NRA-Water Quality Series 4

THE QUALITY OF RIVERS, CANALS AND ESTUARIES IN ENGLAND AND WALES

Report of the 1990 Survey

NRA
National Rivers Authority

December 1991

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PREFACE

It is essential for the National Rivers Authority (NRA) to have an up-to-date overview of the quality of the rivers, canals and estuaries in England and Wales. The last national survey was undertaken in 1985 and a further one was due in 1990, just a few months after the NRA was set up in September 1989. The purpose of the survey was to assess the current quality of rivers, canals and estuaries in order to evaluate the extent to which water quality had changed over the previous five years, and to provide a basis for future planning and development. The latter is particularly important, in view of the NRA's role in advising the Secretaries of State on the setting of objectives for future water quality.

It is equally essential for the NRA to have methods of assessing water quality which are as accurate and precise as possible. The 1990 Survey was conducted in a similar manner to that of 1985 in order to minimise differences in assessment which were due to methodology. In the light of the many staff and organisational changes which had occurred since 1985, this has been largely successful. It was previously acknowledged, however, that the methodology was in need of a considerable revision. The opportunity was therefore taken during the 1990 Survey to obtain additional data and assess different approaches to classifying rivers. Such information is not included in this report, but will be used in further evaluations with a view to setting Statutory Water Quality Objectives, following public consultation later this year.

Notwithstanding differences in methodology however, the Report makes it clear that, whilst in many areas the net change in water quality has been small, there has been a real and significant deterioration in the quality of some rivers in recent years. This has been partly exacerbated by the lack of rainfall in some parts of the country, but it has also been due to excessive polluting inputs. This is a trend which must be reversed and the NRA will use all of its powers to ensure that it is reversed.

DR R J PENTREATH
Chief Scientist

ACKNOWLEDGEMENTS

The 1990 Survey of water quality in England and Wales involved the combined efforts of a large number of staff throughout the 10 Regions of the National Rivers Authority. The contributions of all those who took part in the planning of the Survey, the taking of samples, the laboratory analyses and the handling, interpretation and presentation of the data are gratefully acknowledged. Special thanks are due to the members of the Water Quality Survey Group, chaired by Dr John Stoner, who carried out the planning for the Survey, and to the members of the working group who co-ordinated the Survey in each of the NRA regions and contributed to the writing of this report. The members of this working group were:

Tony Warn (Chairman)	Anglian Region
Barrie Harbott	Anglian Region
Malcolm Helm	Northumbria Region
Clive Gaskel	North West Region
Peter Whalley	Severn Trent Region
Bob Edmunds	Southern Region
Martin Jerome	Southern Region
Rosanne Broome	South West Region
Tim Reeder	Thames Region
David Jowett	Thames Region
Colin Strange	Welsh Region
Peter McGillivray	Wessex Region
Colin Urquhart	Yorkshire Region.

Thanks are also due to Carolyn Ullmer and Paul Barraclough who managed the national database.

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1 SUMMARY

A major survey was carried out during 1990 by the National Rivers Authority to assess the quality of rivers, canals and estuaries in England and Wales. The previous survey of similar extent, in 1985, was co-ordinated by the Department of the Environment, Welsh Office and by the regional Water Authorities.

National Results

Using the classification systems introduced by the National Water Council (NWC), the 1990 Survey found that about 89% of rivers, 90% of canals, and 90% of estuaries were of either Good or Fair quality; and that about 2%, 1% and 3% respectively were of Bad quality.

A large number of changes in quality class of individual stretches of water were recorded compared with 1985. About 15% of the total river length was downgraded, about 11% upgraded. Comparable changes for canals were 15% and 7%, and for estuaries, 3% and 1%. For rivers, canals and estuaries, most of the decline was in the best quality waters.

Margins of Error

The large number of apparent changes in class to individual stretches can be attributed, in part, to the influence of 'chance' on sampling. Using conventional sampling procedures, there is a probability of 20% to 30% that an individual stretch of water may be declared to have changed class, when in fact the actual quality may not have changed at all; however, the influence of sampling error on the overall result for England and Wales is substantially reduced by the averaging of data for thousands of sites.

Overall the estimated net downgrading in class of rivers since 1985 is 3.6% of length. There is, however, some uncertainty in this estimate. The methods used are not reliably accurate. Moreover there are historic, regional differences in the way that the classification system has been interpreted and applied. Taking this into account, the actual net class downgrading is estimated to lie within the range 2.1% to 4.3%.

Regional Variations

There are marked regional differences in trends. For 8 out of 10 Regions, the percentage net changes are small. The Southern, Welsh, Severn Trent and Wessex Regions show small net improvements in river water quality since 1985; Anglian, Northumbria, North West and Yorkshire show small net deteriorations.

However, the national results were heavily influenced by the unusually large net deteriorations recorded for Thames and South West. Data obtained on rivers in the Thames basin, and in Devon and Cornwall, were responsible for most of the river length reported to have deteriorated. It is estimated that over half the changes in class reported by Thames Region have arisen because of increased monitoring; thus many of the reported deteriorations could have occurred before 1985. Had the South

West Region followed the procedures used in some Regions, the proportions of river lengths in each class would have been different. In both Regions, therefore, an important part of the apparent deterioration may be due to changes in survey methods rather than to real changes in water quality.

Three Regions - Southern, Thames and Welsh - also recorded net improvements in the quality of canals. No Region reported any appreciable net improvement in the quality of estuaries.

Reasons for Change

The net overall downgrading is mostly explained by three factors. First, changes in methodology, particularly the increased monitoring effort in some Regions. This provided more accurate information on water quality than was available in 1985. The two other factors - both of which caused real changes in water quality - are the effect of two hot, dry summers and discharges from sewage works, industry and farms. It is estimated that these three factors - improved monitoring, the weather and discharges - contributed in approximately equal proportions to the net assessment of deterioration in water quality.

Where water quality improved this was either because of better treatment of waste waters, or because industries closed down. Increased enforcement by the NRA may also have begun to have an impact on the efforts of dischargers to make sure that they comply with consents.

Conclusion

The vast majority of rivers, canals and estuaries in England and Wales are of Good or Fair quality. In much of the country the net overall changes have been slight but there have been substantial variations both within and between Regions. In two Regions there appears to have been marked deterioration; this is partly attributable to survey methods. It is essential to maintain the high quality areas whilst improving the others. Substantial improvements need to be made in the methods of assessment. Progress is needed too in tackling the real causes of poor water quality. Both aspects are being addressed. A separate NRA consultation paper (Water Quality Series No 5) outlines how objectives for river and estuarine water quality could be set on a statutory basis. The paper also describes how the traditional means of assessing river water quality, as used in the 1990 Survey, could be substantially improved by drawing upon information on the biological state of the river.

2 INTRODUCTION

When the NRA was formed in September 1989, one of its first tasks was to organise a survey of the quality of the rivers, canals and estuaries in England and Wales. Such surveys had previously been organised by the Department of the Environment/Welsh Office and undertaken by the Water Authorities. A five yearly pattern of surveys had developed; the last was undertaken in 1985 and thus the next was due in 1990. It was therefore very opportune for the NRA to conduct such a survey, both to continue the quinquennial series and to determine the state of such waters at the time the NRA was formed. It also provided the opportunity for the NRA to examine alternative ways of classifying such waters. This report, however, is restricted to an evaluation by the methods used in 1980 and 1985 in order to conclude that series of evaluations. The NRA's view on alternative objectives and methods for such surveys are discussed in a separate report (Water Quality Series No 5) within the context of its proposals for the introduction of Statutory Water Quality Objectives.

The NRA was formed from what were, briefly, the ten Rivers Units of the regional Water Authorities in England and Wales. The regional pattern has been retained by the NRA, apart from some minor adjustments; the ten NRA Regions are shown in Figure 1.

This report first describes the methods applied to classify the quality of rivers, canals and estuaries established by the National Water Council (NWC) in the late 1970s. Details of the methods are given in Appendix 1. For the purposes of comparison, as far as possible, the methods used in 1990 were the same as those applied in 1985. It is recognised that there are certain shortcomings with these methods, particularly with respect to how they have been applied to different parts of the country and the statistical basis for assigning quality classes. The statistical background to the assessment is covered in Appendix 2, and the shortcomings detailed in Appendix 3. The need for a new, less subjective, system which can be applied within the framework proposed for the introduction of Statutory Water Quality Objectives under the 1989 Water Act is also discussed.

The results of the 1990 Survey for rivers, canals and estuaries are thus summarised in the report and presented on the enclosed national map. Detailed water quality information is provided in Appendix 4. The results are compared with those of past surveys and the reasons for the observed changes discussed. The prospects for future improvements in water quality are briefly considered. Finally, summary reports on the findings of the 1990 Survey are provided for each of the 10 Regions of the NRA.

Figure 1: The NRA Regions

3 THE CLASSIFICATION SYSTEM

The quality of individual lengths of rivers, canals and estuaries is currently reported according to the classification schemes introduced by the former National Water Council (NWC). Stretches of river and canal are ranked in four categories from Good quality (Classes 1a and 1b), to Bad quality (Class 4). The classes are described in Table A1 in Appendix 1. Classes are broadly related to the potential use of the waters, especially in the support of fisheries.

The class for a particular stretch of fresh water is determined mainly by the data on concentrations of dissolved oxygen, biochemical oxygen demand (BOD) and ammonia obtained from the routine monitoring work conducted by the NRA. The limits of quality which define the classes are expressed as 95-percentiles - that is to say, the limits must be met for at least 95 percent of the time in order for the stretch to be placed in that class. Additionally, some Regions applied criteria derived from the European Inland Fisheries Advisory Commission (EIFAC). These use data for suspended solids, un-ionised ammonia, temperature, pH, cadmium, copper, chromium and zinc. Table A2 in Appendix 1 gives details of the NWC classification system.

For estuaries, the classification scheme ranks water from Good Quality (Class A) to Bad Quality (Class D). The system combines an assessment of the biological and aesthetic state of the water with the measurements of the minimum levels of dissolved oxygen. Table A3 in Appendix 1 gives details of the system.

The report of the 1985 Survey[1] recognised that the classification systems had been applied differently in different parts of England and Wales and that this made it difficult to compare regional data. Nonetheless, the NRA has attempted to repeat the procedures and practices of 1985 so that the results of 1990 could be compared with 1985. The regional differences noted for 1985 are thus also partly reflected in the results of the 1990 Survey.

The Survey for 1990 will be the last to use the NWC classifications. A new system is required to:

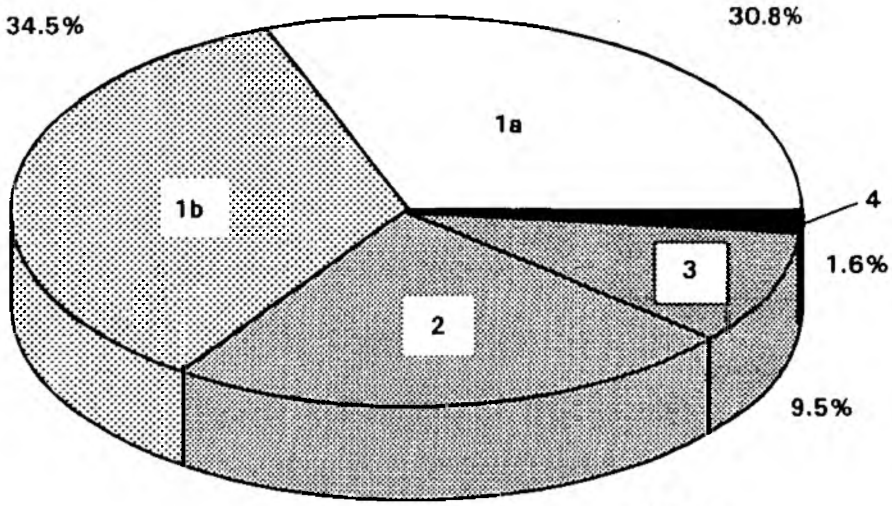
- provide a scheme which is suitable for Statutory Water Quality Objectives to be introduced under the 1989 Water Act;
- secure consistency throughout England and Wales; and
- minimise subjectivity.

