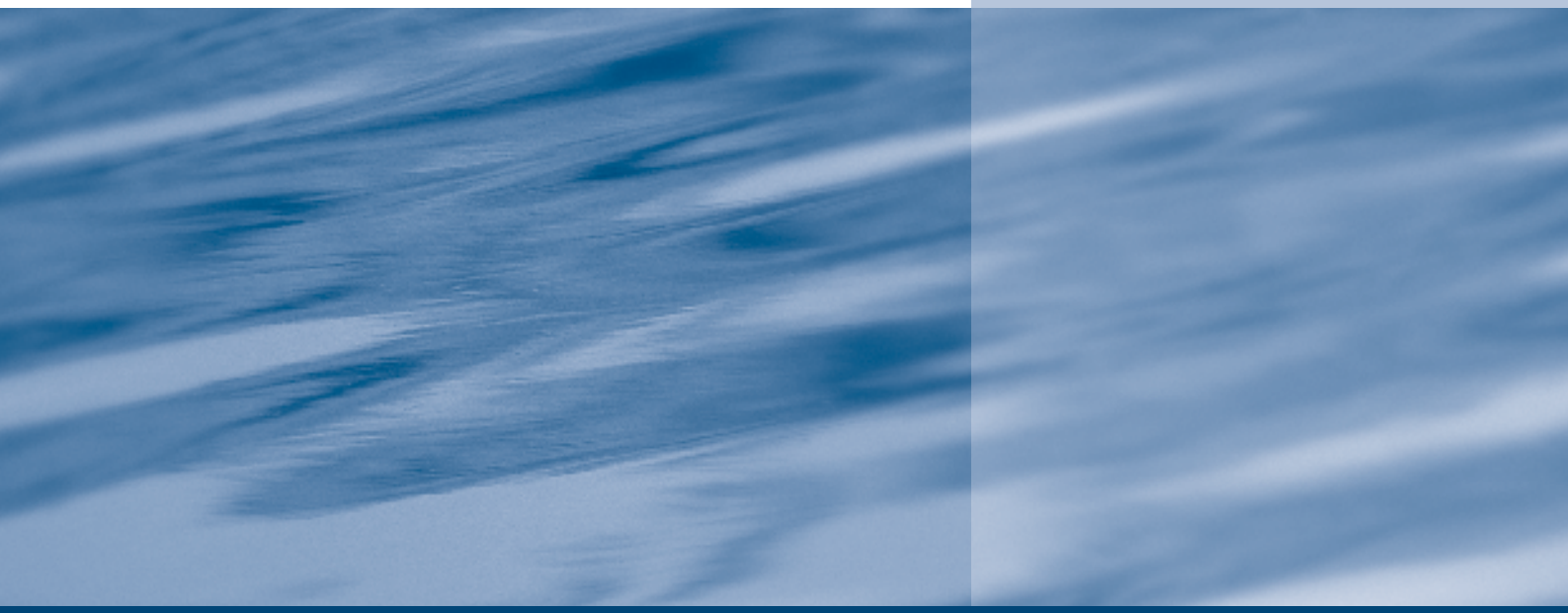


www.environment-agency.gov.uk

The Collection and Analysis of Environmental Stresses Influencing Biological General Quality Assessment in 2000

Science Report E1-114/SR

ENVIRONMENT AGENCY

The Environment Agency is the leading public body protecting and improving the environment in England and Wales.

It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

This report is the result of research commissioned and funded by the Environment Agency's Science Programme.

Published by:
Environment Agency, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol, BS32 4UD
Tel: 01454 624400 Fax: 01454 624409
www.environment-agency.gov.uk

ISBN: 1 84432 340 4

This report is printed on Cyclus Print, a 100% recycled stock, which is 100% post consumer waste and is totally chlorine free. Water used is treated and in most cases returned to source in better condition than removed.

Further copies of this report are available from:
The Environment Agency's National Customer Contact Centre by emailing enquiries@environment-agency.gov.uk or by telephoning 08708 506506.

Author(s):
R. W. Martin, M. A. O'Connor and W. J. Walley

Dissemination Status:
Publicly available

Keywords:
River, Environment, Survey, Pressure, Stress, Quality, Survey

Research Contractor:
Centre for Intelligent Environmental Systems, Faculty of Computing Engineering and Technology, Staffordshire University, PO Box 334, Beaconside, Stafford, ST16 9DG
Tel: + 44 (0) 1785 353510

Environment Agency's Project Manager:
Dr. John Murray-Bligh.

Statement of use
This report has been produced to summarise changes in stresses reported by Areas between 1995 and 2003. The report is aimed mainly at Environment Agency Ecological Appraisal Staff as a record of what has been done and to inform future projects. Readers should be aware of the limitations of the data presented, which are based on perceptions and not necessarily confirmed by survey or physical evidence. The main use of the data is to assist further development of diagnostic tools.

Science Project Number:
E1-114/SR

Product Code:
SCHO1004BIJL-E-P

Science at the Environment Agency

Science underpins the work of the Environment Agency, by providing an up to date understanding of the world about us, and helping us to develop monitoring tools and techniques to manage our environment as efficiently as possible.

The work of the Science Group is a key ingredient in the partnership between research, policy and operations that enables the Agency to protect and restore our environment.

