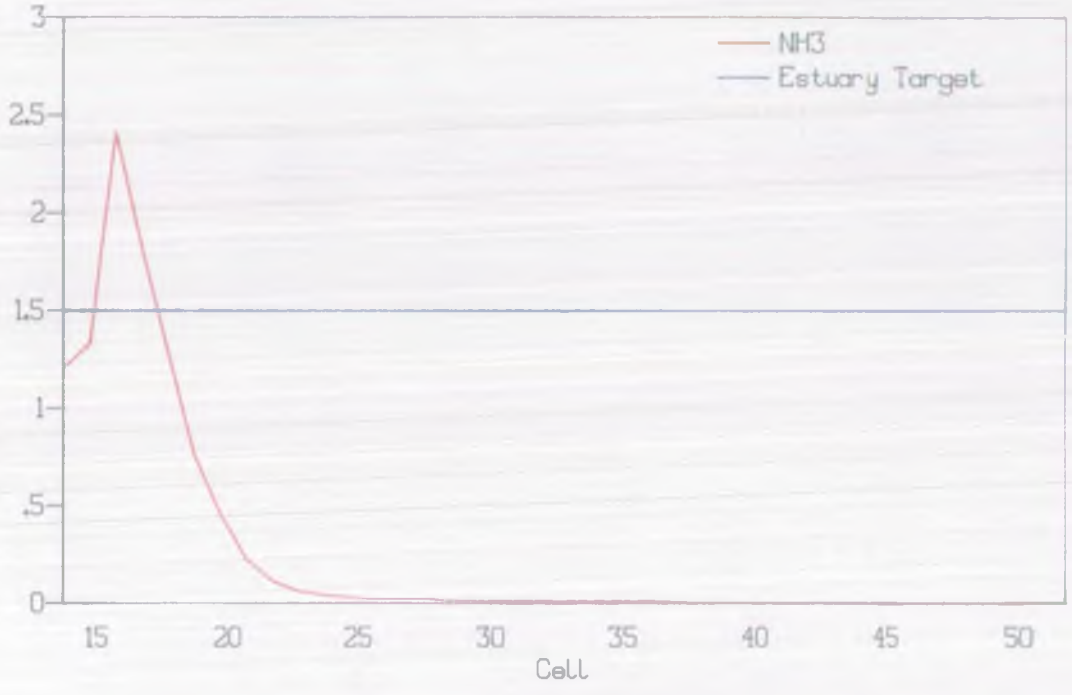
FIGURE 3.4




Period : August 1991 to December 1991.

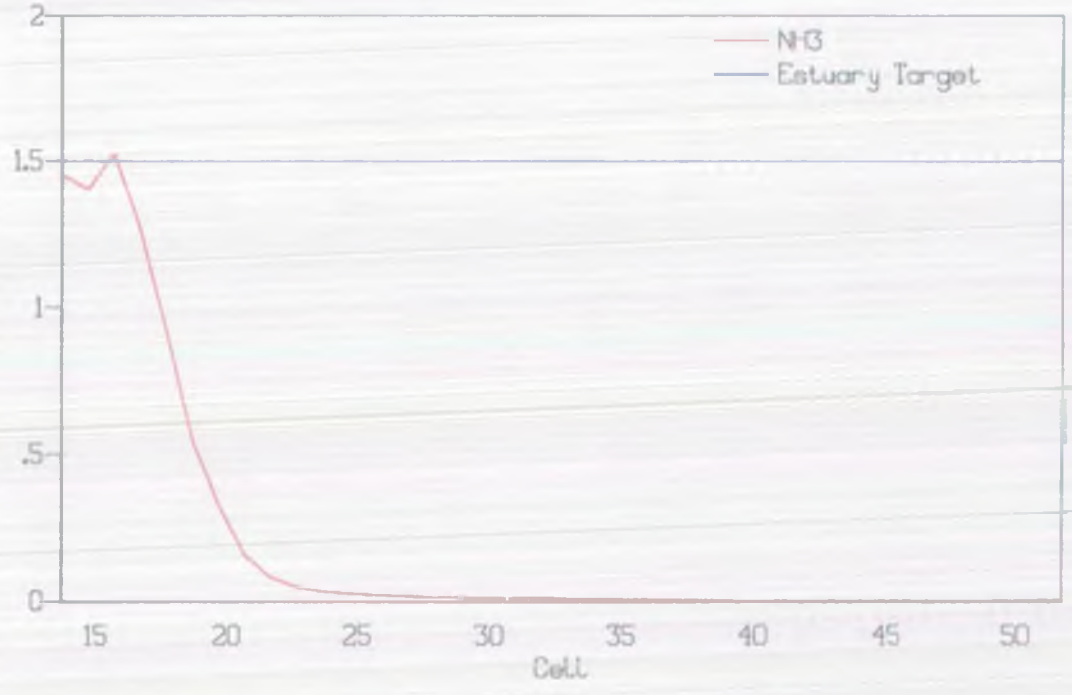
FIGURE 3.5
CROUCH AND ROACH ESTUARY MODEL
PREDICTED CURRENT CONDITIONS

Ammonia mg/l (95 %ile)




PREDICTED CONDITIONS AFTER CLEAN-UP

Ammonia mg/l (95 %ile)



A model of the Colne Estuary system has been completed and another model, for the Stour/Orwell/Harwich Harbour System, is nearing completion by the Water Research Centre.

Further models are planned over the next 5 years for the the Wash, Witham, Welland and Yare estuaries.

### 3.9.2 Coastal Waters

In 1987, the Water Research Centre completed mathematical models describing coastal waters in the area of Heacham and Hunstanton in the Wash. These models were used to assess the impact of discharges from existing and proposed outfalls on the bacterial quality of recreational waters and fisheries.

Following the success of this study, models were proposed for ten further locations, which are shown in Figure 3.6.

The work was set in motion by Anglian Water and is mainly funded now by Anglian Water Services. Details of the studies are managed by a Steering Group comprised of representatives from Anglian Water Services, the Water Research centre, and our region of the NRA.

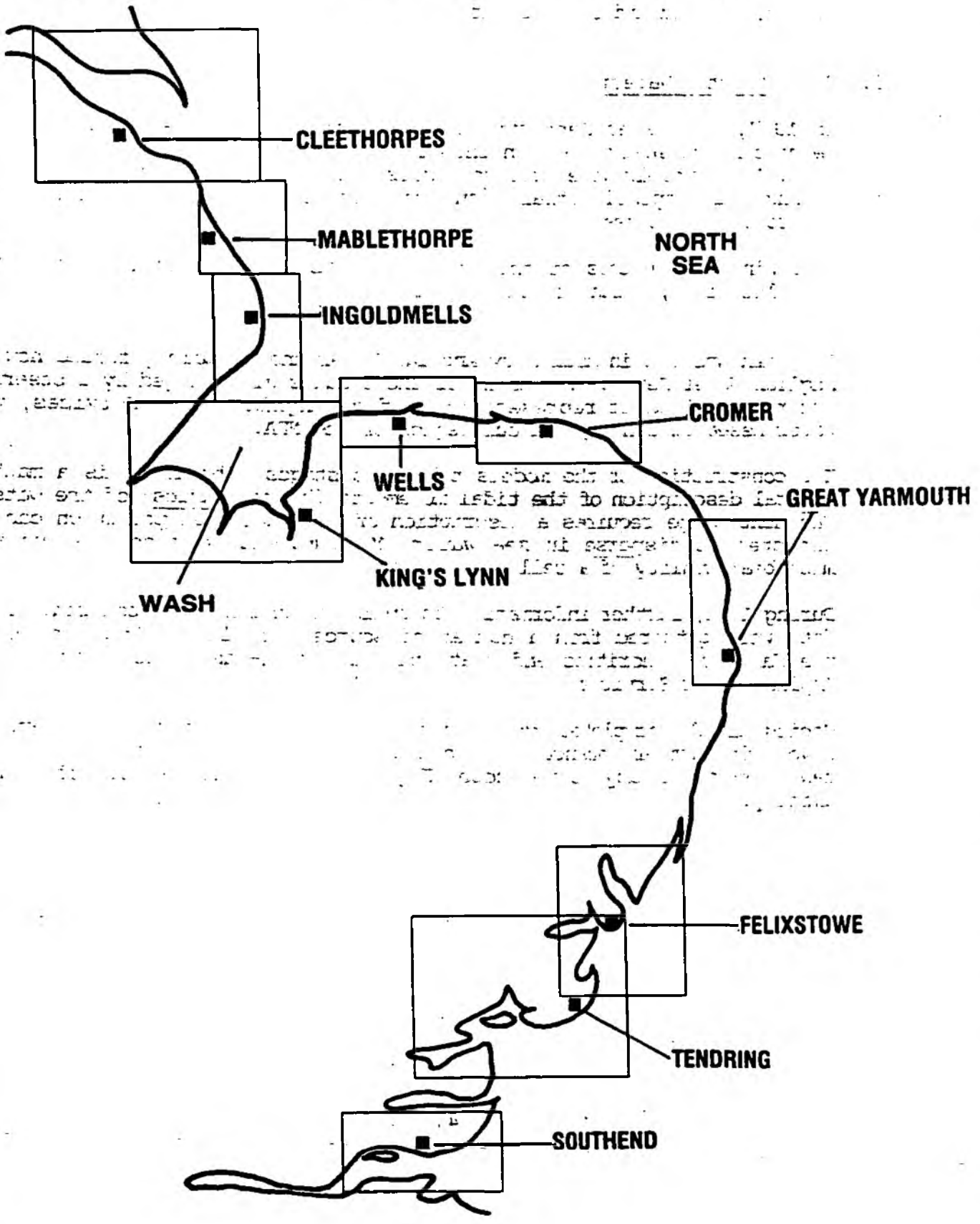
The construction of the models takes two stages. The first is a mathematical description of the tidal movements (hydrodynamics) of the water. The next stage requires a description of how bacterial pollution can be expected to disperse in sea water. Most models work on the average microbial quality of a cell 333m square.

During 1991, further information to build the models was acquired. These data were gathered from a number of sources, including the Admiralty, the Harbour Authorities and boat and helicopter-based field surveys by Anglian Water Services.