The need for continuity will be addressed by applying both the old and new systems to the data collected in 1990. Thus this report has compared the results of 1990 with those of 1985 and 1980 using the NWC classifications. The results produced by the new system will be published next year, and future changes in water quality will be assessed against this new baseline.

4 MAIN RESULTS OF THE 1990 SURVEY

4.1 RIVERS

Figure 2: River Quality in England and Wales: 1990



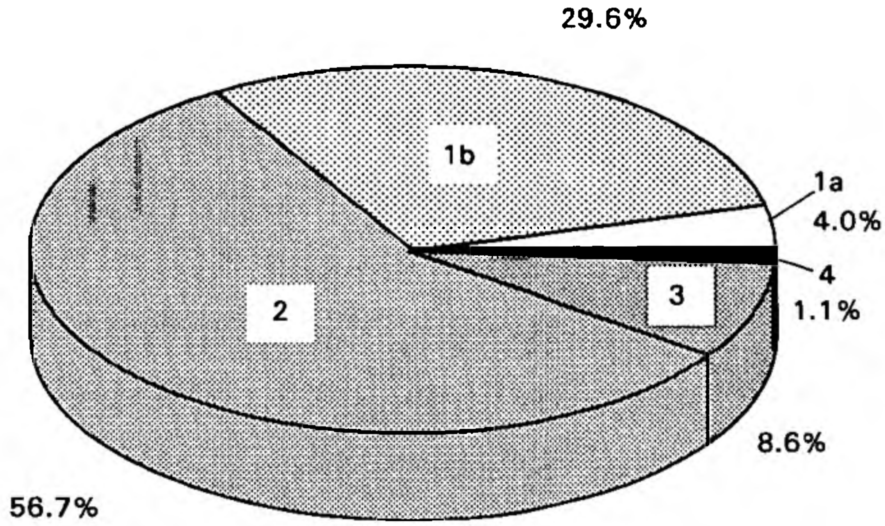
The summarised results of the 1990 Survey for England and Wales are shown in Figure 2. About 89% of total river length was found to be of Good or Fair quality, 10% was Poor and 2% was Bad. Table 1 shows how these results vary from Region to Region. Welsh and Northumbria Regions had the highest proportion of river length classed as Good quality, whereas North West and South West Regions had the highest proportions of Poor and Bad quality river length.

Table 1: River Quality in 1990 by NRA Region

Region	Percentage of River length in each class							Total (km)
	Good		Fair	Good & Fair	Poor	Bad	Poor & Bad	
	1a	1b	2	1a, 1b and 2	3	4	3 and 4	
Anglian	8	49	35	92	8	0.3	8	4328
Northumbria	60	26	11	97	3	0.2	3	2801
North West	45	14	20	79	16	5	21	5323
Severn-Trent	15	40	32	87	11	2	13	5721
Southern	23	47	22	92	7	1	8	2185
South West	17	35	30	82	17	1	18	3037
Thames	16	45	32	93	7	0.3	7	3530
Welsh	54	32	8	94	5	1	6	4647
Wessex	28	32	34	94	5	1	6	2622
Yorkshire	39	33	14	86	11	3	14	5767

4.2 CANALS

Figure 3: Canal Quality in England and Wales: 1990



CANALS
(2474 km)

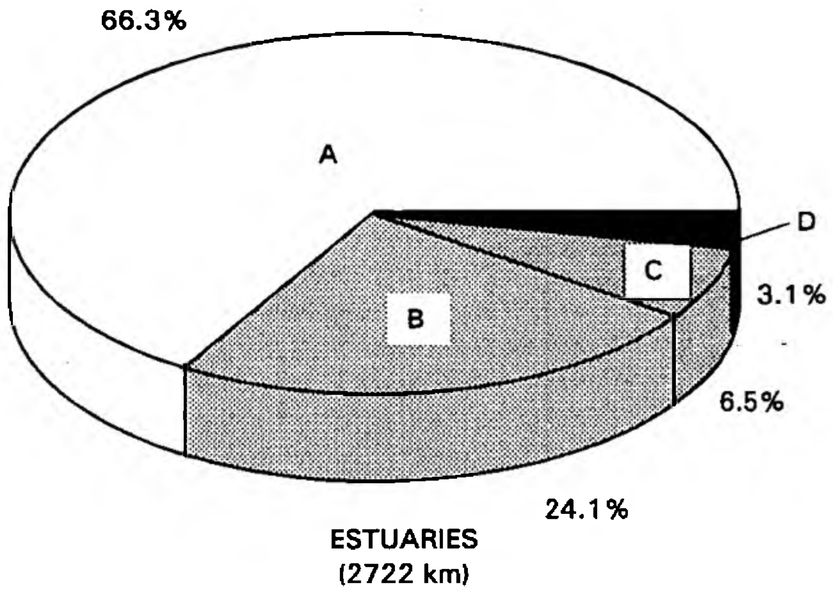
Figure 3 presents the results of the Survey for canals. Some 90% of total canal length was of Good or Fair quality, 9% was Poor and 1% was classified as Bad. Table 2 gives the results for each NRA Region. The highest proportions of canal length classed as Good were in the Thames and Wessex Regions. Yorkshire and South West Regions had the highest percentages of Poor and Bad quality canal length.

Table 2: Canal Quality in 1990 by NRA Region

Region	Percentage of Canal length in each class							Total (km)
	Good		Fair	Good & Fair	Poor	Bad	Poor & Bad	
	1a	1b	2	1a, 1b and 2	3	4	3 and 4	
Anglia	0	40	60	100	0	0	0	125
Northumbria	--	--	--	no canals	--	--	--	---
North West	5	12	79	96	4	0	4	577
Severn-Trent	2	32	59	94	6	0	6	990
Southern	0	26	74	100	0	0	0	41
South West	0	0	10	10	28	62	90	29
Thames	18	43	35	96	4	0	4	210
Welsh	0	37	45	83	17	0	17	152
Wessex	12	62	26	100	0	0	0	82
Yorkshire	1	31	32	64	32	4	36	268

4.3 ESTUARIES

Figure 4: Quality of Estuaries in England and Wales: 1990



The summarised results on the quality of estuaries in England and Wales are given in Figure 4. About 90% of estuary length was of Good or Fair quality, 7% was Poor and 3% was Bad. Table 3 gives the results across the Regions. South West and Anglian Regions had the highest proportions of Good quality estuary length whereas Yorkshire and North West had the highest percentages of estuary length classified as Poor and Bad.

Table 3: Quality of Estuaries in 1990 by NRA Region

Region	Percentage of Estuary length in each class						Total (km)
	Good	Fair	Good & Fair	Poor	Bad	Poor & Bad	
	A	B	A and B	C	D	C and D	
Anglian	79	14	93	7	0.4	7	514
Northumbria	34	38	73	17	10	27	135
North West	49	23	72	13	15	28	452
Severn-Trent	14	61	75	25	0	25	56
Southern	75	21	96	4	0	4	388
South West	92	8	100	0	0	0	350
Thames	45	55	100	0	0	0	112
Welsh	78	20	98	2	0	2	420
Wessex	45	51	96	4	0	4	120
Yorkshire	12	43	55	45	0	45	40
Shared estuaries:							
Humber	43	57	100	0	0	0	65
Severn	61	39	100	0	0	0	71

5 CHANGES SINCE PREVIOUS SURVEYS

The results of surveys from 1958 to 1990 are summarised in Table 4. It is not possible to compare the results from all years directly, because the classification systems were changed in 1980. However, there was a trend for a small but steady improvement in water quality from 1958 through to 1980, but since 1980 this trend has not continued.

Table 4: Water Quality in England and Wales: 1958 - 1990

Former Classifications 1958 - 1980 Surveys

NON TIDAL RIVERS AND CANALS

Class	1958		1970		1975		1980	
	km	%	km	%	km	%	km	%
Unpolluted	24950	72	28500	74	28810	75	28810	75
Doubtful	5220	15	6270	17	6730	17	7110	18
Poor	2270	7	1940	5	1770	5	2000	5
Grossly Polluted	2250	6	1700	4	1270	3	810	2
Total	34690		38400		38590		38740	

New Classification 1980 - 1990 Surveys

FRESHWATER RIVERS AND CANALS

Class	1980*		1985		1990	
	km	%	km	%	km	%
Good 1a	13830	34	13470	33	12408	29
Good 1b	14220	35	13990	34	14536	34
Fair 2	8670	21	9730	24	10750	25
Poor 3	3260	8	3560	9	4022	9
Bad 4	640	2	650	2	662	2
X	-	-	-	-	39	-
Unclass.	-	-	-	-	17	-
Total	40630		41390		42434	

TIDAL RIVERS

Class	1958		1970		1975		1980	
	km	%	km	%	km	%	km	%
Unpolluted	1160	41	1380	48	1360	48	1410	50
Doubtful	940	32	680	23	780	27	950	34
Poor	400	14	490	17	420	15	220	8
Grossly Polluted	360	13	340	12	280	10	220	8
Total	2850		2880		2850		2800	

ESTUARIES

Class	1980*		1985		1990	
	km	%	km	%	km	%
Good A	1870	68	1860	68	1805	66
Fair B	620	23	650	24	655	24
Poor C	140	5	130	5	178	7
Bad D	110	4	90	3	84	3
Total	2730		2730		2722	

* As revised in 1985[1]

All figures, except those for 1990, are from Table 6 in the 1985 Report[1]

Unclass. stands for Unclassified River

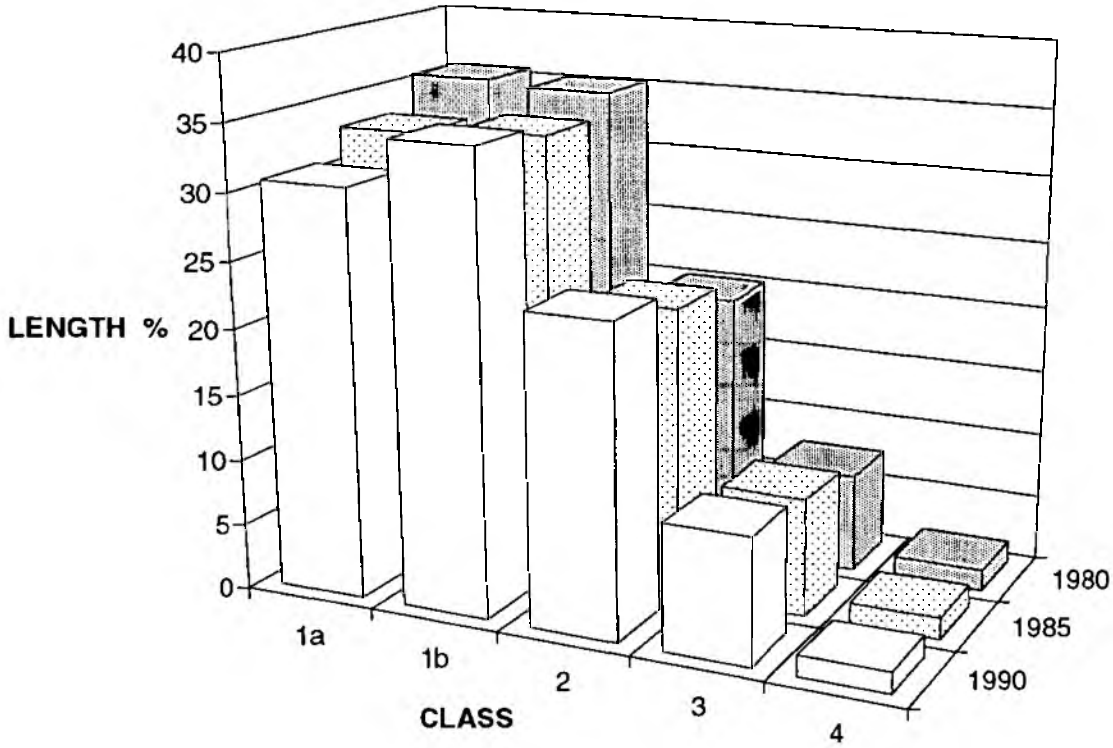
Table 5 gives information on total length of rivers, canals and estuaries which changed class between 1985 and 1990. In all cases, the lengths which were assigned a lower quality class exceeded those given a higher class, resulting in an overall net downgrading in class.

Table 5: Length of Rivers, Canals and Estuaries Assigned a Different Quality in 1990

Type of water	Length assigned a higher quality in 1990 from that in 1985 (km)	Length assigned a lower quality in 1990 from that in 1985 (km)
Rivers	4444	5886
Canals	179	371
Estuaries	18	83

5.1 RIVERS

Figure 5: River Quality in England and Wales: 1980 - 1990

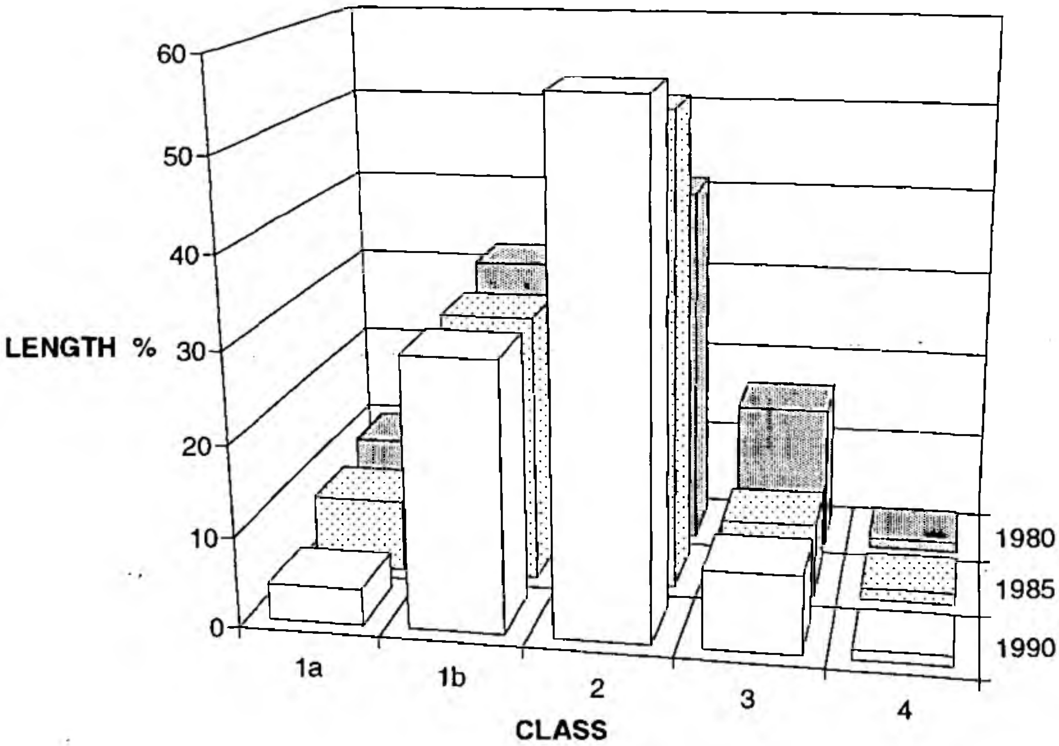


The percentage changes in river quality class from 1980 to 1990 are shown in Figure 5. Three surveys have been carried out throughout this period using essentially the same classification methodology; it is therefore possible to compare the results directly. Over this period there has been an overall decrease in the proportion of classified river length falling in the very best quality Class, 1a, and an increase in the percentage of Fair, or Class 2 river. In comparison with the 1985 results, the 1990 Survey has revealed a downgrading in class of 15% of the total river length in England and Wales whereas 11% has improved. The estimated net downgrading in class is 3.6%. Some 80% of this net downgrading is accounted for by changes in the Thames Region, which covers the Thames River Basin, and in the South West Region which covers Devon and Cornwall.

The report of the 1985 Survey[1] stated that 12% of river length was of higher quality in 1985 than it was in 1980 and 14% was of lower quality. This suggested a net deterioration of 2% from 1980 to 1985. This change was considered too small to be certain that it represented a real change in quality from 1980 to 1985. The results for 1990 suggest a decline of nearly 4% since 1985. This 4% in addition to the 2% decrease from 1980 to 1985 suggests that a real net deterioration in river quality has occurred over the last decade.

5.2 CANALS

Figure 6: Canal quality in England and Wales: 1980 - 1990



The percentage changes in quality class for canals over the period 1980 to 1990 are shown in Figure 6. The trends for canals are similar to those found for rivers: there has been a decrease in the proportion of canal length falling into the best quality Class, 1a, and an increase in the percentage of those classified as Fair. There has been a decrease in the proportion of Poor quality canal length, although most of this took place between 1980 and 1985 with little subsequent improvement to 1990.

Since 1985, 15% of canal length has been downgraded in class and 7% has been assigned a higher class. This suggests a net deterioration in quality of 8% of canal length throughout England and Wales.

5.3 ESTUARIES

Figure 7: Quality of Estuaries in England and Wales: 1980 - 1990

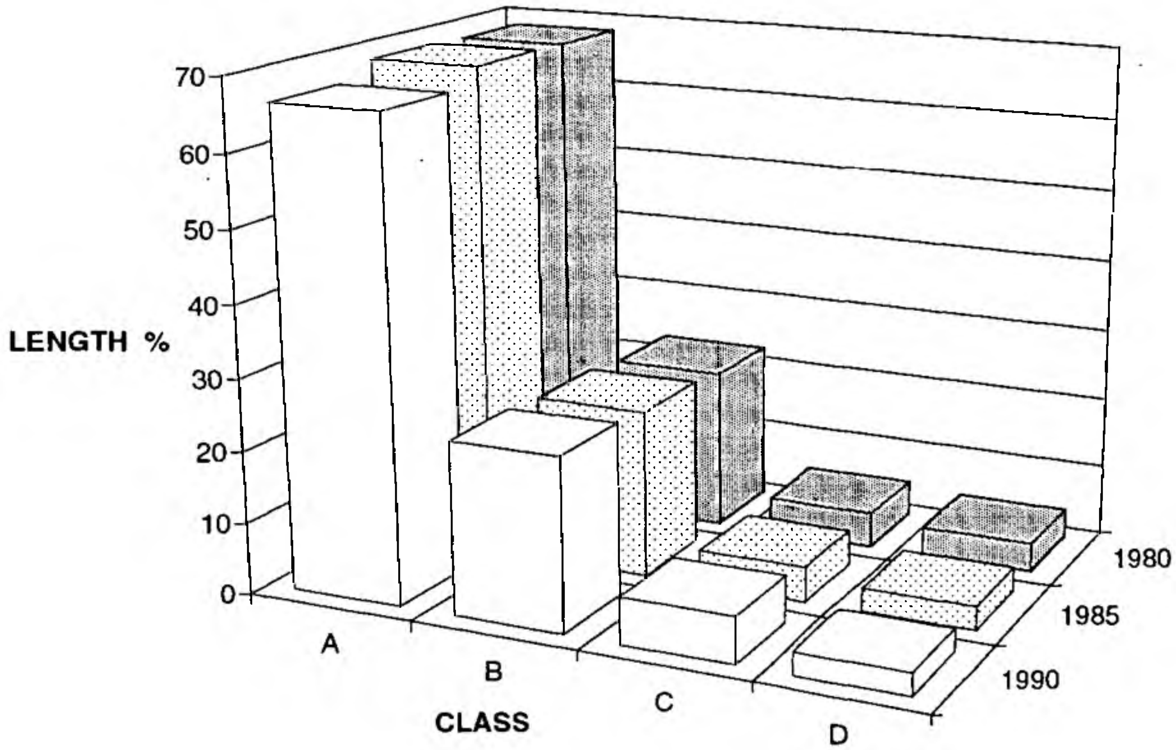


Figure 7 shows the percentage class changes in estuaries. Since 1985 there has been a decrease in the proportion of the best class estuary lengths. The overall downgrading in class between 1985 and 1990 was 3% and an upgrading of 1%. This suggests a net deterioration in class of estuaries of 2%.

6 REASONS FOR THE REPORTED CHANGES

6.1 REGIONAL DIFFERENCES IN THE APPLICATION OF THE CLASSIFICATION SYSTEM

As noted above, the classification systems have been applied differently in different parts of England and Wales. The NRA has tried to repeat all the procedures of 1985 so that the results for 1990 could be compared with 1985 and indicate trends. The scale of the Regional differences is indicated in Table 6.

Table 6: Percentages of River Length Changing Class: 1980 - 1990

Region	1980 to 1985			1985 to 1990		
	Up	Down	Net	Up	Down	Net
Anglian	21	13	+ 8	9	11	- 2
Northumbria	4	1	+ 3	2	5	- 3
North West*	4	12	- 8	7	11	- 4
Severn Trent	10	7	+ 3	10	9	+ 1
Southern	19	20	- 1	23	16	+ 7
South West	4	45	-41	18	40	-22
Thames	15	18	- 3	19	33	-14
Welsh*	22	21	+ 1	20	18	+ 2
Wessex	27	10	+17	4	3	+ 1
Yorkshire			+ 2	4	9	- 5
England & Wales	12	14	- 2	11	15	- 4

Figures for 1980 - 1985 are from the body of the 1985 Survey Report[1]

* Figures for 1980 - 1985 are for both rivers and canals

This gives a picture in which water quality appears stable in some parts of the country and volatile in others. The cause of the Regional differences is discussed below (in Paragraph 6.2) and in Appendix 3.

For Regions reporting a decline in quality from 1985 to 1990, South West and Thames stand out. If the results for South West are omitted, the net downgrading of rivers in the rest of England and Wales from 1985 to 1990 is reduced from 3.6% to about 2.1%. On the other hand, without the Region with the biggest improvements in water quality (Southern), the net decline for England and Wales rises to about 4.3%. This range in the net decline, 2.1% to 4.3%, can be viewed as an indication of the uncertainty surrounding the results of the 1990 Survey.

The data in Table 6 also suggest that the NRA has not succeeded completely in repeating exactly the procedures used in individual Regions in 1985. This is to be expected because the procedures require interpretation (see Table A2 in Appendix 1, for example) and the re-organisation of the Water Industry in 1989 led to widespread changes in staff.

In order to achieve harmony in future, the NRA proposes a new classification scheme which includes the use of biological information, and a uniform protocol for its application. Such a system is also required for the implementation of Statutory Water Quality Objectives. The need for continuity will be addressed by applying both the old and new systems to the data collected in 1990.

6.2 RANDOM CHANGES IN CLASS

Compared with 1985, 26% of river length appears to have a changed class (15% down and 11% up). Most of this can be explained by the operation of random chance through sampling. Appendix 2 explains that the classification procedure, if applied punctiliously, produces a probability of 20% to 30% that a site may be declared to have changed class when the true quality of the site has not changed at all. Part of the inconsistency between Regions is actually caused by attempts to control this error; the degree to which this was done explains why some Regions report large changes in river quality whilst others report a more stable position.

Some of the former Water Authorities used to seek confirmation that small apparent changes were real by looking at extra data. As a result:

- some sites which 'failed' a chemical standard because of a single bad analytical result at a place where river quality was good according to all the other indicators, such as biological data, were recorded as passes;
- some sites which 'complied' with all the chemical standards but had no fishery or poor biology were often downgraded; and
- some sites which failed (or passed) marginally after several years of compliance (or failure), but for which there was no obvious cause for the change, were not re-classified.