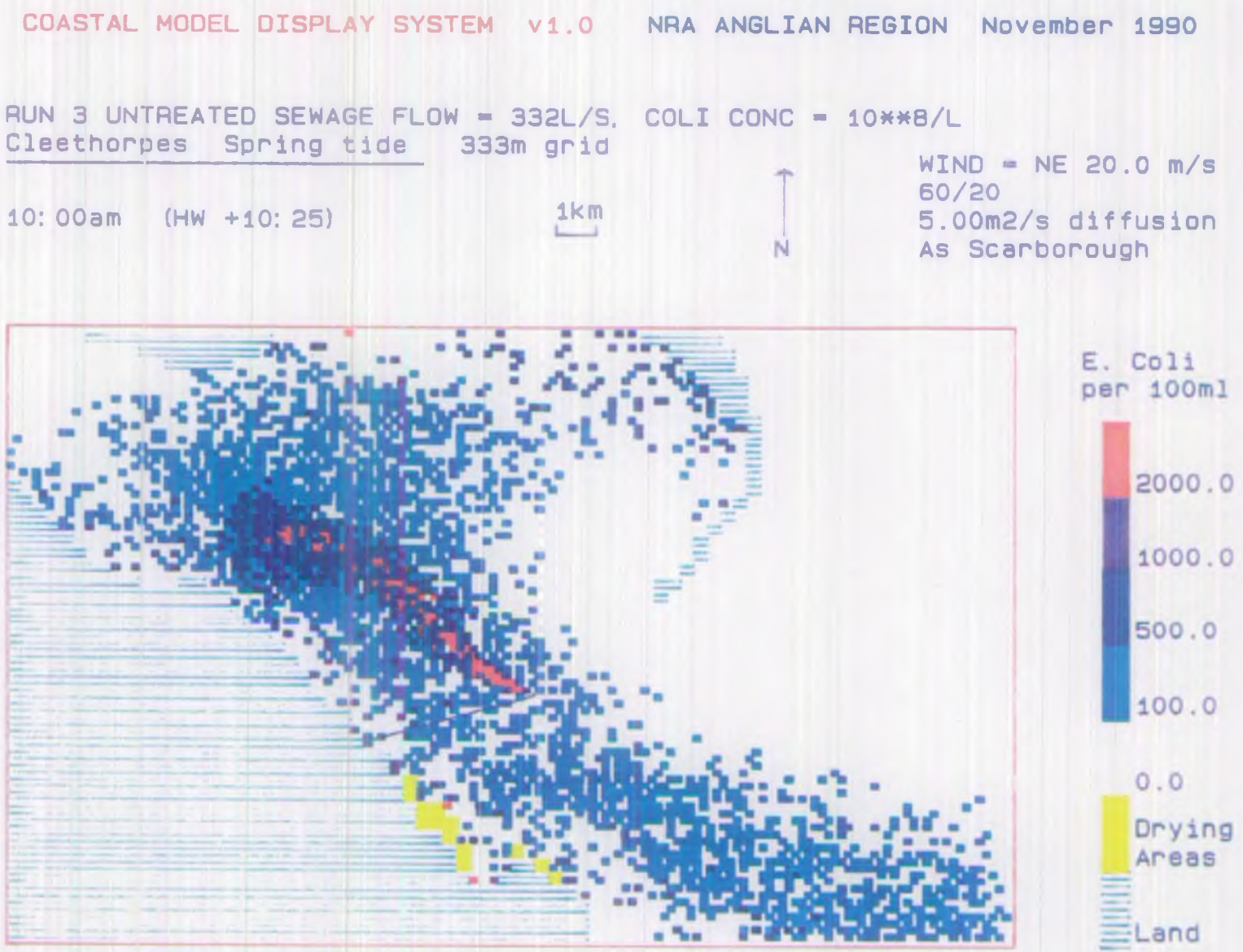
Copies of all completed models are maintained on our own computer. We have made further enhancements to the output, so that animated displays can be shown on any PC we chose. Figure 3.7 shows an example of such a display.

# FIGURE 3.6

## COASTAL MODELLING
## FINE GRIDS



# FIGURE 3.7


COASTAL MODEL DISPLAY SYSTEM v1.0 NRA ANGLIAN REGION November 1990
RUN 3 UNTREATED SEWAGE FLOW = 332L/S, COLI CONC = 10**8/L
Cleethorpes Spring tide 333m grid
10:00am (HW +10:25)
1km
N
WIND = NE 20.0 m/s
60/20
5.00m2/s diffusion
As Scarborough
E. Coli
per 100ml
2000.0
1000.0
500.0
100.0
0.0
Drying
Areas
Land

## Part 4: DISCHARGES

The discharge of wastewaters is controlled by granting a Legal Consent. A Consent is the legal permission to discharge pollution to a Controlled Water, and one is required for every sewage or industrial effluent discharged to the environment. Consent is also required for discharges of surface water drainage (except from roads).

Before the 1989 Water Act, Consents for the discharges operated by Anglian Water Services were issued by the Secretary of State for the Environment under Part II of the Control of Pollution Act. Consents for all other discharges were issued by the former Water Authority, Anglian Water.

Since the Water Act 1989, all Consents have been issued by the NRA. Prior to December 1991 consent processing was administered regionally, but from December 1991 this passed to Area administration. Because they have different types of Consent, we distinguish between STWs owned by the main Utility (Anglian Water Services) and those which are not. The latter are called Non-Utility discharges.

On 1 December 1991, to consolidate all existing rivers law into one document, the Water Resources Act 1991 wholly replaced the Water Act 1989.

### 4.1 Utility Discharges

#### 4.1.1 Discharges

Discharges made by Anglian Water Services may be categorised thus:

| | |
|---|---|
| Sewage Treatment Works | 1049 |
| Storm Sewage Overflows | 1516 |
| Emergency Overflows | 852 |
| Surface Water Sewers | 368 |
| Water-Treatment Works | 152 |

Of the STWs, 693 works had Legal Consents which included numeric limits on the quality of the effluent. Descriptive consents applied to 354 small works and a few large coastal outfalls.

#### 4.1.2 Types of Consents

The *Legal Consent* is the consent now in force. This may contain numeric limits on the quality and quantity of the effluent. For small works the Legal Consent may be a statement of the type of treatment which must be

provided. This is a *Descriptive Consent*.

Compliance against numeric Legal Consents is reported each year to the Department of the Environment.

The *River Needs Consent* has no legal force but is a working estimate of the Consent which may be needed in the future to achieve the Quality Objectives for Controlled Waters (see Section 1.2).

In the run up to privatisation, the Water Authorities were given a chance to reduce their risk of prosecution. In our Region *Time-limited Consents* were granted to 200 STW discharges which were failing their Legal Consents. These relaxations were conditional. The new private water company would have to bring these works into compliance, during 1992, with the stricter of either the old Legal Consent or a Consent based on maintaining the 1984 load. The Company would achieve the River Needs Consent for discharges where the extra cost was less than 10% .

Perhaps it is surprising that the net effect of all this activity is that sewage treatment works in this Region have, on average, the tightest standards in the United Kingdom.

### 4.1.3 Policy on Setting Consents

The policy of the National Rivers Authority is that all revised or new Consents will maintain the quality of Controlled Waters (*No Deterioration*) and meet Water Quality Objectives by achieving River Needs Consents. The Water Quality Objective is the same concept as the River Quality Objective, but is applied to all kinds of Controlled Water.

The main policy of Anglian Water Services is to ensure compliance with Legal Consents. The company has identified works at risk of failing Legal Consents and intends to design schemes to meet the current discharged load.

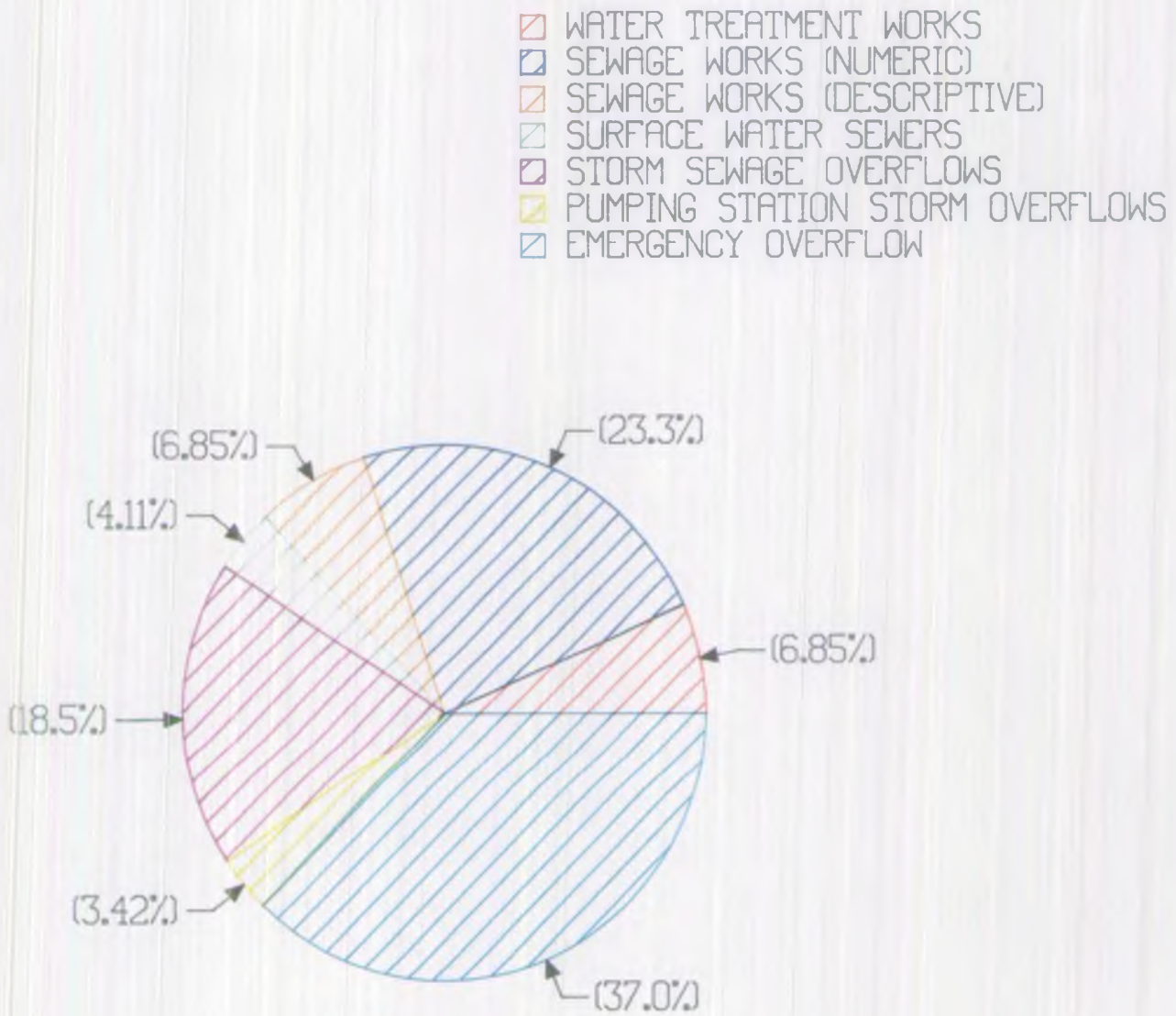
The Company will want to apply to the Director General for Cost-Pass-Through for expenditure beyond this in order to achieve River Needs Consents.

### 4.1.4 Application Processing

During 1991, 146 Consent Applications were received from the Utility. By the end of 1991, the total number of Applications lodged with us was 386. The proportions of applications in different categories are shown in Figure 4.1.

During 1991, 96 Consents were issued. Of these, 40 were for sewage treatment works and most of the rest were for storm or emergency overflows. Under the Water Resources Act 1991 Section 91(2), the person who applied for the consent may appeal to the Secretary of State against the

# FIGURE 4.1
## UTILITY : APPLICATIONS RECEIVED



conditions of the consent. The Utility started to appeal against some of the conditions included in their consents early in 1991. We stopped issuing storm/emergency overflow consents until the situation could be resolved. This accounts for the low number of consents issued during 1991.

### 4.1.5 Monitoring

The minimum frequency at which a discharge is sampled is governed mainly by its size. The size of the works is a key factor governing the potential impact of the effluent on the Environment. The number of samples taken at works is indicated in the following table:

| Equivalent Population ('000s) | Samples per Year |
|---|---|
| >100 | 48 |
| > 10 <100 | 41 |
| > 5 < 10 | 17 |
| > 1 < 5 | 8 |
| < 1 | 4 |

A secondary factor, the degree of treatment provided at the works, is also used to determine the sampling rate. This factor is applied by starting with the category produced from the above table and moving to a higher or lower category according to the following rules:

| | |
|---|---|
| Secondary treatment: | No change |
| Primary treatment: | Down one class |
| No treatment: | Down two classes |
| Tertiary treatment: | Up one class |

These adjustments work well where river quality is good because the degree of treatment will reflect what has been constructed in order to protect the Environment. A final condition was added to cater for sites where the current degree of treatment may be inadequate: if the River Needs Consent for the BOD is less than 20 mg/l, the sampling rate is moved up by one class.