By using such methods, attempts were made to dampen out the effects of low precision in the estimates of percentiles.

Other Water Authorities preferred to adhere strictly to the classification scheme but took account of poor precision and other factors as part of the process of deciding whether or not there was a real need for action to restore water quality.

Although the potential error in reporting for a particular individual site may be as much as 20% to 30%, this introduces no significant error in the aggregated result of a net downgrading of 3.6% of river length throughout England and Wales. This is because the aggregate is the average of 6,000 sites. At this scale the effects of random chance on the average of all these results becomes minimal. As discussed above, the main source of uncertainty in the aggregated result lies in the differences between Regions and procedures.

6.3 MONITORING

In 1990 the NRA revised the monitoring programmes in several Regions as part of its drive to apply resources more evenly across the country. With the benefit of more monitoring, a more confident estimate of class has been possible for 1990. This has resulted in some reported changes of class which may have been caused before 1985. For example, it is estimated that over half the changes in class reported for Thames Region have arisen because of increased monitoring; thus many of the reported deteriorations could have occurred before 1985.

The results for Southern Region are affected by the fact that a number of stretches were classified on the basis of inadequate evidence in 1985. Without this factor, the results for Southern Region would not have shown an improvement and would have been similar to those in most other Regions.

6.4 CHANGES IN REPORTED LENGTHS

In 1985, 38,896 km of freshwater rivers were surveyed. This 1990 Report covers 39,960 km. Of the net increase, 250 km were for new lengths of river, mostly in Southern Region, which were included in the Survey for the first time. The balance is due to the better measurement of river lengths, mainly in Severn-Trent, Wessex, and South West Regions.

Since 1985, the net overall decline of river quality in England and Wales is 3.6% of river length. Of the extra 250 km of new river length, 100 km is excluded from the calculation because there are no data which can be used to assign class for 1985. The remaining 150 km has not affected the estimate of the net decline. Without the extra 750 km of re-assessed river length, the net downgrading would have been 4.1%.

The total length of canals classified was 24 km less than in 1985 and this had no significant effect on the comparison between 1985 and 1990. There were hardly any changes to the total length of estuaries reported.

6.5 THE WEATHER

Certain characteristics of water quality are affected by the weather. Many rivers had dense algal growths in the hot, dry summers of 1989 and 1990, and water quality subsequently deteriorated because of the increased oxygen demand from the plant material. On the other hand, the natural processes by which rivers cope with pollution take place more quickly when the weather is warm.

The dry weather caused a reduction in river flows and this provided less clean water to dilute discharges, producing higher concentrations of pollutants. Conversely, sewage treatment works perform better in warm, dry weather and the lower rainfall resulted in less contaminated run-off from farms and urban areas. There were also fewer discharges of storm sewage. Thus, in some places, rivers received less polluting discharges than in an average year.

The effect of the weather on water quality therefore varied from place to place according to the local balance of all of these effects. Overall, the effect was detrimental and, with more 'typical' weather, the net downgrading of 3.6% might have been closer to 2.5%.

6.6 INVESTMENT IN EFFLUENT TREATMENT

The Report on the 1985 Survey forecast a modest improvement in water quality for England and Wales during the period up to 1990. One reason that this did not occur was because of reduced expenditure on sewage treatment. In some Regions the impact of this was compounded by the effects of growth in population and an increase in the use of water. This produced pressure on water resources, bigger discharges, and more urban areas.

The 1990 Survey has occurred too soon to reflect the impact of the investment programmes of the new Water Services Companies.

6.7 ENFORCEMENT

One reason for some of the improvements reported in 1990 may well have been the result of tighter pollution control exercised by the NRA, but it will require future surveys to show the full impact of this.

6.8 RELATIVE INFLUENCE OF THE DIFFERENT CAUSES

As discussed above, the large number of apparent changes in class of individual stretches can be ascribed to statistical aspects of the classification system. The causes of the residual net downgrading include increased monitoring, which provided more accurate information on water quality which was not available for the assessments made in 1985. Other factors which caused a real change in water quality include the weather, and discharges of waste water from sewage works, industry and farms. In total, it is estimated that changes in monitoring and procedures, the weather, and discharges, contributed in roughly equal proportions to the net assessment of deterioration in water quality.

7 COMMENTS ON REGIONS

This section discusses the results of the 1990 Survey for individual Regions. It highlights river lengths where an important change has occurred and, where possible, gives the reasons for the change. Where no reason is given, the cause of the change is either unknown or may be ascribed to the effect of chance on sampling.

7.1 ANGLIAN

Changes since 1985

Some of the improvements which were forecast to take place between 1985 and 1990 have been achieved, but these are limited mainly to small stretches of rivers.

Freshwaters

Since 1985, 11% of classified river length has deteriorated, while 9% has improved. The net length of river downgraded is therefore 2% (81 km). There have been no changes in the classes of canals.

The causes of this class downgrading are various. Reduced levels of expenditure on sewage treatment works certainly increased effluent loads which in turn affected water quality. This was especially noted in the increased concentrations of ammonia observed. Sporadic discharges from storm overflows contributed to the downgrading of several stretches. A few downgradings were caused by particular incidents of pollution from industry or agriculture. The majority of deteriorations were changes from Classes 1a and 1b to 2. About one third of the significant downgradings were related to the drought and thus, without the drought, this Region might well have reported a small net improvement in river water quality.

The effects of tighter pollution control and increased surveillance are exemplified by the improvement of over 50 km of the River Waveney in 1988, following a campaign to reduce pollution from agriculture.

During 1989 and especially in 1990, improved effluent quality from sewage treatment works operated by Anglian Water resulted in over 120 km of river being upgraded. Some of the other reported improvements were due to the availability of better data.

The majority of improvements were changes from Classes 3 to 2 and from 2 to 1b. Examples include 15 km of the River Cam, which moved from 2 to 1b as a result of improvements in the quality of the discharge from the sewage treatment works at Saffron Walden, improvements to the sewage works serving Buckingham, which led to better water quality in 10 km of river, and better facilities at Mablethorpe Sewage Treatment Works, which resulted in a changed class for the Wold Grift Drain in Lincolnshire.

Estuaries

The main change since 1985 has been the downgrading of the Nene estuary from Class A in 1985, to Class B in 1986, and to Class C in 1987. Low levels of dissolved oxygen and limited biological life are found over a substantial length of the estuary during summer. This is related to increased discharges of effluent, the effects of which were detected by increased monitoring.

Part of the Stour estuary was regraded from Class A to Class B because of lowered oxygen concentrations due to effluent discharges in and around Harwich Harbour. Part of the Orwell estuary remains in Class D.

Prospects

In 1985 a modest improvement in river water quality was forecast for 1990. This has not occurred because of reduced levels of investment in sewage treatment, rapid population growth and, more recently, low river flows. By the end of 1992, investment programmes at over 200 sewage treatment works are expected to have been completed by Anglian Water, this will improve the quality of a number of rivers.

The implementation of the Farm Waste Regulations which came into force on 1st September 1991, and set standards for farm waste storage facilities, is also expected over the next few years to reduce the adverse effects on river quality caused by the release of farm wastes from these sources in the Anglian Region.

7.2 NORTHUMBRIA

Changes since 1985

Most of the improvements which were forecast to take place between 1985 and 1990 have been observed, but these were offset by downgradings elsewhere.

Freshwaters

Since 1985, 5% of the classified river length has deteriorated, while 2% has improved. The net downgraded river length is therefore about 3% (85 km). Most of the change was in losses of Class 1a to Class 1b and from Class 1b to Class 2.

The River Leven has been downgraded from Class 1a to Class 1b over 18 km in its lower reaches, probably as a result of the influence of farming on water quality. About 12 km of the Baydale Beck, a small tributary of the River Tees, has been downgraded from Class 1a to Class 2. The stream flows though an area which is intensively farmed and has been subject to the effects of run-off and intermittent discharges of farm effluents. About 8 km of the Ouse Burn, which is affected by urban run-off, has been downgraded from Class 2 to Class 3. An 8 km stretch of the River Wear in the area of Bishop Auckland has been downgraded from Class 1a to

1b. The classifications assigned in 1985 to these stretches were based on limited data and may have been optimistic.

Five stretches below sewage treatment works (totalling 4 km), have deteriorated from Class 3 to Class 4.

Several improvements occurred because industrial plants have closed. Others have been caused by the abandonment of sewage treatment works following the provision of pumping stations to transfer the flows to alternative facilities.

The closure of Lambton Coke Works resulted in 3 km of the Lumley Park Burn, a tributary of the River Wear, improving from Class 4 to Class 3. Since the closure of Fishburn Coke Works, the quality of 16 km of the Skerne in its upper and middle reaches has also improved from Class 4, partly to Class 3 and partly to Class 2. This has resulted in an improvement from Class 2 to Class 1b of 9 km of the River Tees below the confluence with the River Skerne.

The effluent from Cramlington Sewage Treatment Works used to discharge into the non-tidal River Blyth but has now been diverted into the estuary. This has resulted in the improvement of 3 km of the inland river from Class 3 to Class 1b.

Estuaries

A net improvement in the classification of estuaries had been expected between 1985 and 1990. Despite considerable reductions in polluting loads, the improvement has not materialised.

The River Derwent estuary has improved from Class D to Class B following the closure of Derwenthaugh Coke Works (2 km). A 3 km length of the River Team estuary has improved from Class D to Class C as a result of the closure of Norwood Coke Works and the commissioning of a section of the South Bank Interceptor Sewer (part of the Tyneside Interceptor Scheme) which eliminated discharges of untreated sewage to the river.

Prospects

Improvements to most remaining Class 3 and 4 stretches will be achieved by the abandonment of certain sewage treatment works or the provision of better sewage treatment. Those stretches which are affected by intermittent or diffuse discharges will be improved by better measures to prevent pollution. Schemes of land reclamation should improve a few stretches affected by contaminated run-off or leachate.

Significant improvements are expected in the estuaries of the Tyne and Tees following the completion of sewerage schemes. On Tyneside, the North Bank Interceptor Sewer is due to be completed by the end of 1991. The remaining significant discharges of untreated sewage from the north bank to the upper estuary will then be connected into the Interceptor System. Extensions to the South Bank Interceptor Sewer, from Blaydon to Clara Vale, are due for completion in 1992/3.

The only remaining discharges of untreated sewage into the estuary will then be from the low-lying riverside strip areas. These will be dealt with progressively as re-development proceeds.

Reductions of the polluting discharges from industry into the Tees estuary will result from the commissioning of treatment plants and other measures to control pollution. Secondary treatment will be provided at Portrack Sewage Treatment Works by the end of 1992. At Cargo Fleet, a sewage works providing preliminary treatment will be commissioned in 1991, resulting in the termination of several major discharges to the estuary from the Middlesbrough area. Biological treatment will be provided by the end of 1993.

It is expected that the runs of small numbers of migratory fish, which have returned to the Tees in recent years, will increase substantially as pollution levels fall.

7.3 NORTH WEST

Changes since 1985

Reductions in polluting inputs from farms, which were expected to take place between 1985 and 1990 have been achieved. They resulted in no net improvement in classification however, because they were outweighed by downgradings.

In this respect it is important to note that over the five year period there has been a greater recognition, due to improved monitoring, of the effects of acid deposition on upland watercourses. This has resulted in several tributaries in the central Lake District and Pennines being downgraded.

Freshwaters

Since 1985, there has been a net downgrading of 4% (191 km) of river length; 11% has been downgraded and 7% upgraded. Several streams formerly recorded as Class 1a have been downgraded to 1b to reflect the impact of acid deposition on the natural fauna. Of particular note is the River Etherow in the southern Pennines where 11.2 km have been downgraded on this basis.

Of particular concern in this Region is the high proportion of Class 4 watercourses caused by the extensive utilisation of the river network for urban and industrial waste disposal, together with run-off from intensive farming practices. These problems are predominantly, although not exclusively, to be found in the Mersey Basin.

Despite a small overall reduction in the length of Class 4 (3.2 km), some 74 km of river have deteriorated to Class 4 since 1985, almost matching the 77 km which have improved. The main areas of deterioration are the River Alt in Merseyside and the River Irk in Greater Manchester which, together with associated tributaries, account for 35 km. The deteriorations are principally due to poor performance of the sewerage and sewage treatment facilities; indeed, almost 90% of the downgrading to Class 4 is accounted for by these factors, whereas the remainder is largely due to industrial estate drainage.

The upgradings from Class 4 have resulted from sewage treatment, industrial and agricultural improvements; the largest individual contributors are sewage treatment improvements on the River Irwell in Rossendale and River Tame at Hyde. Overall, the need for continuing, substantial investment in sewerage and sewage treatment facilities is emphasised.

On the extensive canal network there has been little real change, although 35% (201 km) has been downgraded as a result of more realistic assessments of the data. The only significant change has been an improvement from Class 3 to Class 2 of 3.6 km of the Trent and Mersey Canal due to diversion of industrial effluents in the Middlewich area.

The overall improvement of 51 km of rivers and canals from Classes 3 and 4 to Class 2 or better was the result of investment in the sewage disposal infrastructure and the reversal of recent trends in agricultural pollution due to the farm liaison and enforcement campaigns undertaken by NRA staff.

Estuaries

There are no reported changes to the classification of estuaries in the Region, although extensive new sewerage, sewage treatment, and industrial treatment facilities are under construction (or recently completed) on the Mersey Estuary.

Prospects

An accelerating level of investment in the sewage disposal infrastructure and the application of tighter standards to industry should result in a steady improvement in the quality of watercourses, with many substantial schemes already under construction. In particular, major re-sewerage schemes in Oldham and Bolton, already underway, will considerably reduce the input of storm sewage to the Rivers Medlock and Croal respectively, and work is continuing on the Mersey estuary to finally eliminate discharges of crude sewage.

Recent increases in staff will result in additional pollution control activities by the NRA which will enable tighter control of industrial and sewage discharges to be attained. Improved grant facilities for farmers should reduce the impact of pollution from agricultural sources in the Region.

7.4 SEVERN TRENT

Changes since 1985

Improvements to sewage treatment, which were expected to take place between 1985 and 1990, have occurred and they contributed to a net improvement in river quality.

Freshwaters

Some of the reported deteriorations are attributable to an increased level of monitoring at sites on smaller streams that were previously judged to be of good quality on the basis of limited evidence. Others are due to recent weather conditions.

Since 1985, over 9% of classified river length has deteriorated, while more than 10% has improved. The net upgraded river length is therefore about 1% (70 km). There has been a net downgrading of 2% (19 km) in the length of canals.

The lengths of all rivers classified in 1985 were re-measured in 1988. As a result, the total length of reported river increased by 570 km. Those stretches whose lengths were altered were assumed to have had the same quality in 1985 as that reported for the original length. In effect, these changes in river length are a retrospective correction of the 1985 Survey. The change has affected the results, because in 1985 the length of Class 3 river was underestimated. About 170 km of the new extra length improved in quality from Class 3. If the old, incorrect, lengths had been retained in the 1985 and the 1990 Surveys, the above mentioned 1% net improvement in river quality would be transformed into a 2% net deterioration.

Within the basins of both the Severn and the Trent there has been a net loss of Class 1a river length to 1b. The Severn had a greater length improving from Class 2 to 1b than the reverse. For the Trent catchment, movement between Classes 1b and 2 showed little net change. In the Severn catchment, less river length changed from Class 2 to Class 3 than improved from 3 to 2. For the Trent catchment, three times the length moved from Class 3 to 2 than the reverse.

There has been an increase in Class 4 river length in the Trent catchment. This was mostly in the Tame where inadequate sewerage facilities are still a problem. In the Severn, a short stretch of Class 4 has been upgraded by improvements to industrial and sewage discharges.

Particular features in the results for the Severn basin include a deterioration of the River Avon downstream of Coventry. This should now recover following the completion of the improvements at Coventry Sewage Treatment Works. Poor trade effluent quality in Ledbury led to a deterioration in the quality of the sewage effluent and the downgrading of the River Leadon.

Good quality has returned to the River Perry following its recovery from agricultural pollution.

In the Trent, a downgrading from Class 2 to Class 3 downstream of the Nottingham sewage discharge was caused by high concentrations of un-ionised ammonia. Improvements to river quality will require improvements at Nottingham Sewage Treatment Works. High levels of un-ionised ammonia are also seen in the River Soar downstream of the Leicester Sewage Treatment Works. A number of long-standing problems, such as those in the River Churnet downstream of Leek, and the River Anker downstream of Nuneaton, have got worse and led to a downgrading of class.

Poor sewage effluent quality was aggravated by trade effluent problems; these are now being tackled, and satisfactory conditions should soon be seen again.

Estuaries

The classified length for Severn Trent Region excludes 14 km of that part of the Severn estuary which is shared with Wessex Region. The length is incorporated into the figures for shared estuaries, (see Table A4). Overall, there has been a deterioration of 52% (29 km), mostly in the Severn Estuary downstream of Gloucester. This is caused by an increase in the organic load from Gloucester Sewage Treatment Works.

Prospects

The NRA is particularly concerned about water quality in stretches of the Tame, Stour (in Worcestershire), Erewash and Chelt. Substantial improvements on effluent treatment are required to improve these rivers.

In the Upper Tame system, inadequate sewerage facilities have caused an increase in the length of river assigned to Class 4. Further downstream, the Tame Purification Lakes, which were constructed in the early 1980's, have led to further improvements in the lower Tame. This stretch is now populated with fish and there is the prospect of an improvement to Class 2.

The major water supply rivers, the Dove and Derwent, continue to be of good quality and longer-term improvements in the Trent make it a source of public water supply with some potential. It is now used to support water supplies drawn from the Rivers Witham and Ancholme in Anglian Region.

7.5 SOUTHERN

Changes since 1985

Improvements to sewage and agricultural effluents, which were expected to take place between 1985 and 1990, have been achieved; they contributed to a net improvement in water quality.

Freshwaters

A comparison of the 1990 results with those for 1985 gives the impression that 9% of river length has deteriorated, mainly through the loss of river length in Class 1a. However, a re-appraisal of the 1985 data showed that 195 km of minor streams were classified on the basis of inadequate data. Up to 164 km of this length was placed in Class 1a on the basis of subjective judgement and, from evidence gathered since 1985, the classification was probably optimistic in many cases.

Following a review in 1989, an additional 398 km of minor streams and 41 km of canals were included in the 1990 Survey. There was sufficient information for canals to assign classes for 1985, but not for the rivers. As a result, a comparison between

1990 and 1985 is best provided by using only those lengths for which data are available for both years. This shows that 16% of river length classified in 1990 has deteriorated, while 23% has improved. The net length of river upgraded is therefore 7% (168 km). Comparable figures for canals are 19% deterioration, 34% improvement and a net upgrading of 15% (6 km).

The single most widespread cause of class downgrading was a lack of dilution available for sewage effluents. This resulted in the deterioration of 88 km of watercourse. Low flows and warm water also encouraged the growth of algae and eutrophication. This resulted in deteriorations in 66 km. In all, about 326 km was affected by low flows. Drought Orders were in force in Kent and Sussex throughout the summer of 1990 as a result.

The headwaters of rivers and their tributaries suffered across the Region, but the impact of low flow was most noticeable in Kent, with The Royal Military Canal and its feeder streams being particularly affected. On the other hand, the lack of rainfall resulted in a reduction of contaminated run-off into these catchments with the result that whilst watercourses with very low gradients or very low flows deteriorated, those with higher flows improved. Agricultural pollution affected more than 13 km.

Deteriorations in the River Hamble, and 9 km of the River Meon, reported in 1985 have now been rectified. Previous agricultural pollution of the Eden Brook was notable, but this has now been remedied.

Identified improvements include those resulting from capital expenditure on sewage treatment works or improved operation (123 km), diversion of sewage flows to other works (9 km), and improvements to sewerage systems (5 km). The provision of settlement ponds at fish farms improved 8 km, and the control of agricultural practice improved 58 km, whilst industrial improvements accounted for 48 km.

Estuaries

The reported quality of estuaries remained unchanged.

Prospects

The rainfall during the autumn and winter of 1990 has been too low to prevent another summer of low river flows, although the unexpectedly cool and wet weather in early summer has improved conditions in some of the worst affected areas.

7.6 SOUTH WEST

Changes since 1985

Despite improvements to sewage and agricultural effluents, river quality deteriorated from 1985 to 1990. However, this masks a small improvement from 1989 to 1990; this is a welcome sign of the end of a consistent decline since 1980.

Freshwaters

An additional 96 km of rivers have been added to the Survey since 1985. This was due to the redefinition of the sources of rivers. The extra length had no effect on the Region's results.

Since 1985, 40% of river length has been downgraded and 18% upgraded. This gives a net deterioration of 22%. Some 19 km of canals were also downgraded. The results reflect net losses from Classes 1a and 1b, and increases for Classes 2 and 3.

In past surveys, the procedure used to classify rivers in this Region has tended to produce volatile results and to place rivers in a worse class than might have been the case elsewhere. In addition, it has proved difficult to reproduce exactly all the subjective factors used in the classification for 1985. These two circumstances account for part of the decline recorded from 1985 to 1990.

The compounded impact of the two successive drought years had a critical impact on water quality assessed during the 1990 Survey. The prolonged periods of low flow generally had an adverse effect on river quality, often resulting in eutrophication and algal blooms, as observed in the lower reaches of the River Cober and Exeter Canal. Other rivers known to have been significantly affected by the drought were the Dart, Taw, Tavy and Axe.

The principal reasons for inadequate water quality were high BOD and ammonia, and low dissolved oxygen. Inadequate water quality was also caused also by high suspended solids, copper or zinc, or low pH and high temperatures. The main causes remain as they were in 1985; land use and agricultural practices, and historic mining and the associated contaminated land.

The most notable improvements include the River Torridge, where most of the main river is now within its objective of Class 1b. The Red River improved from Class 4 to 3, generally as a result of a reduction in pollution from mines.

Estuaries

Estuarine quality shows no change from 1985.

Prospects

A considerable programme of investment in waste treatment and pollution control is being undertaken by industry. This includes 150 schemes by South West Water to improve discharges to freshwaters. These will lead to improvements in water quality. The NRA is also targeting specific catchments in order to attain sustained water quality improvements.

Future reviews of the quality of estuaries will benefit from a programme of monitoring which has been expanded to cover 114 new sites on 22 estuaries. The quality of estuaries looks set to improve as a result of the Marine Improvement

Programme being carried out by South West Water. The Authority is now issuing the consent conditions associated with the Programme.

It is expected that the Farm Waste Regulations will have an important beneficial effect on the quality of rivers in the South West Region, as also noted in 7.1.

7.7 THAMES

Changes since 1985

There has been an apparent net decline in river quality since 1985. The quality of canals has improved. There has been no significant change in the quality of estuaries.

Over half the changes in river class can be attributed to the greatly increased monitoring programme in 1990 compared with 1985. The Region now routinely monitors 575 sites compared with 213 in 1985. In 1985, the stretches not monitored were either assumed to be within their target class or were assumed to retain the class assigned in 1980. Thus some of the changes reported now could have occurred prior to 1985. The increased monitoring has provided a more accurate assessment of the true water quality.

Freshwaters

Since 1985, 33% of classified river length is reported to have deteriorated while more than 19% has improved. The net length of river downgraded is therefore about 14% (485 km). There has been a net improvement to about 20% (42 km) of the length of canals.