Some Legal Consents contain criteria for List I and List II Dangerous Substances (Part 2.8). We analyse for these determinands at monthly intervals.

During 1991, the planned number of samples was 11599. Because some works discharge effluents from more than one outfall, and because separate samples are required for extended suites of analysis, the actual number collected was 12,829.

We aim to inspect works with Descriptive Consents quarterly. Descriptive Consents include the need to refer to the state of the receiving water, so monitoring is co-ordinated with the inspections of these waters.

### 4.1.6 Compliance with Standards

Two summary statistics are used to monitor performance. The first, the *Percent of Compliant Works*, is a simple statement of the number of sites which meet their Consent. This can be volatile and does not necessarily reflect the impact of effluents on the receiving water.

In managing the quality of receiving waters, large works are more important than small ones so we also report the percent of the total flow from all works which complies with the Consent Limits. This statistic, the *Percent of Compliant Flow*, is less volatile and gives a better measure of the damage which can be done by non-compliance.

The pollutants commonly associated with sewage treatment are Suspended Solids, BOD and Ammonia. These are called sanitary determinands. Other determinands are called non-sanitary. The Consent Limits for the sanitary determinands are 95-percentile limits. The 95-percentile is a concentration which must be met for 95% of the time. Hence a summary target which covers all discharges is a Percent of Compliant Flow which exceeds 95%.

The definition of compliance allows a certain number of sample results to exceed the limit. If the number of exceedences is more than the permitted number, then we are 95% certain that the failure is not due to chance. We then report the discharge as having failed its Consent.

The numbers of permitted failures is laid down in a Look-up Table, which is referred to in the Legal Consent.

Some works also have additional standards for sanitary determinands which are absolute limits on quality. These must not be exceeded at any time and are called Upper Tier Limits. Upper tier limits apply to works with Time-Limited Consents and all numeric STW consents issued since the NRA was formed.

Figure 4.2 shows the performance of works against the percentile limits in their Legal Consents. The results cover all discharges which have numeric limits on the discharge quality.

Around 20% of all flows are discharged to Tidal waters. Table 4.1 summarises the proportions of discharges to Non-Tidal and Tidal waters and shows the improvements seen over the last year.

# FIGURE 4.2

## COMPLIANCE WITH LEGAL CONSENTS

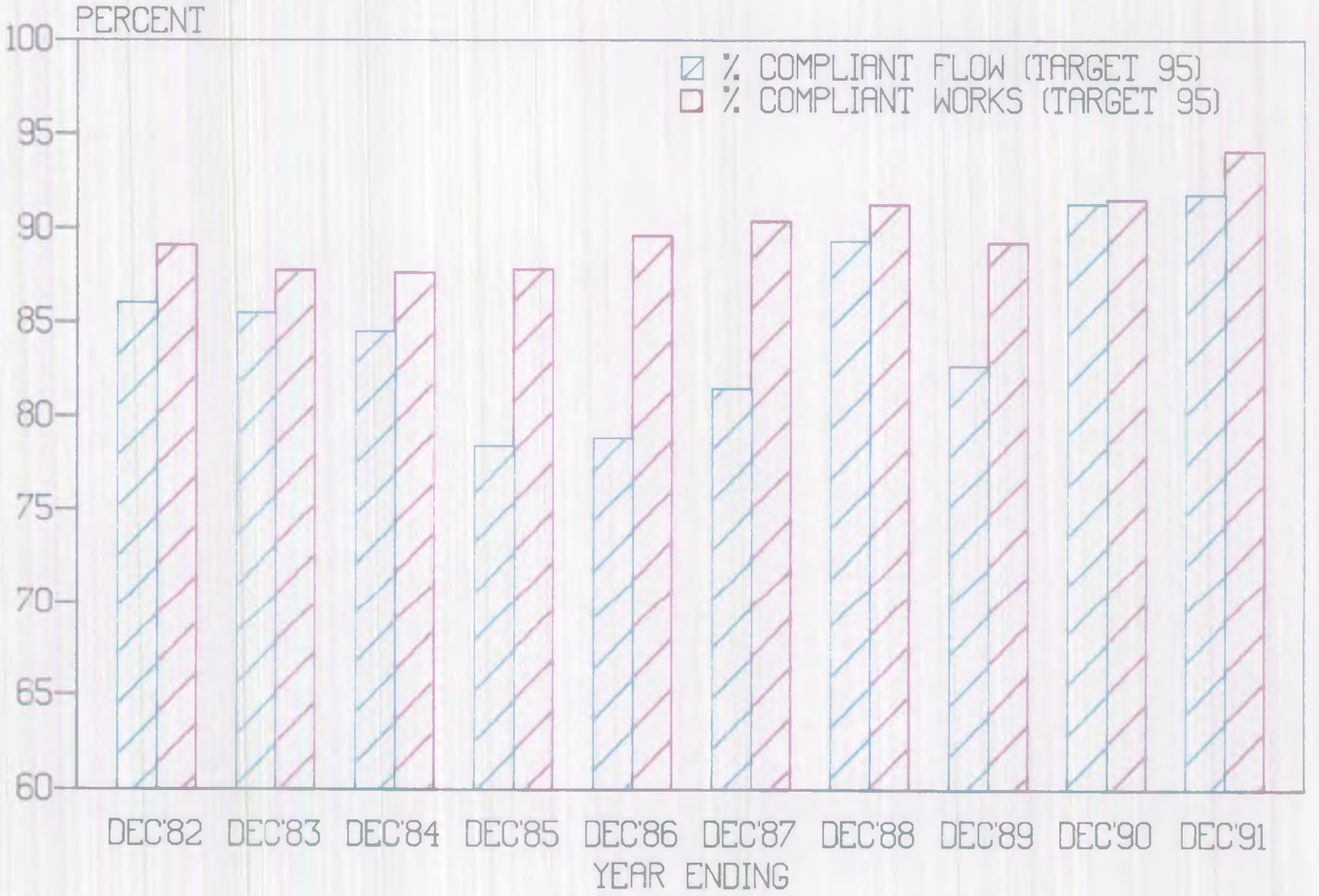


Table 4.1: Sanitary Criteria

| Receiving Water | Number of Works | Percent Compliant | | | |
|---|---|---|---|---|---|
| | | Works | | Flow | |
| | | 1990 | 1991 | 1990 | 1991 |
| Non-tidal | 657 | 91.8 | 94.1 | 82.5 | 92.4 |
| Tidal | 36 | 86.1 | 94.4 | 88.0 | 90.2 |
| Total | 693 | 91.5 | 94.1 | 91.3 | 91.8 |

The percent of discharges which fail the Upper Tier Limits in their Consents is now 10.6 (11 discharges), compared with 16.6 at the end of 1990.

There are 33 discharges with criteria for non-sanitary substances in Legal Consents. All limits for non-sanitary determinands are absolute. Three STWs had a single failed sample, Royston for mercury, Ashton for cyanide, and Cambridge for lindane.

At the end of 1991, 354 small discharges had Legal Descriptive Consents, compared with 353 at the end of 1990. About 99% (352 discharges) were inspected at least once in 1991, compared with 92% (326 discharges) in 1990.

Figure 4.3 shows how the compliance of these discharges has altered over the last two years. The proportion which complied at the latest inspection is 90% (317 discharges).

Performance against a River Needs Consent gives an indication of the action needed to cater for growth and achieve Water Quality Objectives. Figure 4.4 shows that since December 1990 the Percent of Compliant Flow judged against River Needs Consents has decreased from 76.1% to 73.8%, although the Percentage of Compliant Works has improved from 71.5% to 75.7% over the same period.

## 4.2 Non-Utility Discharges

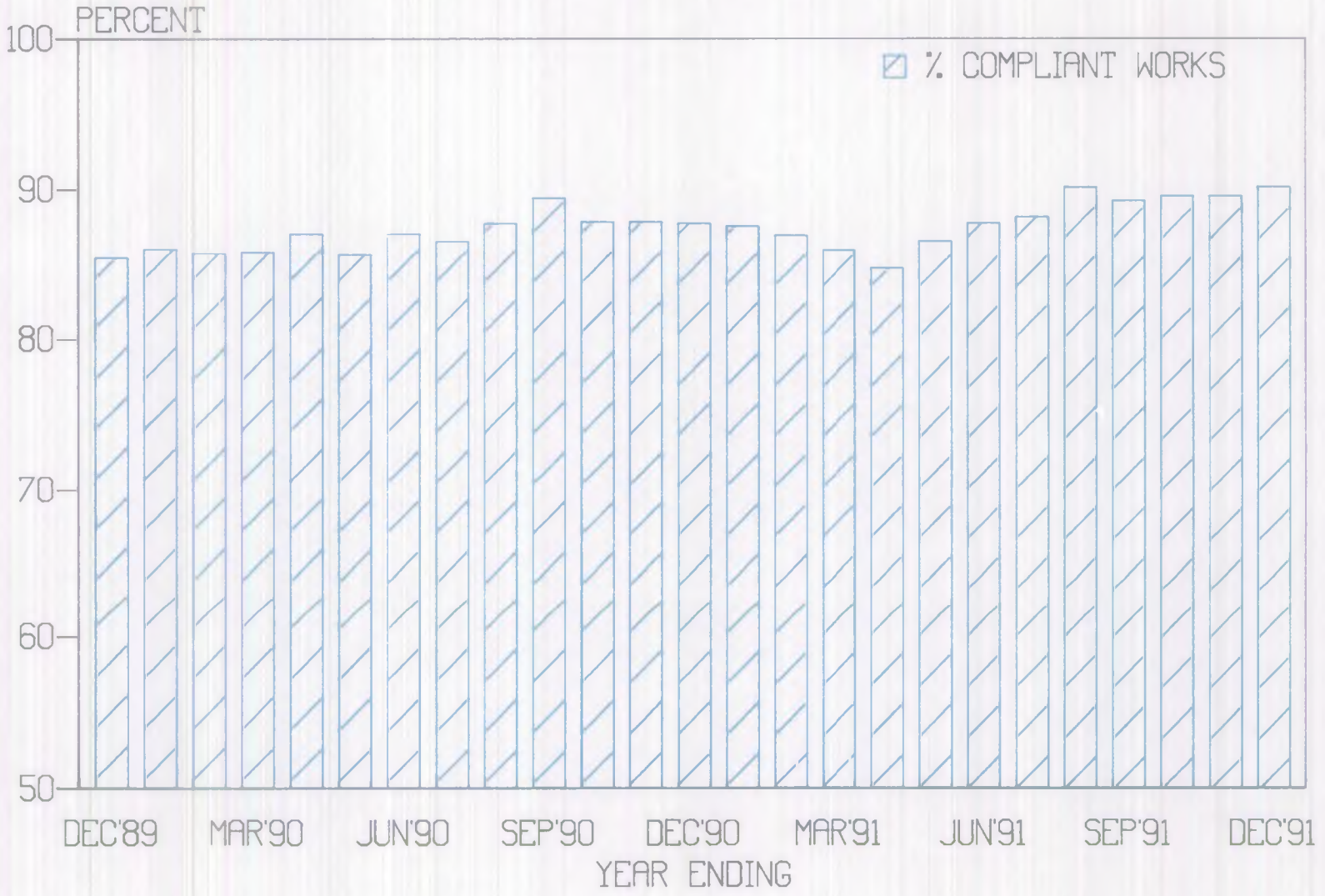
### 4.2.1 Discharges

Non-Utility discharges may be categorised thus:

| | |
|---|---|
| Sewage Treatment Works | 3058 |
| Industrial Effluent | 586 |
| Surface Water | 813 |
| Agriculture | 63 |

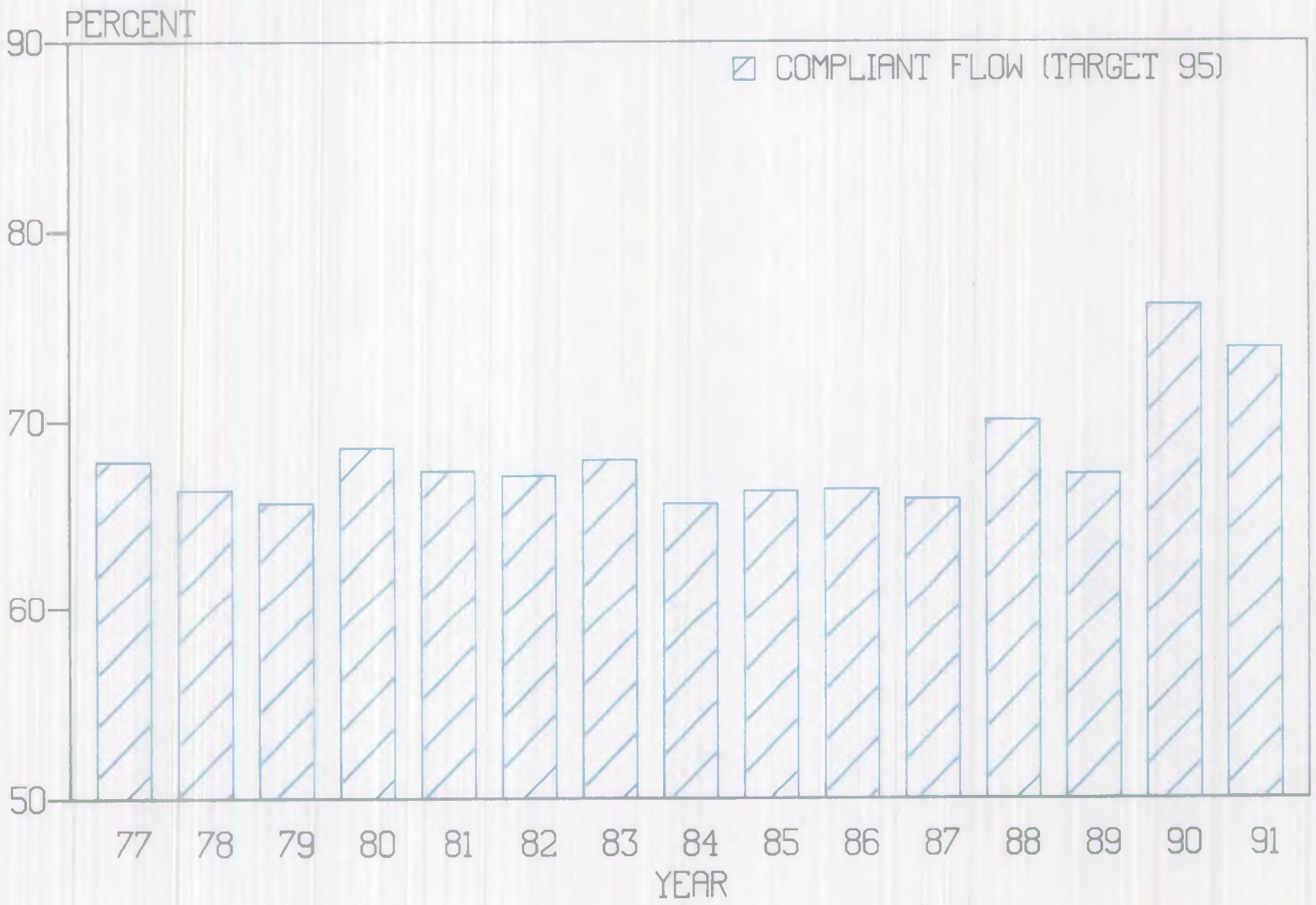
# FIGURE 4.3

## COMPLIANCE WITH DESCRIPTIVE CONSENTS



# FIGURE 4.4

## COMPLIANCE WITH RIVER NEEDS CONSENTS



■ This figure excludes septic tanks of which there are 10566.

### 4.2.2 Types of Consent

Most of the consents on the Water Resources Act Register, are Descriptive Consents for discharges of effluent from private sewage treatment works and industrial premises. Discharges with the greatest potential to affect the environment have numeric limits in their Consents. Legally, all numeric limits for the non-utility discharges are absolute, even those for the sanitary determinands.

### 4.2.3 Application Processing

The number of Applications for Consent decreased during 1991. The total was 490 of which 331 were for sewage effluents. The proportions of applications in different categories are shown in Figure 4.5. During 1991, 529 Consents were issued.

The reduced number of applications was due to the change in policy for consenting sewage effluent discharges to land. From 1 September 1990 these discharges have not been consented. Pending the introduction of a National Policy of controlling these discharges we have been sending letters to potential dischargers detailing the conditions to which the treatment system should be constructed. This controls the installation of the soakaway and also exempts the discharger from paying the application fee (see Part 4.6).

### 4.2.4 Monitoring

Many of the records on the Water Act Register are for tiny discharges whose effect on the environment is negligible. We monitor only those effluents judged to have a potential for environmental impact (as a safeguard we rely on the biological monitoring of watercourses to tell us if we have misjudged the potential impact of discharges).

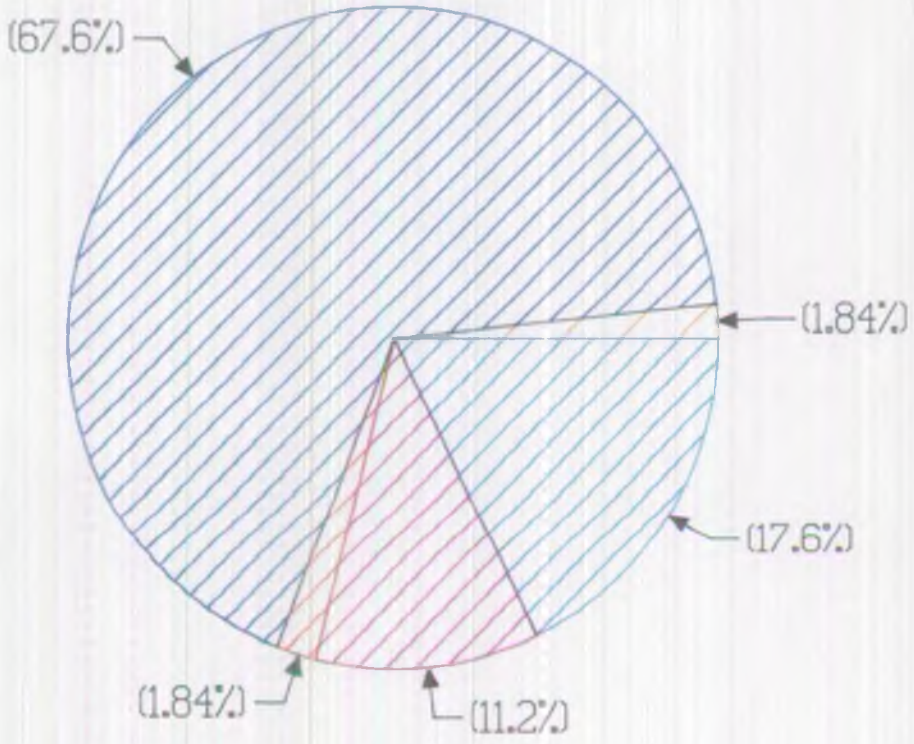
The audit sampling frequencies range from twice per week for the larger discharges to the Humber, to a minimum of four times per year for smaller discharges. Some other discharges, not on the routine sampling programme, are sampled as part of occasional or routine inspections.

Of the 170 significant private sewage treatment works, 59% (94 discharges), were sampled, compared to 51% (84 discharges) in 1990. In addition forty nine discharges are the responsibility of the Property Services Agency. These are Crown Property and are exempt from prosecution.

Most trade discharges are direct to sewer. These are managed by Anglian

# FIGURE 4.5

## NON-UTILITY : APPLICATIONS



RECEIVED

- ☐ SEWAGES TO LAND
- ☑ SEWAGES TO RIVER
- ☑ TRADES TO LAND
- ☑ SURFACE WATERS TO RIVER
- ☑ TRADES TO RIVER

Water Services. Our control of these traders rests with setting consents for sewage treatment works. For industrial discharges, the NRA issues Consents only for those which discharge direct to environmental water. Over 150 industrial effluents in this category were sampled. This compares with 140 in 1990.

### 4.2.5 Compliance

The proportion of compliant private sewage treatment works is 40% (38 discharges). This is a greater number of discharges than last year. The figure for discharges owned by the Property Services Agency is 49% (20 discharges). This is four fewer discharges than last year.

The proportion of compliant industrial effluent discharges is 46% (71 discharges). More discharges are monitored and more are compliant than in 1990.

The compliance position is poor but the potential impact of most of these effluents is small. The proportions of sites failing when judged as 95-percentiles against the Look-Up table are:

| | |
|---|---|
| Non-utility STWs | : 29 % |
| Industrial Discharges | : 34 % |
| Crown Properties | : 24 % |

When assessed on this basis, the compliance figures can be compared more fairly with those for Anglian Water Services' sewage treatment works where the failure rate is 5.9% against Legal Consents and 24% against River Needs Consents.

## 4.3 Priority Lists and the Index of Discharge Impact

The Index of Discharge Impact (IDI) is used to rank discharges in terms of their apparent or potential impact on receiving waters. The IDI is calculated from statistics for the compliance of discharges with their River Needs Consents, and from an assessment of compliance of waters with their quality standards. These data are then weighted according to our views on the relative importance of different waters.

We are investigating the use of biological data in assessing the effects of discharges on receiving waters. This information will be incorporated into the IDI to further refine the system.

We use the IDI as the basis for producing ranked lists of discharges where we would like to see improvements in the quality of their effluents.

A preliminary list of about 50 works was passed to the Utility in September 1991. Discussions about improvements to effluent quality were then initiated.

## 4.4 Targeting and Tripartite Sampling

When a discharge consistently fails to meet its legal consent conditions, that discharge becomes a candidate for the routine collection of *Tripartite Samples*. These are samples which are especially collected, documented and analysed. The main sample is split into 3 parts : one part is analysed by the NRA, one is given to the discharger and one is held in reserve. They provide the basis for legal evidence. If sufficient tripartite samples fail the allowed Look-up Table ratios over a one year period, the discharger can be prosecuted in court.

In the year ending December, 1991, we were targeting 6 utility sewage treatment works by taking tripartite samples of their effluent. Four discharges, Fritwell, East Rudham, Wickford, and Great Totham, had enough failed tripartite samples for us to be able to successfully prosecute the Utility. A further four cases, Acle, Beachampton, Briston, and Southminster, are to heard in 1992.

## 4.5 Progress on Consent Conditions

We need to calculate revised standards for discharges for a number of reasons. These include:-

- growth in loads;
- changes in environmental standards;
- new or altered discharges.

We are continuing to extend the number of consents which include standards for fish and invertebrate toxicity testing.

During 1991 several national NRA consenting policies were formulated. These cover the following topics:

- Enforcement and Prosecution with respect to Pollution Incidents affecting Controlled Waters;
- Enforcement of Numeric Discharge Consents;
- Interim Guidance on Issuing Consents for Discharge;
- Short-term (Constructional) Variations to Consents;
- Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations 1991.

## 4.6 Charging for Discharges

A scheme of charges for consented discharges was introduced in 1991. There are two kinds of charge, an application charge, and an annual charge.

### 4.6.1 Application Charge

The charging scheme incorporates charges for the processing of consent applications. This was introduced in September 1990 and is as follows:-

| | | |
|---|---|---|
| Sewage effluents of less than five $m^3$/day | - | £ 50 |
| Cooling water of less than ten $m^3$/day | - | £ 50 |
| Uncontaminated surface water | - | £ 50 |
| All other effluents | - | £350 |

### 4.6.2 Annual Charge

In 1991 an annual recurring charge on most categories of discharge was also introduced. Small domestic sewage discharges of less than 5$m^3$/day are exempted from the scheme.