In 1985, 66% of rivers were classed as Good quality (Class 1a or 1b). This proportion has fallen to 61% of the total length in 1990. Consequently, 39% of rivers are now classed as Fair, Poor or Bad quality (Class 2, 3 or 4), a corresponding increase of 5%.

In 1985, 44% of canal length was classed as Good quality. This has increased to 61% in 1990.

A significant cause of the deteriorations, apart from the consequences of the increased monitoring programme and poor effluent quality, was the unusual weather during 1990. Stretches showing a deterioration in quality due to the various effects of low flows include the lower 43 km of the Cherwell, 42 km of the Kennet, the whole (64 km) of the Evenlode, 24 km of the Oxfordshire Ray, and 19 km of the Thames from its source to the Key.

Specific deteriorations related to sewage effluent quality were: 7 km of the lower Oxford Canal downstream of Kidlington Sewage Treatment Works; 28 km of the Wey (South) downstream of Bordon Sewage Treatment Works; 22 km of the Lee downstream of Luton Sewage Treatment Works, and 14 km of the Thames from the Ray to the Coln downstream of Swindon Sewage Treatment Works. Other, diffuse sources of pollution, such as those from agriculture and other trade effluents, continued to be a problem for a few rivers.

There was an improvement of the whole length of the Cut (24 km) from Class 3 to Class 2 as a direct result of improved effluent quality from sewage treatment works serving Ascot, Bracknell and Maidenhead. Over 32 km of the lower River Loddon has improved from Class 2 to Class 1b due to improved effluent quality from Basingstoke and Wargrave Sewage Treatment Works. The 7 km of the Cherwell below Banbury have improved from Class 3 to Class 1b following much improved effluent quality from Banbury Sewage Treatment Works. Other improvements directly attributable to improved effluent quality were 5 km of the Wye and more than 10 km of the Roding. The majority of other improvements were attributed to the better spread of sampling in 1990.

Estuaries

There has been no significant change in estuarine quality.

Prospects

Action is being planned to rectify the deteriorations mentioned above caused by effluent quality. By the end of 1992, the refurbishment programme at sewage works operated by the relevant Water Service Companies should be completed. This should result in improved water quality; however, further urbanisation and pressures on water resources may offset some of these benefits. The 1990 Survey has neverthless provided a more complete picture of water quality than was previously available; this will greatly assist in the planning of improvements.

7.8 WELSH

Changes since 1985

Most of the improvements which were expected to have taken place between 1985 and 1990 have been achieved. This includes 28 km of the River Alyn, which improved from Class 2 to Class 1b, due mainly to capital investment in Mold Sewage Treatment Works by Dwr Cymru and to efforts to reduce farm pollution. Sustained efforts by pollution control staff to reduce farm pollution have also led to the upgrading of 17 km of the Worthenbury Brook, from Class 3 to Class 2 (8 km) and from Class 3 to Class 1b (9 km). Some 5 km of Allensmore Brooke and 7 km of Worm Brook improved from Class 3 to Class 2 due to more stringent policing of industrial effluents.

The improvements predicted in 1985 for the Ystwyth and Rheidol estuaries were achieved, but those for the Ely and Tywi have not yet been accomplished. The Tywi oxygen injection system was installed but, because of technical difficulties, it failed to solve the problem.

Freshwaters

A more accurate measurement of river length has led to an increase of 47 km in the length of river reported. The extra length had no effect on the Region's results.

Since 1985, 18% of classified river length has deteriorated and 20% has improved. The net length of river upgraded is therefore 2% (100 km). There was a net upgrade of about 2% (3 km) to canals.

Individual stretches have changed class for a variety of reasons. Deteriorations are attributable to the weather which affected the measurements of dissolved oxygen, BOD and temperature and the impact of acidification. The general decline in heavy industry and coal mining has been responsible for the improvement in quality of some river stretches, including part of the Rhondda Fach. Increases in monitoring may also have contributed to observed improvements and deteriorations.

Pollution from sewage treatment works caused some downgrading, including 9 km of Willersley Brook from Class 1a to Class 4 due to the effect of Eardisley Sewage Treatment Works combined with low flows. Low flows and the effect of Woebley Sewage Treatment Works caused the deterioration of 5 km of Newbridge Brook from Class 2 to Class 4. Diversion of the Eardisley STW effluent to a watercourse affording higher dilution has now resolved the first problem; the remaining problem is currently being addressed.

Net changes in the quality of rivers and canals resulted in about 4% of lengths being upgraded from Class 2 to Class 1b.

Estuaries

Welsh Region's estuaries exclude 51 km of that part of the Severn which is shared with Wessex Region. The length is counted under shared estuaries (see Table A4). There has been very little change in the quality of estuaries in the Region since 1985.

Prospects

Dwr Cymru's (Welsh Water) capital programmes, drawn up in consultation with the NRA, will yield improvements in the quality of discharges from sewage treatment works and should reduce pollution from storm sewage.

The quality of estuaries should improve as the new standards for discharges are achieved and as capital works are carried out to improve the quality of bathing waters.

The introduction of the Farm Waste Regulations, as noted in 7.1, is expected to have a beneficial effect on river quality in the Welsh Region. This will be of particular importance in the predominantly dairy areas in the south west of the Region, such as the Cleddau, Nevern and Gwaun catchments.

7.9 WESSEX

Changes since 1985

No major changes had been expected to take place between 1985 and 1990.

Freshwaters

The total length of rivers reported has risen from 2,467 km to 2,622 km. This is due to a more accurate measurement of river lengths.

Since 1985, 3% of the classified river length has deteriorated, while 4% has improved. The net length of upgraded river is therefore about 1% (28 km). Over 6% (5 km) of the total length of canals has been downgraded.

Only 6% of the total length of rivers now lies within the categories of Poor or Bad quality. The general picture has been of fairly consistent water quality, with some improvement of rivers from Class 3 to 2 and some deterioration from 1b to 2. Further investigations are being undertaken on these stretches. The main causes of the reported deteriorations are inputs of waste from agriculture, discharges from sewage treatment works, and failures of the sewerage systems.

Agricultural pollution, especially from dairy and beef farms, continues to affect water quality. Many of the more acute problems, caused by direct discharges of farm waste, have been remedied. In some cases low rate irrigation systems may have caused local problems. In some catchments the volume of farm waste being spread exceeds the capacity of the land to take it. This has resulted in polluted run-off into rivers following rainfall.

The deterioration in the Siston Brook and the River Frome in Bristol appears to have been caused by the development of industrial estates in these catchments. The change is not attributable to any specific input, but there seems to have been a decline in water quality both during and after development.

The dry weather caused a reduction in summer river flows but also reduced both the volume of sewage discharges and the frequency of storm overflows. This, together with the improved efficiency of treatment, due to warmer temperatures, has resulted in a smaller pollution load being discharged to rivers. Overall this produced a higher river quality than would be expected in a wet year.

Some of the improvements to Class 3 rivers have been achieved by mounting special campaigns in catchments with inputs of agricultural waste. Notable amongst these are those on the Caundle Brook in Dorset and the River Biss in Wiltshire. Both campaigns resulted in significant improvements to water quality.

Many of the upgradings recorded are due to improvements to both the sewerage system and to sewage treatment works. Thus, for example, improvements have resulted from reductions both in the discharge of trade effluent (the Glastonbury Mill Stream and the River Yeo, both in Somerset) and from investment in the upgrading or refurbishment of sewerage systems and treatment works (the River Marden at Calne and the Bydemill Brook below Thingley Sewage Treatment Works).

Estuaries

There have been no changes to the classification of estuaries.

Prospects

The recent introduction of the Farm Waste Regulations, as noted in 7.1, is expected to have a beneficial effect on river quality in the Wessex Region.

Industrial and agricultural impacts resulting in Class 3 rivers will continue to be targeted and it is planned to cut the small amount of Class 4 stretches by half as a result of action plans currently being drawn up.

7.10 YORKSHIRE

Changes expected since 1985

Some of the improvements which were expected to take place between 1985 and 1990 have been achieved. These did not result in a net improvement in water quality because they were outweighed by downgradings elsewhere. Most downgradings were due to deteriorations in the quality of effluents from sewage treatment works and to reduced river flows caused by the drought.

Freshwaters

Since 1985, 9% of classified river length has deteriorated, while 4% has improved. The net length of river downgraded is therefore 5% (300 km). The overall quality of canals has not changed appreciably since 1985.

The length of river of Bad quality declined by 20 km to 164 km, but the length of river with Poor quality increased by 140 km to 623 km. The net result has been a loss of Class 1a and 1b rivers, with corresponding increases in Classes 2 and 3.

The general downward shift in water quality towards Classes 2 and 3 has resulted mainly from changes in quality over short river lengths at a large number of locations. Lack of dilution is partly responsible. An increase in the number of sampling locations allowed a reappraisal of water quality at some sites. Nonetheless, most problems are caused by discharges of sewage and sewage effluent. The downgradings of 4 km of watercourse from Class 1b to Class 4, 20 km from Class 2 to Class 4, and 26 km from Class 3 to Class 4, were all due to the effects of sewage effluents and storm sewage overflows.

The deterioration of 61 km of river from Class 1a and 1b to Class 3 also occurred primarily because of sewage or sewage-related causes. The most significant impact was on the River Hertford, a tributary of the River Derwent, where 12 km were downgraded. This caused a downgrading of 10 km of the River Derwent from Class 1a to Class 2 and a further 4 km from Class 1a to Class 1b.

Improvements to sewerage and sewage treatment have led to 8 km being upgraded from Class 4 to Class 2, 30 km from Class 4 to Class 3, 20 km from Class 3 to Class 2, and 4 km from Class 3 to Class 1. One of the most significant improvements has been to Bradford Sewage Treatment Works at Esholt. This has resulted so far in 8 km of the River Aire being upgraded to Class 3. Further improvements to the works are in hand.

Improved control of trade effluents was responsible for the upgrading of 2 km of Class 4 rivers to Class 2, while the transfer of trade effluents to sewer and the closure of some works led to the improvement of 21 km from Class 4 to Class 3, and 31 km from Class 3 to Class 2.

Estuaries

The classified length reported for Yorkshire Region excludes about 63 km of the Humber, responsibility for which is shared with Anglian and Severn Trent Regions; the figures appear under shared estuaries, (Table A4). Overall, estuaries showed a slight deterioration in quality.

Prospects

Over the next five years there should be a progressive reduction in rivers of Bad quality (Class 4) and some redress of the slippage in recent years from Class 1b to 2. Investment by Yorkshire Water is currently targeted to eliminate the lengths of river in Class 4, and reduce the length of Class 3 rivers from 641 km to 29 km by the year 2000. The NRA believes that major improvements in the quality of the main industrial rivers are achievable by the mid 1990s. To effect this, a strategy has been developed which will form the basis of consultation with the dischargers.

The rivers in the north of the Region are generally of high quality. Ongoing work to reduce farm pollution and to improve some sewage treatment works should raise the quality of some "black-spots" on tributaries during the period 1990 to 1995. The downgrading of the Rivers Nidd, Hertford and Derwent should be reversed by 1995.

Schemes are in progress at the sewage treatment works serving Leeds and Bradford, which discharge to the Aire. Further improvements may result in Leeds, but there are also problems with the overflows of storm sewage. On the Calder, the main improvements depend on work at Huddersfield Sewage Treatment Works.

Major reconstruction is in progress at the works serving Sheffield. This should eliminate some of the Class 4 length of the Don. Schemes for effluent treatment are now in progress which will upgrade 33 km of the Rother from Class 4. These improvements will then benefit the quality of the River Don through Rotherham and Doncaster.

The Tidal Ouse and the upper part of the Humber will benefit from the improvements to the Aire and Don, but possibly not to the extent that the stretch of Class C is eliminated during the next five years.