The scheme was introduced to recover part of the costs of the NRA's pollution control function, in accordance with the Water Resources Act 1991, section 131.

The draft scheme was advertised at the beginning of March and dischargers were given two months in which to give their comments to the Secretary of State for the Environment.

The revised scheme was approved at the end of May and came into force on 1 July 1991. It is due to run for three years and will then be subject to review.

As part of the preparation for the scheme, discharge consents held on the Public Register were checked to confirm the accuracy of the information. Details of discharge consents were entered onto a computer database. Charges will be levied on 5700 consented discharges.

The annual charge is calculated on the basis of the size , nature and location of the discharge, three features significant in determining the cost to the NRA of carrying out our pollution control function. Each discharge is assigned a weighting to reflect the volume and nature of the discharge and the nature of the receiving water. The weighting is multiplied by the unit charge for the financial year (£270 for 1991/92). The unit charge is set annually in agreement with the Government.

Here are some examples for a full year:

Domestic sewage of less than five $m^3$ /day - No Charge

Emergency overflow from a pumping station to stream - £108
Drainage from Trade premises to a watercourse - £270
Cooling water of high temperature, pH or chlorinity - £270
STW serving 1,000 people, discharging to estuary - £2,430
Large trade effluent, toxic Substances, to estuary - £30,375

## 4.7 Integrated Pollution Control

Integrated Pollution Control (IPC) was introduced on 1st April 1991 under the Environmental Protection Act 1990. IPC is administered by Her Majesty's Inspectorate of Pollution (HMIP).

The main objective of IPC is to prevent, minimise or render harmless discharges of the most persistent pollutants entering the whole environment, air, land and water. IPC lists the specific pollutants as "prescribed substances" and the industrial processes that produce most of the prescribed substances as "prescribed processes".

Operation of a prescribed process will require an Authorisation (HMIP version of a consent). All new operations will require authorisation immediately. For the large number of existing operations it was decided to split the prescribed processes into groups, and deal with them on a rolling programme which will reach completion in 1996. In 1991 the existing large combustion processes (power stations) have applied.

Before the introduction of IPC, discharges to controlled waters (surface and groundwater), required discharge consents from the NRA. Those discharges not resulting from prescribed processes will continue to be dealt with in this way. However, discharges from prescribed processes will also require HMIP authorisation which will in some circumstances replace the NRA Consent.

The NRA is a statutory consultee in the authorisation process for discharges to controlled waters. HMIP send NRA a copy of an application. NRA provide detailed recommendations to HMIP on the conditions that must be included in the Authorisation.

HMIP must ensure that the conditions of an Authorisation are at least as tight as the NRA recommendations. However HMIP can require more stringent limits in its Authorisations based on two principles of IPC. The first is that the operator should use the "best available technique not entailing excessive cost" (BATNEEC) to minimise all discharges from the process, and the second that the operator should choose the "best practicable environmental option" (BPEO) for any discharge made.

IPC is a step towards the complete integration of pollution control under the auspices of an environmental protection agency.

## Part 5: THE WATER RESOURCES ACT: WATER QUALITY REGISTER

The Water Resources Act Water Quality Register contains copies of all Consents to discharge effluent, together with Applications for Consents dating back five years. The Register also holds the results of analysis of samples of effluent and environmental waters.

The Register contains details of over 31,000 Consents and new Applications are being made at a rate of 600 per year. The Register holds information on 276,000 samples taken since August 1985, and new samples are added at a rate of 50,200 per year. There are more than one million analytical results.

The Consents and Applications are held in the form of paper copies and the sample results are stored on computer.

The Register is kept at Peterborough and is open on weekdays (except Bank Holidays) from 10.00 to 16.30. Inspection of the Register is free. Data retrieval is free to most students in full time education as well as to water undertakers. Otherwise a charge of £5.00 is made for an initial retrieval from the Register with copies of any data/consents being charged at 50p per sheet. Lengthy retrievals are charged at £15.00 per hour of staff time plus 50p per sheet of hard copy produced. An appointment to view the Register is not essential, but recommended. Written requests for information can also be made, but telephone requests for information will not be accepted.

Details of Consents are retained on the Register until 5 years after they are revoked.

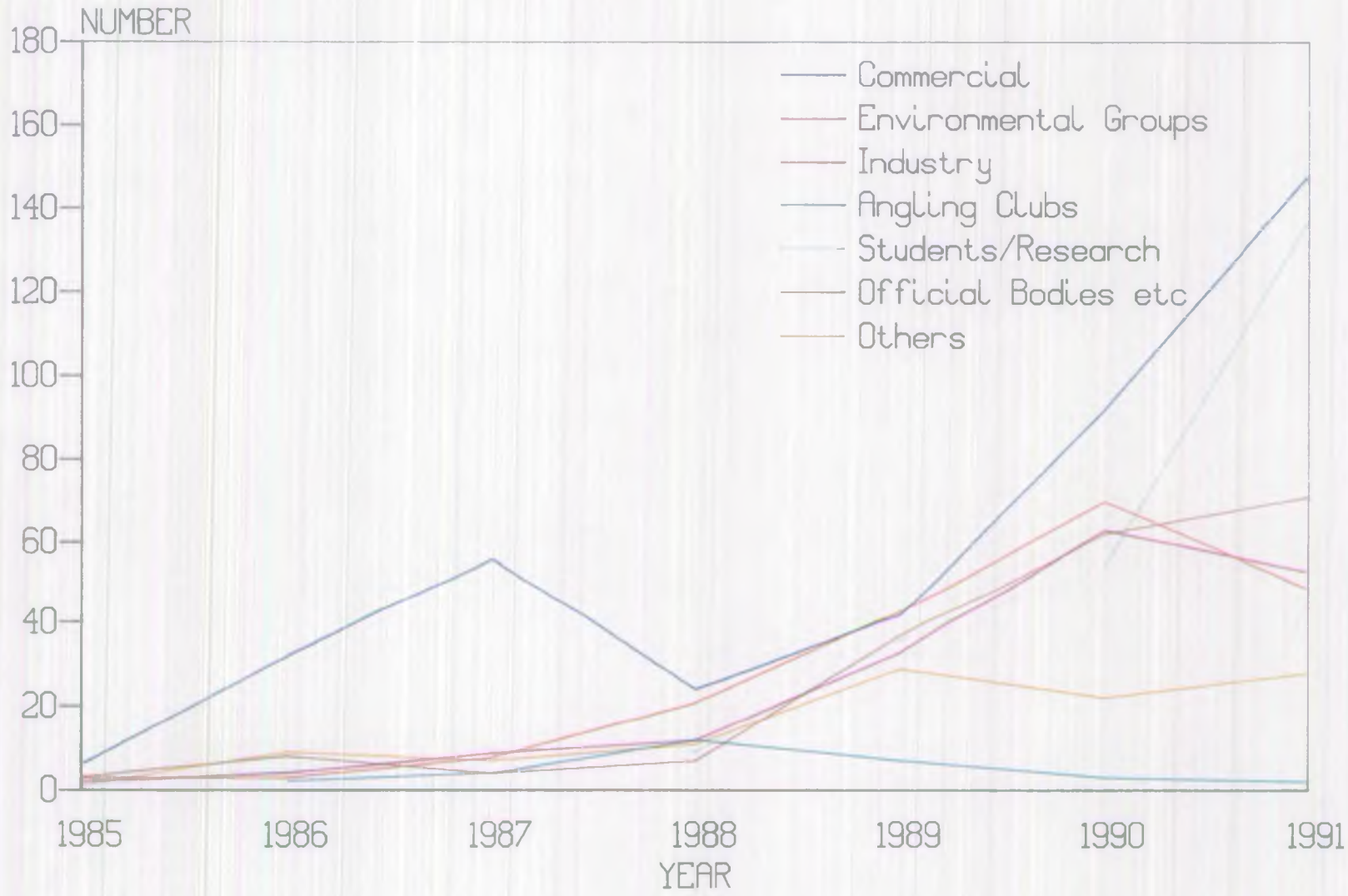
Immediate access is provided for sample results. Results for samples obtained before August 1985 are not available from the Register.

The Register utilises a geographical mapping system. This makes it easier for the enquirer to find out what is available for a particular location. As well as enhancing the display of data, the system assists with data retrieval.

The year saw another large increase in interest in the Register. Four hundred and eighty eight enquiries for information were received in 1991, of which 137 were from students. Many students, of all levels of education and ages, make good use of the Register facilities to assist with their studies. Trends are shown in Figure 5.1.

# FIGURE 5.1

## WATER ACT REGISTER ENQUIRIES



## Part 6: CAPITAL DEVELOPMENT PROGRAMME

The initial budget awarded for Capital Development in the financial year 1991/92 was £1,239,000. This was subsequently reduced to £850,000 through a transfer of £389,000 to Head Office. Later additional bids raised the final programme total to £1,290,000.

The number of schemes funded by the Department of the Environment was 44. The assets developed under these schemes are:

**TABLE 6.1**

| Type of asset | Number | Cost (£ 000's) |
|---|---|---|
| Water Quality Monitoring Stations | 8 | 86.5 |
| Pollution Control | 7 | 147.8 |
| Marine Survey Facilities | 7 | 375.2 |
| Scientific Equipment | 13 | 201.0 |
| Laboratories | 9 | 480.2 |
| Totals | 44 | 1290.7 |

The total for 1991 compares with £2,164,000 (at September 1991 prices) for 1990. Although reduced, the expenditure reflects the Authority's continuing expanding responsibilities, with water quality monitoring and associated laboratory developments being the area of greatest increase.

## Part 7: RESEARCH AND DEVELOPMENT

In 1991, Anglian Region maintained its position at the forefront of research within the NRA. The research undertaken fell into two programmes, the National Research and Development Programme, which addresses National issues, and the Regional Operational Investigation Programme which covers site-specific or region-specific research within Anglian Region.

In the 1991 National Programme, 23 Anglian staff lead 32 projects. We are developing areas of expertise, in particular, blue-green algae, groundwater quality, water resource management and coastal engineering. In the fiscal year 1991/92, the Anglian programme budget of £1,400,000 was achieved, representing the largest single budget devolved to a Region for R & D.

Under the Regional Programme we managed 34 projects in 1991/92 and £573,000 was spent on these. £32,000 of the expenditure on Regional Operational Investigations was met by contributions from other environmental organisations. A reduction in expenditure on Operational Investigations was made with the completion of several large projects and the increase in the role of the National R&D programme.

### 7.1 Benefits

Benefits are closely assessed before any project is initiated. A continual assessment of progress and benefits is undertaken by the Project leader and R&D support staff throughout the life of a project.

Benefits of R&D include:

- the development of strategies to implement new legislation;
- responding to and meeting new environmental concerns;
- improvements in effectiveness and efficiency in the Authority's business; and
- underpinning knowledge about the aquatic environment which allows the priority to make considered decisions.

## Part 8: CHEMICAL LABORATORY SERVICES

During 1991 the laboratory at Kingfisher House was extended to meet increased workloads. This extension was integrated into the operation of the laboratory with minimal disruption to service.

All NRA laboratories have established a timetable for achieving the standard recognised by the National Measurement Accreditation Service (NAMAS). The NAMAS scheme is an internationally recognised mark of quality assurance. This Regions chemistry laboratory has now been accredited under the scheme. Written procedures have needed to be produced in connection with this and these cover a wide range of activities, including Methods, Protocols, Training, and Analytical Quality Control. All methods and equipment in routine use in the laboratory are covered by the scheme. New items of equipment and non-routine methods will be added as required.