8 DISCUSSION

The results of the 1990 survey have further highlighted a number of difficulties of long standing. The principal one is that of determining whether or not the quality of a river or estuary, as determined by its 'class', really has changed with time. Even if the practice and methods used were constant, there would always be a chance of mis-classification; where the practice and methods have also changed over time, the accuracy of the assessment is considerably degraded.

Nevertheless, it is clear from the data obtained in the Survey that there has been a real decline in river water quality between 1985 and 1990. The reasons for this appear to be partly attributable to the dry and sunny weather during 1989 and 1990, the effects of which differ from one area of the country to another, but primarily result in a lack of water to dilute the inputs of contaminating waste. A more substantial reason, however, has been the consented and unconsented inputs of waste materials which collectively lead to pollution. In order to address this, the NRA has already reviewed the manner in which discharge consents are set and has greatly increased efforts to achieve compliance with existing consents. It is likely, however, that many of these consents are no longer relevant to the increasing demands placed upon the receiving water. In order to revise discharge consents, therefore, a new framework is required based upon the use to which the receiving waters will be put, together with a new means of classifying rivers to ensure that they meet, in time, the desired objectives. A NRA consultation paper on this subject is being published separately (Water Quality Series No 5).

Some improvement programmes are already in hand. The newly privatised Water Service Companies are investing in numerous works to secure improvements in the quality of discharges from sites which were given relaxed consents on a temporary basis in the run up to privatisation. The introduction of the EC Urban Waste Water Treatment Directive will also have an effect on future capital programmes, and such plans will be incorporated into the consideration of the means by which Statutory Water Quality Objectives (SWQOs) will be met once they are set by the Secretaries of State under the 1989 Water Act.

The setting of such objectives will draw heavily upon the data obtained in the 1990 Survey. The consultation paper on the SWQO scheme will also address the means by which the value of such data can be greatly enhanced by using additional information on the biology of the waters surveyed. This method can by applied retrospectively to the 1990 Survey and thus, following the results of the public consultation, the NRA will publish a re-evaluation of the situation in 1990 to use as a baseline for the future.

The setting of specific SWQOs, in order to provide a basis for revising discharge consents, will only be successful if steps are also taken to prevent pollution at source, particularly when much pollution can enter waters in a diffuse manner. Such general problems are being approached through the development of catchment planning techniques. Part of this strategy involves targeting specific areas, and ensuring that powers available to the NRA through regulations relating to farm waste production and storage, and codes of practice which apply to the farming community, are effectively used to reduce pollution. Other sources, such as leaking contaminated land, are also being addressed. Progress on all of these fronts is essential in order to reverse the deterioration of some of the country's best rivers and to accelerate the necessary improvement of those rivers which have long been abused.

CLASSIFICATION SYSTEMS

Table A1	Classification Scheme for Water Quality in Rivers and Canals
Table A2	Part 1: River Quality Classification Part 2: Notes on the River Water Classification
Table A3	Scheme for Classifying Estuaries

APPENDIX 1

Table A1: Classification Scheme for Water Quality in Rivers and Canals

Description	Class	Current Potential Use
Good Quality	1a	Water of high quality suitable for potable supply abstractions; game or other high class fisheries; high amenity value.
	1b	Water of less high quality than Class 1a but usable for substantially the same purposes.
Fair Quality	2	Waters suitable for potable supply after advanced treatment; supporting reasonably good coarse fisheries; moderate amenity value.
Poor Quality	3	Waters which are polluted to an extent that fish are absent or only sporadically present; may be used as a low grade industrial abstraction; considerable potential for further use if cleaned up.
Bad Quality	4	Waters which are grossly polluted and are likely to cause nuisance.

Table A2: River Quality Classification

RIVER CLASS	QUALITY CRITERIA	REMARKS	CURRENT POTENTIAL USES
1a Good Quality	1) 5 percentile Dissolved Oxygen Saturation greater than 80% 2) 95 percentile Biochemical Oxygen Demand not greater than 3 mg/l 3) 95 percentile Ammonia not greater than 0.4mg/l 4) Where the water is abstracted for drinking water, it complies with requirements for A2* 5) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures are unavailable)	1) Mean Biochemical Oxygen Demand probably not greater than 1.5 mg/l 2) No visible evidence of pollution	1) Water of high quality suitable for potable supply abstractions 2) Game or other high class fisheries 3) High amenity value
1b Good Quality	1) 5 percentile Dissolved Oxygen Saturation greater than 60% 2) 95 percentile Biochemical Oxygen Demand not greater than 5 mg/l 3) 95 percentile Ammonia not greater than 0.9 mg/l 4) Where water is abstracted for drinking water it complies with the requirements for A2* 5) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures are unavailable)	1) Mean Biochemical Oxygen Demand probably not greater than 2 mg/l 2) Mean Ammonia probably not greater than 0.5 mg/l 3) No visible evidence of pollution 4) Water of high quality which cannot be placed in Class 1a because of the effect of physical factors such as canalisation, low gradient or eutrophication	Water of less high quality than Class 1a but usable for substantially the same purposes.
2 Fair Quality	1) 5 percentile Dissolved Oxygen Saturation greater than 40% 2) 95 percentile Biochemical Oxygen Demand not greater than 9 mg/l 3) Where water is abstracted for drinking water it complies with the requirements for A3* 4) Non-toxic to fish in EIFAC terms (or best estimates if EIFAC figures are unavailable)	1) Mean Biochemical Oxygen Demand probably not greater than 5 mg/l 2) Water showing no physical signs of pollution other than humic colouration and a little foaming below weirs	1) Waters suitable for potable supply after advanced treatment 2) Supporting reasonably good coarse fisheries 3) Moderate amenity value
3 Poor Quality	1) 5 percentile Dissolved Oxygen Saturation greater than 10% 2) Not likely to be anaerobic 3) 95 percentile Biochemical Oxygen Demand not greater than 17 mg/l. This may not apply if there is a high degree of re-aeration.		Waters which are polluted to an extent that fish are absent or only sporadically present. May be used for a low grade abstraction for industry. Considerable potential for further use if cleaned up.
4 Bad Quality	Waters which are inferior to Class 3 in terms of dissolved oxygen and likely to be anaerobic at times.		Water which are grossly polluted and are likely to cause nuisance.
X	DO greater than 10% saturation		Insignificant watercourses and ditches which are not usable, where the objective is simply to prevent nuisance.

* See note (e) overleaf

Table A2: Notes on the River Quality Classification

NOTES:

a) Under extreme weather conditions (eg flood, drought, freeze-up), or when rivers are dominated by plant growth, or by the decay of aquatic plants, rivers usually in Class 1, 2 and 3 may have levels of Biochemical Oxygen Demand and Dissolved Oxygen, or Ammonia outside the stated levels for those classes. When this occurs the cause should be stated along with analytical results.

b) The Biochemical Oxygen Demand refers to the 5-day carbonaceous determination performed in the presence of Allylthiourea (ATU). Ammonia is expressed as the Ammonium Ion, NH_4^+.

c) In most instances the chemical classification given above will be suitable. However, the basis of the classification is restricted to a finite number of chemical determinands and there may be a few cases where the presence of a chemical substance other than those used in the classification markedly reduces the quality of the water. In such cases, the quality classification of the water should be downgraded on the basis of biota actually present, and the reasons stated.

d) The standards set up to protect freshwater fisheries by the European Inland Fisheries Advisory Commission (EIFAC). The standards should be expressed as 95-percentiles.

e) The definition and the requirements of A2 and A3 are those specified in the Directive on the Quality of Water Intended for Abstraction for Drinking Water.

Table A3: Scheme for Classifying Estuaries

DESCRIPTION		Points awarded if the estuary meets this description
Biological Quality (scores under a, b, c & d to be summed)		
a)	Allows the passage to and from freshwater of all relevant species of migratory fish, when this is not prevented by physical barriers.	2
b)	Supports a residential fish population which is broadly consistent with the physical and hydrographical conditions.	2
c)	Supports a benthic community which is broadly consistent with the physical and hydrographical conditions.	2
d)	Absence of substantially elevated levels in the biota of persistent toxic or tainting substances from whatever source.	4
	Maximum number of points	10
a)	Estuaries or zones of estuaries that either do not receive a significant polluting input or which receive inputs that do not cause significant aesthetic pollution.	10
b)	Estuaries or zones of estuaries which receive inputs which cause a certain amount of pollution but do not seriously interfere with estuary usage.	6
c)	Estuaries or zones of estuaries which receive inputs which result in aesthetic pollution sufficiently serious to affect estuary usage.	3
d)	Estuaries or zones of estuaries which receive inputs which cause widespread public nuisance.	0
Water Quality (Score according to quality)		
Dissolved Oxygen exceeds the following saturation values:		
	60%	10
	40%	6
	30%	5
	20%	4
	10%	3
	below 10%	0

The points awarded under each of the headings of biological, aesthetic and water quality are summed. Waters are classified on the following scale.

Class A Good Quality 24 to 30 points	Class B Fair Quality 16 to 23 points
Class C Poor Quality 9 to 15 points	Class D Bad Quality 0 - 8 points

STATISTICAL BACKGROUND

(a) This Appendix explains how the classification of water quality is affected by the Laws of Chance in sampling.

Sampling Error

(b) A river flows for 31 million seconds in a year and samples give a measurement of the quality of a small bit of it during those few seconds required to fill the sampling bottles. This means that the results from a set of samples are influenced by the Laws of Chance. There is a risk that the samples collected at a site may just happen to have been taken at those times when river quality was at its best or worst.

(c) Given the number of sites in England and Wales it is inevitable that a proportion will show misleading results purely because of chance.

(d) To illustrate, the following table shows the average uncertainty from the use of 35 samples to estimate percentiles:

Determinand	90% Confidence Interval
BOD	-19% to + 34%
Ammonia	-31% to + 68%
Dissolved Oxygen	-6% to + 9%

(e) This uncertainty produces a risk that rivers are placed in the wrong class. For example, a site with a true 95-percentile BOD of 4.2 mg/l is in Class 1b but has, with 36 samples, the following probabilities of being classified:

1a: 1%	1b: 82%	2: 17%

This suggests a chance of 18% of wrongly reporting the class.

(f) This error is bigger when using the data to detect a change of class. In the first period, the percentile might actually be in Class 1b but the probability calculations (combining Classes 1a and 1b for simplicity) show:

Probability of 1b	83%
Probability of 2	17%

which is taken as Class 1b. In the next period, the data could give a result that suggests:

Probability of 1b	40%
Probability of 2	60%

which suggests Class 2. Over the two periods this looks like a downgrading from 1b to 2, but the range of possibilities is:

From 1b to 2	50%
From 1b to 1b	33%
From 2 to 2	10%
From 2 to 1b	7%

(g) So there is a strong possibility (50%) that the reported deterioration from Class 1b to 2 did not really happen. There is a small chance (7%) that quality actually improved (but was recorded as a downgrading).

(h) The practical consequence of these effects is that the reported class can change randomly back and forth, every year. The effect on a large number of sites is calculated by the Class Allocation Model, CLAM[2]. The results indicate an average error of 20% in assigning class and an average error of 29% in reporting a change in class.

(i) The need to control these errors is one of the main reasons for creating the new "NRA" Class. Standard statistical techniques will be used to assess the risk that an apparent change was caused by chance[3].

PROBLEMS WITH THE NWC CLASS

The 1985 Survey revealed differences between the former Water Authorities in the monitoring and classification of rivers. Such differences can only be explained by differences in procedure.

The preparatory work done by the NRA and its predecessors for the 1990 Survey showed differences between the former Water Authorities in:

(a) the statistical methods used to obtain the summaries of water quality (mainly 95-percentiles);
(b) the inclusion or exclusion of any analytical results suspected as being in error because they differed markedly from others from the same site (or caused by extreme events like flood, drought and plant growth (Table A2));
(c) the sampling frequencies;
(d) the number of years' data used for the assessment;
(e) the inclusion of non-routine samples (like those for pollution incidents);
(f) the pooling of data for different sites;
(g) the procedure used to interpolate between sampling points;
(h) the use of judgements based on the effects of algae, biological data, and visual pollution to qualify or overrule the classification suggested by other data;
(i) the weight given to the EIFAC standards, especially for un-ionised ammonia;
(j) the status given to non-compliance with standards in Directives (especially metals); and
(k) the allowance made for statistical sampling error when deciding whether a river had changed class.

This last point may require explanation. It is a fact, often overlooked, that the summary statistics which are used in classification (such as percentiles) are estimated with low precision in relation to the ranges of concentration which define the better quality classes.

Another problem with the NWC Class is that new water quality standards and new Directives are being introduced steadily over the years. If these were incorporated within the NWC Class, in the same ways as the EIFAC Standards and the EC Directive on the Quality of Surface Water for Abstraction of Drinking Water, the system will cease to be usable as an absolute measure of water quality because not all the additions will apply to all rivers. Also, if the definition of class changes over time in this way, the NWC Class cannot be used sensibly to indicate national trends in water quality. Instead, the system will produce apparent changes which are due to changes in the method of classification.

Recognising this, the former Water Authorities Association recommended a new Class specifically to show absolute quality. Rivers would be checked separately for compliance with other standards and Directives. The new Class was similar to the NWC Class but based only on the BOD, the dissolved oxygen, and ammonia. These recommendations, together with proposals to use biological data, are the basis of the NRA's suggestions for a new classification system. These suggestions are being issued for consultation as part of the NRA's proposals on Statutory Water Quality Objectives.

DETAILED WATER QUALITY INFORMATION

Table A4: Lengths of Rivers, Canals and Estuaries in each class: 1985 - 1990

Region	Class	RIVERS (km)			CANALS (km)			ESTUARIES (km)			
		1985*	1985#	1990	1985*	1985#	1990	Class	1985*	1985#	1990
Anglian	1a	443	442.7	357.8	0	0	0	A	445	448.7	406.4
	1b	2094	2094.0	2120.2	51	50.5	50.5	B	61	56.8	69.3
	2	1392	1391.8	1501.8	75	74.8	74.8	C	7	6.5	36.3
	3	392	392.1	335.4	0	0	0	D	2	2.0	2.0
	4	7	7.2	12.6	0	0	0				
	x	–			–						
	Unc	–			–						
	Total	4328	4327.8	4327.8	125	125.3	125.3	Total	514	514.0	514.0
Northumbria	1a	1729	1729.0	1669.1				A	50	50.0	46.5
	1b	708	709.4	727.4				B	45	45.3	51.8
	2	264	262.4	307.0				C	22	22.0	23.5
	3	62	62.8	75.6		NO CANALS		D	18	18.0	13.5
	4	22	21.7	6.2							
	x	–									
	Unc	–	15.2	15.2							
	Total	2784	2800.5	2800.5				Total	135	135.3	135.3
North West	1a	2579	2581.8	2382.2	131	130.6	27.4	A	222	220.8	220.8
	1b	656	653.7	767.9	106	105.8	71.7	B	101	102.2	102.2
	2	923	921.6	1056.1	316	316.2	455.7	C	60	59.8	59.8
	3	898	898.7	852.8	25	24.5	22.3	D	69	69.0	69.0
	4	268	267.5	264.3	0	0	0				
	x	–			–						
	Unc	–			–						
	Total	5323	5323.3	5323.3	577	577.1	577.1	Total	451	451.8	451.8
Severn-Trent	1a	919	977.3	860.6	20	20.5	20.5	A	27	25.0	8.0
	1b	1858	2045.1	2271.0	316	327.0	319.5	B	34	31.1	34.1
	2	1682	1800.7	1852.9	556	593.4	587.3	C	0	0	14.0
	3	621	786.7	611.5	102	46.9	62.8	D	0	0	0
	4	70	71.4	85.2	3	2.3	0				
	x	–	39.3	39.3	–						
	Unc	–			–						
	Total	5150	5720.5	5720.5	996	990.1	990.1	Total	61	56.1	56.1
Southern	1a	621	307.3	500.1		0	0	A	310	293.1	293.1
	1b	885	846.8	1032.9		7.8	10.5	B	57	81.4	81.4
	2	436	482.6	483.7		19.2	30.5	C	13	13.6	13.6
	3	47	132.7	150.3		14.0	0	D	0	0	0
	4	3	17.7	18.1		0	0				
	x	–									
	Unc	–	398.0								
	Total	1992	2185.1	2185.1		41.0	41.0	Total	380	388.1	388.1
South West	1a	745	765.9	506.2	0	0	0	A	330	322.2	322.2
	1b	1215	1288.5	1065.1	8	8.0	0	B	25	27.8	27.8
	2	792	795.0	909.0	14	14.0	3.0	C	0	0	0
	3	170	167.3	523.9	0	0	8.0	D	0	0	0
	4	19	19.0	33.2	7	7.0	18.0				
	x	–	1.7		–						
	Unc	–			–						
	Total	2941	3037.4	3037.4	29	29.0	29.0	Total	355	350.0	350.0

* 1985 figures as published in 1985[1]

1985 figures as revised in 1990

Unc stands for unclassified rivers

APPENDIX 4

Table A4: Lengths of Rivers, Canals and Estuaries in each class: 1985 - 1990 (cont.)

Region	Class	RIVERS (km)			CANALS (km)			ESTUARIES (km)			
		1985*	1985#	1990	1985*	1985#	1990	Class	1985*	1985#	1990
Thames	1a	866	878.2	553.8	22	21.5	37.1	A	49	49.1	50.4
	1b	1462	1436.3	1586.1	100	69.9	90.0	B	89	62.5	61.2
	2	981	994.1	1116.1	136	116.7	74.2	C	0	0	0
	3	231	218.9	264.9	2	1.5	8.3	D	0	0	0
	4	5	2.4	9.0	0	0	0				
	x	–			–						
	Unc	–			–						
	Total	3546	3529.9	3529.9	259	209.6	209.6	Total	138	111.6	111.6
Welsh	1a	2418	2477.9	2487.6	23	10.9	0	A	316	324.9	328.2
	1b	1377	1375.2	1505.4	31	30.9	56.5	B	94	87.6	84.3
	2	523	525.4	384.5	73	72.8	69.0	C	7	7.1	7.1
	3	256	242.4	243.9	25	25.4	26.4	D	0	0	0
	4	26	26.2	25.7	12	11.9	0				
	x	–			–						
	Unc	–			–						
	Total	4600	4647.1	4647.1	164	151.9	151.9	Total	417	419.6	419.6
Wessex	1a	650	738.8	740.4	0	9.9	9.9	A	43	53.7	53.7
	1b	864	852.7	833.3	64	56.3	51.0	B	65	60.7	60.7
	2	781	839.9	905.4	17	16.0	21.3	C	3	5.2	5.2
	3	156	166.0	127.3	0	0	0	D	0	0	0
	4	15	15.3	15.3	0	0	0				
	x	–			–						
	Unc	–	9.0		–						
	Total	2467	2621.7	2621.7	81	82.2	82.2	Total	111	119.6	119.6
Yorkshire	1a	2300	2299.9	2251.2	4	3.9	3.9	A	5	4.7	4.7
	1b	2111	2110.8	1895.4	82	81.8	81.8	B	17	17.1	17.1
	2	689	687.3	831.3	85	84.7	86.7	C	18	18.1	18.1
	3	484	483.4	623.0	87	87.2	85.2	D	0	0	0
	4	184	184.0	164.5	10	10.0	10.0				
	x	–			–						
	Unc	–	1.5	1.5	–						
	Total	5767	5766.9	5766.9	268	267.6	267.6	Total	40	39.9	39.9
Shared Estuaries								A	27	27.9	27.9
								B	36	36.9	36.9
							Humber	C	0	0	0
								D	0	0	0
								Total	63	64.8	64.8
								A	36	43.2	43.2
								B	28	28.0	28.0
							Severn	C	0	0	0
								D	0	0	0
								Total	64	71.2	71.2
England and Wales	1a	13271	13198.8	12309.0	198	197.3	98.8	A	1860	1863.3	1805.1
	1b	13229	13412.5	13804.7	757	738.0	731.5	B	652	637.4	654.8
	2	8463	8700.8	9347.8	1271	1307.8	1402.5	C	129	132.3	177.6
	3	3315	3551.0	3808.6	240	199.5	213.0	D	89	89.0	84.5
	4	619	632.4	634.1	31	31.2	28.0				
	x	–	41.0	39.3	–						
	Unc	–	423.7	16.7	–						
	Total	38896	39960.2	39960.2	2498	2473.8	2473.8	Total	2730	2722.0	2722.0

* 1985 figures as published in 1985[1]

\# 1985 figures as revised in 1990

Unc stands for unclassified rivers

GLOSSARY OF TERMS

ALGAE

Simple plants which may be microscopic, or very large plants but which lack true stems, all of which are capable of photosynthesis. Algae occur in water and are often discussed in the context of Eutrophication (ibid).

AMMONIA

A chemical which is often found in water as the result of the discharge of sewage effluents. It is widely used to characterise water quality. High levels of ammonia adversely affect the quality of water for fisheries and abstractions for potable water supply.

BOD and BOD (ATU)
BIOCHEMICAL OXYGEN DEMAND

These are measures of the amount of oxygen consumed in water, usually by organic pollution.

The simple BOD 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, Allylthiourea (ATU), to the sample of water taken for testing; hence BOD (ATU). Without ATU, the BOD is "uninhibited".

CLASSIFICATION/CLASSES

A way of placing waters in categories (classes) according to assessments of water quality based, for example, on measurements of the amount of particular chemicals in the water (especially BOD, dissolved oxygen and ammonia).

COARSE FISH

Cyprinid fish like roach, dace and bream.

CONSENT

A statutory document issued by the NRA to indicate any limits and conditions on the discharge of an effluent to a controlled water.

CONTROLLED WATERS

All rivers, canals, lakes, groundwaters, estuaries, and coastal waters to three nautical miles from the shore.

DANGEROUS SUBSTANCES

Substances defined by the European Commission as in need of special control because of their toxicity, bioaccumulation and persistence. The substances are classified as List I or List II.

DIRECTIVE

A type of legislation issued by the European Community which is binding on Member States in terms of the results to be achieved.

DISSOLVED OXYGEN

The amount of oxygen dissolved in water. Oxygen is vital for life, so this measurement is an important, but highly variable, test of the 'health' of a water; it is used to classify waters.

DETERMINAND

A general name for a characteristic or aspect of water quality. Usually a feature which can be described numerically.

EIFAC STANDARDS

Water quality standards for freshwater fish, recommended by EIFAC, the European Inland Fisheries Advisory Commission.

EUTROPHIC

A description of water which is rich in nutrients. At worst, such waters are sometimes beset with unsightly growths of algae (ibid).

GAME FISH

Salmonid fish, eg trout and salmon.

95-PERCENTILE STANDARD

A level of water quality, usually a concentration, which must be achieved for at least 95 percent of the time.

QUALITY OBJECTIVE

The statement or category of water quality that a body of water should match, usually in order to be satisfactory for use as a fishery or water supply.

QUALITY STANDARD

A level of a substance or any calculated value of a measure of water quality which must be met. The pairing of a specific concentration or level of a substance with a summary statistic like a percentile (ibid) or a maximum.

SALMONID FISH

Game fish, eg trout and salmon.

STATISTICALLY SIGNIFICANT

A description of a conclusion which has been reached after making proper allowance for the effects of random chance.

STATUTORY WATER QUALITY OBJECTIVE

A Quality Objective (ibid) given a statutory basis by Regulations made under the Water Act of 1989.

TARGET CLASS

The class which a water should achieve in the future. Some rivers may already be within their Target Class, others will require improvement.

REFERENCES

(1) River Quality in England and Wales - 1985. HMSO London, 1986.

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NRA

National Rivers Authority