All analyses are performed using strict methods of control on precision. As part of the NAMAS scheme the laboratory runs a quality control check on every batch of samples. In addition, the laboratory participates in the Aquacheck quality control scheme organised by the Water Research Centre. Our performance has generally been good.

Numbers of samples handled for routine monitoring purposes are given in Table 8.1. In addition, a number of unplanned samples are also analysed by the laboratory. These may be taken when there is a pollution incident, for example. The total number of samples processed in 1991 is 50 132, and the total number of determinations is 466 000. A breakdown of the total number of samples taken is shown in Figure 8.1. The total determinations figure covers over 500 determinands/techniques, ranging from relatively simple automated methods eg pH, to more complex organics eg pesticides at ng/l levels.

There is a trend for reduction of samples requiring basic sanitary analysis (eg STW's) and an increase in samples requiring more complex analysis. New equipment was purchased to replace ageing technology and to improve capacity and efficiency.

The increase in Tripartite Sampling observed last year has continued, and analysis and handling of the associated documentation creates a large workload. The laboratory continues to provide an emergency and out of hours service. The number of pollution incidents also has an impact on workload.

The Regulations on the Control of Substances Hazardous to Health (COSHH) have continued to have an impact. A centralised inventory of controlled substances is maintained and a system has been established for handling the requirements of the regulations. All laboratories in the Region are checked for compliance with the COSHH system, and a formal record is

produced. A self audit approach for each laboratory has been developed and will be applied to all laboratories in the next year.

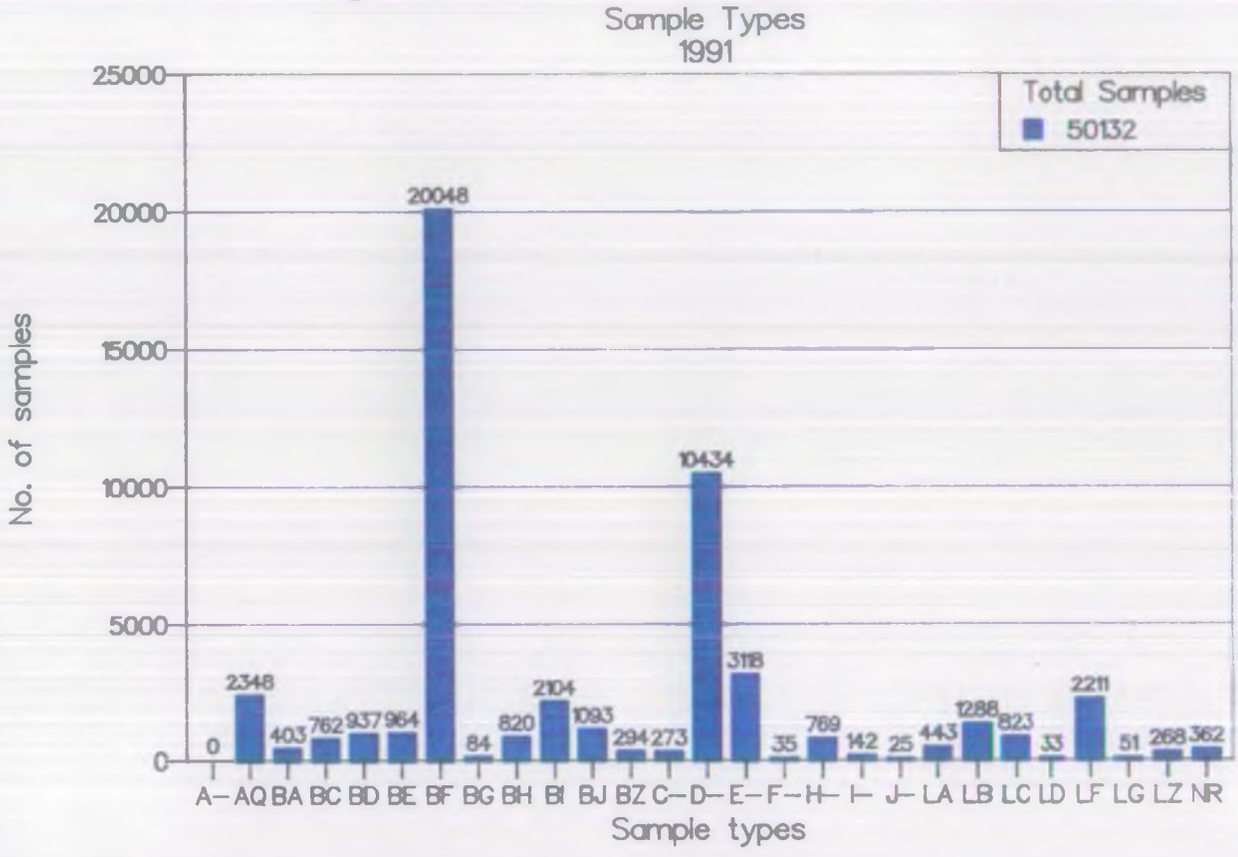
The Laboratory Information Management System (LIMS) has been further developed, both within the laboratory and by connection to District Offices. LIMS has reduced errors and enabled better planning. It has reduced over-sampling and ensures that we take samples at the frequency required.

TABLE 8.1

ROUTINE SAMPLING PROGRAMME: PLANNED AND ACTUAL

| Type of Sample | SITES | | SAMPLES | |
|---|---|---|---|---|
| | Planned | Actual | Planned | Actual |
| Controlled Waters: | | | | |
| Rivers | 1169 | 1170 | 13074 | 14936 |
| Groundwaters | 458 | 461 | 1847 | 2219 |
| Freshwater sediments | 74 | 69 | 126 | 125 |
| Estuaries | 204 | 239 | 666 | 1940 |
| Coastal waters | 51 | 83 | 752 | 1081 |
| Saline sediments | 24 | 85 | 44 | 176 |
| All Discharges: | 1523 | 1588 | 15083 | 15603 |
| Total | 3503 | 3695 | 31592 | 36080 |

# Figure 8.1 – Sample Breakdown




## SAMPLE TYPES

| | |
|---|---|
| A- | Any Gas |
| AQ | Analytical Quality Control |
| BA | Reservior Water |
| BC | Spring/Artesian Water |
| BD | Pumped Groundwater |
| BE | Static Groundwater |
| BF | River/Stream Water |
| BG | Canal Water |
| BH | Lake/Broad/Pond etc. |
| BI | Estuarine Water |
| BJ | Coastal Water |
| BZ | Miscellaneous Environmental Water |
| C- | Any Supply Water |
| D- | Any AWS 'D' Type Effluent |
| E- | Any AWS 'E' Type Effluent |
| F- | Any Leachate |
| H- | Any Solid |
| I- | Any Biota |
| J- | Any WTW Effluent |
| LA | AWS STW Final Effluent |
| LB | Non-AWS STW Final Effluent |
| LC | Surface Water Drainage |
| LD | Any Other Sewage Discharge |
| LF | Industrial Effluents |
| LG | Agricultural Effluents |
| LZ | Miscellaneous Discharges |
| NR | NRA - Southern Samples |

## Part 9: Information Strategy

Water Quality monitoring is a complex process. Thousands of sites are sampled and hundreds of thousands of analytical results are generated each year. Efficient management would be impossible without computer-based systems for handling information.

The Laboratory Information Management System (LIMS) helps manage our resources of sampling and analysis. It is operated on a network of Personal Computers (PCs), and co-ordinates sampling, analysis and storage of results. Laboratory equipment is linked directly to LIMS. Validated results are transferred to the Region's Honeywell mainframe computer for secure long-term storage and for access by the Water Resources Act Register (Part 5).

The Sampling Information Management System (SIMS) is PC-based system which brings together the various monitoring requirements for each site and confirms that LIMS is set up to analyse for all the requirements. In 1991 we extended SIMS to include data conversion facilities. These allow us to extract chemical results from LIMS or the Honeywell mainframe and convert the data into a consistent and accessible format for use by other systems.

We have since developed powerful computer software that can access the formatted chemical data and produce graphs of results against time (Figure 9.1). This allows us to investigate environmental trends.

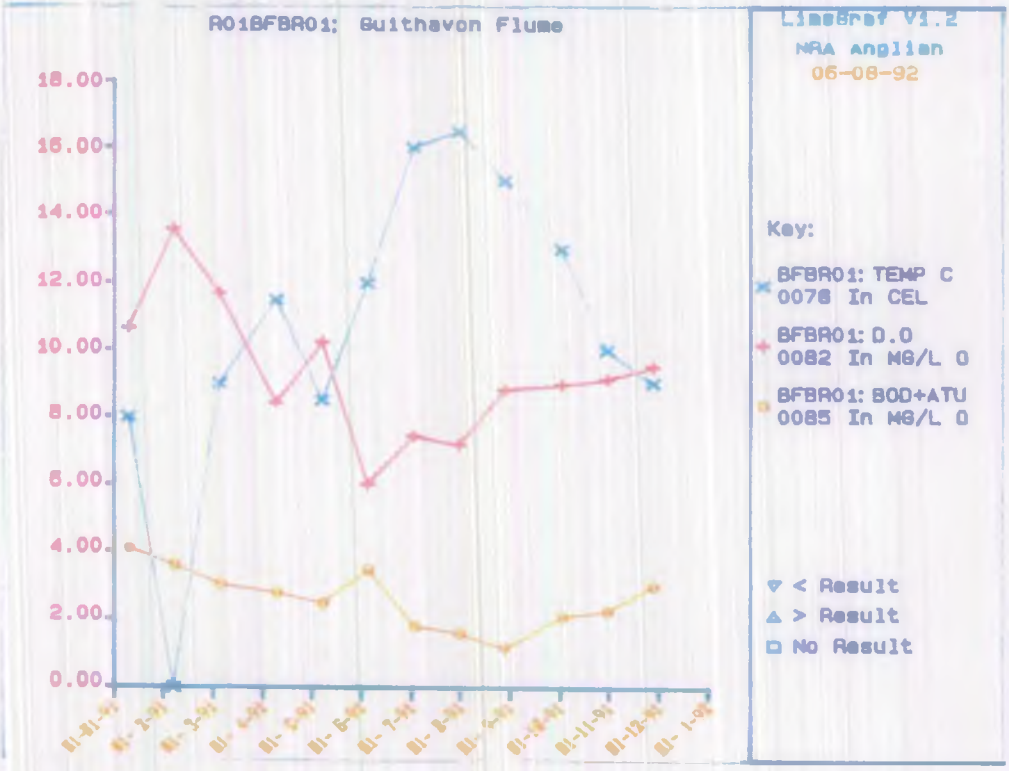
We have also modified our computer mapping software to access the formatted chemical data and produce graphs of chemical results on a background map (Figure 9.2). This allows us to investigate trends along a river or across an estuary or aquifer.

During 1991 we developed software to read waste disposal databases purchased from Aspinwall & Company. The software will enable us to target our sampling towards sites receiving hazardous materials.

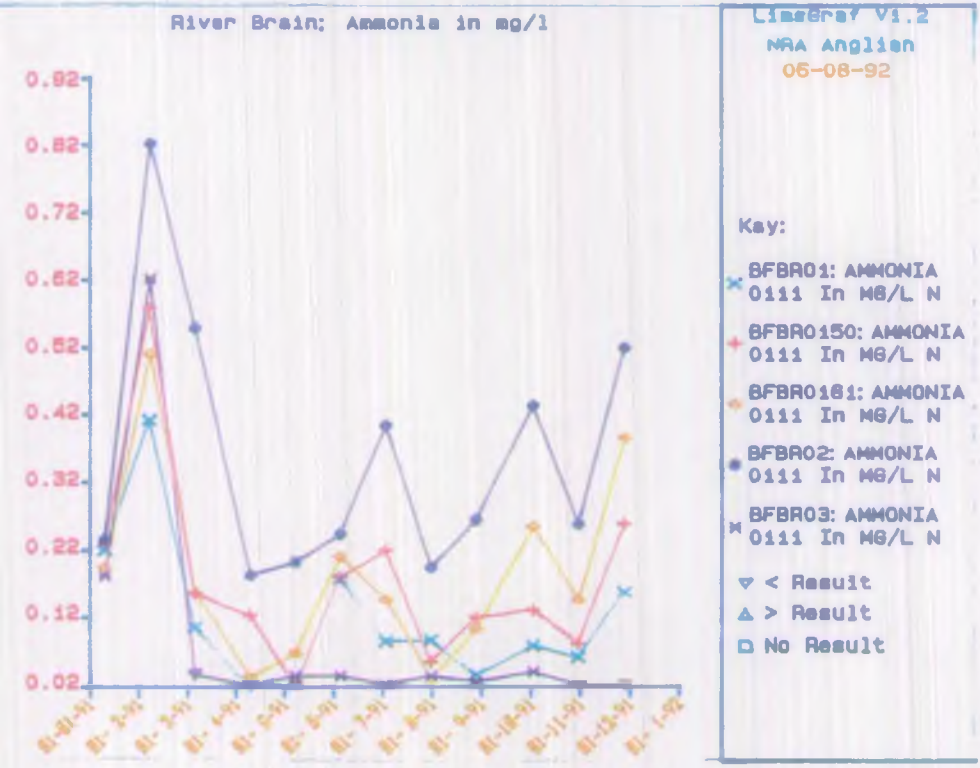
We have extensive software on the mainframe computer that calculates the compliance of effluents and rivers against standards. During 1991 we developed new compliance assessment software on the PC. The new software can take chemical results directly from LIMS. This approach yields compliance statistics faster than the mainframe software.

Throughout 1991 the Water Quality section was involved with WAMS (Water Archive Monitoring System). WAMS is a national project involved with bringing together all aspects of data storage and analysis within the NRA. Much work has been done in defining standards and system requirements.

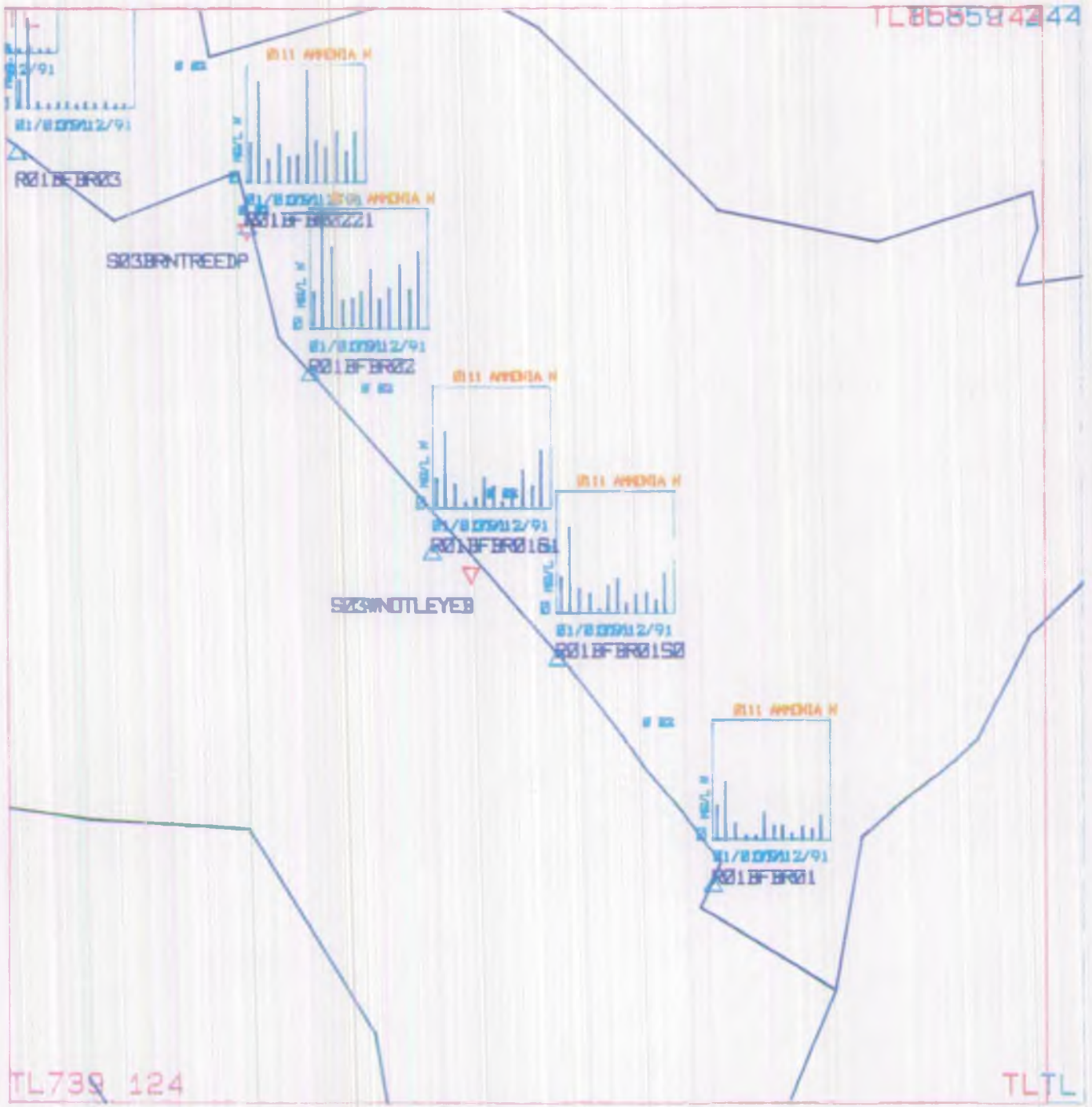
# FIGURE


R01BFBR01: Guithavon Flume
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
LimsBref V1.2
NRA Anglian
06-08-92
Key:
BFBR01: TEMP C
0076 In CEL
BFBR01: D.O
0082 In MG/L O
BFBR01: BOD+ATU
0085 In MG/L O
< Result
> Result
No Result

9.1


River Brain: Ammonia in mg/l
LimsGraf V1.2
NRA Anglian
06-08-92
0.92
0.82
0.72
0.62
0.52
0.42
0.32
0.22
0.12
0.02
Key:
BFBR01: AMMONIA 0111 In MG/L N
BFBR0150: AMMONIA 0111 In MG/L N
BFBR0161: AMMONIA 0111 In MG/L N
BFBR02: AMMONIA 0111 In MG/L N
BFBR03: AMMONIA 0111 In MG/L N
< Result
> Result
No Result

# FIGURE 9.2




EasyMap

NRA Anglian

R.Brain, Essex
Ammonia, mg/l
1991

Date: 06-08-92
Time: 15: 41
Scale=1: 67857

Sampling Key
- Freshwater
- Saline Water
- Sediment
- Groundwater
- Biology
- AWS
- Non-AWS

No. of Sites=9

EasyMap Version
V: 1.3, Apr.1992

## Appendix I: Biological Sampling 1991

| Sample Category | |
|---|---|
| 1. Freshwater - Rivers | |
| a. Macroinvertebrates | |
| Routine | 3656 |
| Pollution | 292 |
| Special investigation | 143 |
| Others | 7 |
| Quantitative | 148 |
| b. Macrophytes | 161 |
| c. Microbes | 967 |
| d. Phytoplankton | 108 |
| e. Zooplankton | 81 |
| f. Others | 18 |
| Blue-green Algae | 10 |
| 2. Freshwater - Lakes | |
| a. Macroinvertebrates | 1169 |
| b. Macrophytes | 78 |
| c. Microbes | 25 |
| d. Phytoplankton | 1142 |
| e. Zooplankton | 851 |
| f. Others | 2503 |
| Blue-green Algae | 43 |
| 3. Estuary and Coastal waters | |
| a. Macroinvertebrates | |
| Intertidal | 676 |
| Subtidal | 813 |
| b. Intertidal algae | 19 |
| c. Microbes | 2113 |
| d. Phytoplankton | 94 |
| e. Zooplankton | 60 |
| f. Beam trawl | 14 |
| g. Other | 32 |
| 4. Borehole | |
| a. Microbes | 4 |

## Appendix II: Prosecutions brought to Court

| Incident | Hearing | Defendant | Fine (£) | Costs |
|---|---|---|---|---|
| Oil;<br>Yaxley Watercourse<br>Yaxley | 1.2.91 | R Humphrey | 800 | 600 |
| Pig Slurry;<br>Paunch Beck<br>Waddingham, Lincs. | 23.1.91 | Ermine Farms Ltd | Not Guilty | |
| Benzene Discharge;<br>River (R) Humber | 18.1.91 | Simons Storage | Case Dismissed | |
| Silage Effluent;<br>Panton &<br>Stainfield Becks<br>Lincoln | 8.2.91 | A Parsonson | 500 | 250 |
| Trade Effluent;<br>R Nene<br>Wellingborough | 6.2.91 | Chettles Ltd | 1000 | 696 |
| Fish Waste;<br>Tributary (Trib) of<br>R Tiffey | 19.3.91 | Gateway Foodmarket Ltd | 1200 | 846 |
| Trade Effluent;<br>R Wensum<br>Great Witchingham | 19.3.91 | Bernard Matthews Foods Ltd | 2000<br>2000<br>2000 | 3374 |
| Sewage Effluent;<br>Fritwell STW | 25.3.91 | Anglian Water Services Ltd | 1750 | 559 |
| Piggery Effluent;<br>Swilland | 25.2.91 | P P Ford | 100 | 480 |
| Cider Waste;<br>Trib of R Thet | 19.3.91 | W M Gaymer & Sons Ltd | 1000 | 986 |
| Piggery Effluent;<br>Badingham | 15.4.91 | D Simper | 500 | 1000 |
| Pollution of Trib<br>of Stone Brook; | 29.4.91 | Lorien Laboratories | 1500<br>1500 | 868 |
| Trade Effluent;<br>R Nene | 30.4.91 | Nene Fruit & Vegetable Ltd | 1000 | 610 |

Appendix II: Prosecutions brought to Court - continued

| Incident | Hearing | Defendant | Fine (£) | Costs |
|---|---|---|---|---|
| Trade Effluent; | 4.4.91 | Frigoscandia Ltd | 500 | 750 |
| Pollution of Somers Brook; Trib of R Stour | 7.5.91 | Stoke By Nayland Golf Club | 200 | 60 |
| Trade Effluent; Green End Brook Great Barford | 4.6.91 | Barfordian Coaches Ltd | 400 | 600 |
| Trade Effluent; Puny Drain Setchey | 18.6.91 | J Rudd & Son Willow Bend | 300 | 344 |
| Trade Effluent; Cemetry Drain Spalding | 28.6.91 | Christian Salvesen | 400 | 835 |
| Sewage Effluent; Rudham Stream East Rudham | 2.7.91 | Anglian Water Services Ltd | 1500 | 620 |
| Trade Effluent; R Nene Dog-in-a-Doublet | 5.7.91 | McCain Foods Ltd | 2000 | 300 |
| Effluent to R Can; Chelmsford | 15.7.91 | R J Matthews & Sons | 500 | 755 |
| Pollution of Brome Stream; Eye, Suffolk | 17.7.91 | Camstar Herbal Products Ltd | 500<br>750<br>1000 | 598 |
| Poultry Effluent; R Little Ouse Redgrave | 19.7.91 | A E Button & Sons | 500 | 796 |
| Sewage Effluent; R Blackwater Hatfield Peverel | 23.7.91 | Wickham Bishops Nursing Home Ltd | 2500 | 500 |
| Sewage Effluent; Spicketts Brook Great Totham | 23.7.91 | Anglian Water Services Ltd | 1000 | 500 |

Appendix II: Prosecutions brought to Court - continued

| Incident | Hearing | Defendant | Fine (£) | Costs |
|---|---|---|---|---|
| Trade Effluent; Exeter Drain Spalding | 26.7.91 | Turners Turkeys Ltd | 4000 | 554 |
| Dairy Slurry; R Oxwell Brook Ingatestone | 1.8.91 | Miss Moody Radley Green Farm | 2000 | 874 |
| Effluent into Stambridge Brook; Great Stambridge | 6.8.91 | Mr Hume, Royal Oak Public House | 250 | 430 |
| Effluent into Trib of Mar Dyke; Cranham, Essex | 7.8.91 | Palmers Wholesale Butchers | 1000 | 889 |
| Trade Effluent; Trib of R Linnet | 9.8.91 | Britag Industries Chedburgh, Suffolk | 3000 | 845 |
| Effluent to R Flit; Shefford, Bedfordshire | 19.8.91 | Beadlow Golf & Country Club | 500<br>1000<br>1500 | 667 |
| Trade Effluent; Trib of Cranbrook Drain | 19.8.91 | Hensby Composts Ltd | 4000 | 1161 |
| Trade Effluent; Ampthill | 20.8.91 | Buildform Ltd | 10<br>10<br>10 | 450 |
| Oil; R Tud Costessey | 19.9.91 | Fincham Demolition | 400 | 300 |
| Piggery Waste; Ransormore Drain Duddington | 24.9.91 | Coneywood Piggeries | 2000 | 324 |
| Sewage Effluent; Fen Lane Drain Marham | 3.10.91 | S S Mondair (Plumtree Mobile Park) | Not Guilty | |

Appendix II: Prosecutions brought to Court - continued

| Incident | Hearing | Defendant | Fine (£) | Costs |
|---|---|---|---|---|
| Poultry Effluent;<br>Trib of R Thet<br>Carleton Rode | 8.10.91 | Penwood Country<br>Chickens Ltd | 7000<br>3000 | 962 |
| Trade Effluent;<br>Barrowby Beck/Stream | 21.10.91 | Jo Treasure Ltd<br>Harlaxton | 1000<br>1000 | 700 |
| Trade Effluent;<br>Clipstone Brook &<br>R Ouzel | 30.10.91 | Leighton Finishers<br>Ltd | 12000 | 1161 |
| Sewage Effluent;<br>R Crouch Estuary<br>Wickford | 25.11.91 | Anglian Water<br>Services Ltd<br>Wickford STW | 1500<br>1500 | 901 |
| Trade Effluent;<br>Buckenham Stream<br>Fettlebridge | 3.12.91 | Fettlebridge Co Ltd | 500 | 244 |
| Sewage Effluent;<br>Trib of R Thet<br>Burns Bank | 3.12.91 | Banham Poultry<br>Produce Ltd | 5000 | 212 |
| Trade Effluent;<br>Trib of R Sapiston<br>Elmswell | 4.12.91 | Farm Kitchen Foods<br>Ltd | 2000<br>2000 | 854 |
| Oil;<br>Parkeston Quay<br>Harwich | 10.12.91 | Sealink Stena Line<br>Ltd | Conditional<br>Discharge | |
| Oil & Grease;<br>Nar Valley Drain<br>Setchey | 12.12.91 | Kier Construction<br>Ltd | 500 | 510 |

## Appendix III: Formal Cautions Issued

| Incident | Defendant | Date Issued |
|---|---|---|
| Piggery Effluent; Stream at Southolt | Z Munter Farms Ltd | 11.9.91 |
| Oil; R Orwell | A W Cowley | 20.11.91 |
| Effluent; | Z Munter Farms Ltd | 4.12.91 |

## GLOSSARY

| | |
|---|---|
| *ASPT* | *Average Score Per Taxon. This is calculated by dividing the biological score (BMWP score) (ibid) by the total number of macroinvertebrate families in the sample.* |
| *Aquifer* | *Layers of underground porous rock which contain water and allow water to flow through them.* |
| *Analytical Quality Control* | *Systems which monitor and control the precision, accuracy and comparability of results.* |
| *Blue-Green Algae* | *Ubiquitous, usually microscopic plankton that can form dense, floating scums in stillwaters during calm weather. Strictly speaking, they are not algae, but* Cyanobacteria. |
| *BMWP* | *An index of biological quality devised for the 1980 National River Quality Survey. The score increases with increasing water quality.* |
| *BOD and BOD(ATU)* | *Biochemical Oxygen Demand. A measure of the amount of oxygen consumed in water, usually by organic pollution. Oxygen is vital for life so the measurement of the BOD tests whether pollution could affect aquatic animal. The value can be misleading because much more oxygen is taken up by ammonia in the test than in the natural water. This effect is suppressed by adding a chemical (Allyl Thio-Urea) to the sample of water taken for testing. Hence BOD(ATU).* |
| *Cadmium* | *A very toxic heavy metal with a wide variety of uses.* |
| *Carbon tetrachloride* | *An organic solvent commonly used as a dry-cleaning agent.* |
| *Chloroform* | *An organic solvent commonly used throughout industry.* |
| *Coliforms* | *Bacteria found in the intestines and faeces of most animals. Their presence in-* |

| | |
|---|---|
| | *dicates faecal pollution by humans or animals.* |
| *Controlled Waters* | *All rivers, lakes, groundwaters, estuaries and coastal waters.* |
| *COPA (Pt II)* | *Part II of The Control of Pollution Act, 1974. Part II is the section dealing mainly with water.* |
| *COSHH* | *Regulations concerning the Control of Substances Hazardous to Health.* |
| *Cyprinid Fish* | *Coarse fish like roach, dace and bream.* |
| *DDT* | *An acronym for Dichloro-diphenyl-tetrachloroethane. This is a persistent organochlorine pesticide no longer approved for use in the United Kingdom.* |
| *Determinand* | *A general name for a characteristic or aspect of water quality. Usually a feature which can be described numerically as a result of scientific measurement.* |
| *Direct Data Capture* | *The collection of analytical results from laboratory instruments, by linking the instruments directly to a data storage system - usually a microcomputer.* |
| *Dissolving Zinc Anode* | *A zinc block found on boats. It is designed to dissolve and prevent corrosion of other metal fittings on the boat.* |
| *Drins* | *The abbreviated name for a group of persistent Organophosphorous insecticides, including Aldrin, Dieldrin and Isodrin.* |
| *Ecological Quality Index* | *This describes how close biological quality is to expectations. An index of 1.0 indicates that the animals are unaffected by adverse conditions.* |
| *Environmental Quality Objective* | *A Use or target for a Controlled Water, which the NRA will aim to maintain or secure, e.g. a coarse fishery.* |
| *Environmental Impact Assessment* | *A procedure by which a developer describes the effect of his proposals on the Environment. The purpose is to provide information to the public and to decision* |

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| | *taking bodies. For big projects the procedure is controlled by an EC Directive.* |
| *Ethyl Acrylate* | *A volatile organic chemical used in the manufacture of plastics.* |
| *Eutrophication* | *The process of nutrient enrichment of surface waters; often the cause of unsightly growths of microscopic plants (algae).* |
| *Faecal Coliforms* | *Usually taken to be synonymous with Escherichia coli (E.coli). These are coliform (ibid) bacteria characteristic of faecal pollution of mammalian origin. These bacteria are relatively harmless but their absence indicates the absence of harmful micro-organisms.* |
| *Groundwater* | *Underground water especially in or from aquifers (ibid).* |
| *Harmonised Monitoring Site* | *A site agreed with the DoE under the Harmonised Monitoring Scheme devised in 1974. The sites are used to assess input loads from rivers to estuaries and identify long term trends.* |
| *Hexachlorobenzene* | *A fungicide commonly used for treating cereal crops.* |
| *Hexachlorobutadiene* | *An intermediary compound commonly used in the plastics industry, particularly in Europe.* |
| *Invertebrates* | *A general term for all animals without backbones,ie. all groups except the vertebrates.* |
| *Legal Consent* | *The legal permission to make a controlled discharge of any effluent or other matter. Consents are issued under the Water Act (1989).* |
| *Lindane* | *An organochlorine insecticide (1,2,3,4,5,6-hexachlorocyclohexane, also known as Gamma-HCH).* |
| *LIMS* | *Laboratory Information Management System. This is based on micro-computers and generates schedules for sampling and analysis, captures data from instruments,* |

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| | *and evaluates and archives the results.* |
| *Look-up Table* | *The numbers of permitted failures in a set of samples is laid down in a Look-up Table, which is referred to in the Legal Consent (ibid).* |
| *Mercury* | *A very toxic heavy metal with a wide variety of uses.* |
| *Microcystin-LR* | *The most commonly occurring toxin in blue-green algal blooms. It is produced by a number of blue-green algae.* |
| *Multiple Regression* | *A mathematical technique for identifying an association between sets of data, for example, river flow and river quality.* |
| *NAA* | *Nitrate Advisory Area. An area where nitrate concentrations in drinking water sources exceed or are at risk of exceeding the EC Drinking Water Directive limit. Free advice is offered to farmers on how to modify current agricultural practice to reduce nitrate leaching to controlled waters.* |
| *NSA* | *Nitrate Sensitive Area. An area where nitrate concentrations in drinking water sources exceed or are at risk of exceeding the EC Drinking Water Directive limit. Payments are name to farmers who voluntarily restrict agricultural practices to reduce nitrate leaching to controlled waters.* |
| *NWC Class* | *A summary of the quality of river based largely on the measured chemical quality. Used by the Government to report on river quality. Originally devised through the National Water Council.* |
| *PCB* | *Polychlorinated Biphenyls. These substances were widely used in the manufacture of electrical insulators.* |
| *Pentachlorophenol* | *An organochlorine fungicide, used primarily for timber preservation.* |
| *POLLEASE* | *A computer-based system for recording pollution incidents* |

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| *Property Services Agency* | *The organisation that administers and maintains Crown Property.* |
| *River-Needs Consent* | *The quality standard required of an effluent in order to achieve Water Quality Objectives (ibid), usually calculated for some estimate of the future flow from a treatment works.* |
| *River Quality Indices* | *A management tool for summarising data used to ensure the sampling programme is achieved, to set management targets, and to alert management to strategic problems of water quality.* |
| *River Quality Objective* | *See Environmental Quality Objective.* |
| *Salmonid Fish* | *Game fish, e.g. trout and salmon.* |
| *Surface Water* | *Rivers, canals, lakes or impoundments.* |
| *Taxon* | *A specific group of macroinvertebrates (a family)* |
| *Tetrachloroethylene* | *A chlorinated organic solvent commonly used as a dry-cleaning agent.* |
| *Time-Limited Consent* | *Legal Consent conditions for the sewage treatment works owned by the Utility, which apply for a limited period of time and only to works where provision has been made for improving the quality of the effluent by capital investment.* |
| *Trichlorobenzene* | *A chlorinated organic solvent.* |
| *Trichloroethylene* | *A chlorinated organic solvent used as a dry-cleaning agent.* |
| *Water Act Register* | *Formerly the COPA Register (see Part 5).* |
| *1-2 dichloroethane* | *A chlorinated solvent used as a degreasing agent.* |
| *95-percentile Standard* | *A level of water quality, usually a concentration, which may be exceeded for 5-percent of the time. Many water quality standards are expressed as 95-percentiles.* |
| *1990 River Quality Survey* | *The national survey of the quality of rivers, canals, lakes and estuaries which was carried out by the NRA in 1990.* |