The Environment Agency's Science Group focuses on five main areas of activity:

- **Setting the agenda**: To identify the strategic science needs of the Agency to inform its advisory and regulatory roles.
- **Sponsoring science**: To fund people and projects in response to the needs identified by the agenda setting.
- **Managing science**: To ensure that each project we fund is fit for purpose and that it is executed according to international scientific standards.
- **Carrying out science**: To undertake the research itself, by those best placed to do it - either by in-house Agency scientists, or by contracting it out to universities, research institutes or consultancies.
- **Providing advice**: To ensure that the knowledge, tools and techniques generated by the science programme are taken up by relevant decision-makers, policy makers and operational staff.

Professor Mike Depledge Head of Science

CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

This technical report presents the results of the research and development (R&D) project *Collection and Analysis of Environmental Stresses Influencing Biological GQA in 2000*, which was financed by the Environment Agency. The project builds on earlier work (reported in Technical Report E126) to collate data on perceived stresses at General Quality Assessment (GQA) biological monitoring sites on rivers throughout England and Wales.

The Centre for Environmental Information (CIES) developed the Stress Recording System (SRS) software to enable the Environment Agency to collate the data. This software overcomes many of the problems identified in the previous attempt to collect stress data using a simple spreadsheet program. The categorisation of stresses was revised to eliminate overlap between stress categories, in order to reduce the level of subjectivity in the data collection process. The Ecological Appraisal Teams in each of the Environment Agency's areas used SRS was used to collect data on the environmental stresses that they perceived at each of their GQA sites. However, this data collection exercise was incomplete when this report was written. Only 13 out of 27 areas provided information by November 2003, and some of this information was incomplete. At the time of writing, further data continues to be collected from the remaining areas. As a result, it was not possible to complete a comprehensive report on the distribution of the stresses and the quality of the stress data, or to analyse the relationships between biological data and the stress categories at a national level. The scope of the project, and hence of this technical report, was therefore reduced.

1. INTRODUCTION

1.1 Background to the study

This technical report presents the results of the R&D *project Collection and Analysis of Environmental Stresses Influencing Biological GQA in 2000*, which was financed by the Environment Agency. The project builds on earlier work (reported in Technical Report E126) to collate data on perceived stresses at GQA sites throughout England and Wales. It spanned three main components: (i) the production of a system for collecting stress data; (ii) the collection and validation of stress data; and (iii) analysis of the data collected.

The work was carried out by the Centre for Intelligent Environmental Systems (CIES) in the Faculty of Computing, Engineering & Technology at Staffordshire University under the supervision of Raymond W. Martin. Research Associates Mark O'Connor (also CIES manager), David Trigg, and Professor W. J. Walley (head of CIES), provided assistance. The data generation and collection work in component (ii) was carried out by the Environment Agency's Ecological Appraisal Teams in each of their areas, and the resulting data was sent to CIES for collation, validation and analysis. The Environment Agency's Project Manager was Dr John Murray-Bligh.

In 1998, an initial set of data about the stresses affecting biological GQA monitoring sites was elicited from area and regional biologists, to accompany the results of the 1995 national biological GQA river survey. This was the first time that such information had been recorded systematically and comprehensively. It was used to help interpret the results of the GQA surveys, to develop software to interpret biological data, to determine suitable sites and data for other R&D projects and to inform the risk assessment and intercalibration of classification schemes across Europe for the Water Framework Directive (WFD). The quality of data on stresses varied across the country. Biologists in some areas didn't have enough time for the task. There was also overlap in the categories defining different types of stress and considerable subjectivity in the interpretation of these categories. The reasons for variable data quality, and proposed solutions, were reported in R&D Technical Report E126.

1.2 Objectives

The overall objective was to provide information on the stresses or pressures affecting biological GQA sites in 2000, to complement the 2000 GQA survey data. The objective was later modified to the collection of data for 2000, 2001, 2002 and 2003. The original specific objectives were:

1. To provide a software system for collecting information about environmental stresses affecting biological GQA sites in 2000 from Agency biologists in area teams. Shortcomings in the system used to collect similar data in 1998 for the 1995 GQA survey that caused variations in the quality of the data would be avoided, particularly problems caused by 'cutting and pasting' records from site to site. The system should be easy for biologists to understand and to use, capable of collecting the information efficiently (i.e. not entail unnecessary effort or time) and be compatible with the Agency's desktop computer system.

2. To devise a categorisation of stresses that would take account of the need to consider new and future uses of the data, including the reporting of river quality objectives and biological quality objectives, the Water Framework Directive and existing databases of

environmental pressures. The new categorisation would resolve shortcomings in the system used for collecting data on stresses in 1995 by taking account of the mutual exclusivity of each category and the clarity of definition of each category.

3. To record the stresses that area biology teams believed to have affected each GQA site in 2000 using the system developed specifically for the purpose (see items 1 and 2 above).

4. To collate the records of stresses provided by each area into a single database to aid its analysis and further use.

5. To check the stress data in order to identify missing or erroneous data.

6. To inform the area biology teams of omissions or errors so that they could provide corrections and additions.

7. To correct the collated database.

8. To produce a technical report on the distribution of the stresses and the quality of the stress data.

9. To analyse and report on the relationships between biological data and the stress categories in order to provide information to help interpret the results of future biological surveys.

1.3 Summary of outcomes

The initial objectives of the project were achieved in that:

1. A Stress Recording System (SRS) was developed and delivered to the Agency to enable collation of data. This software overcame many of the problems identified in the previous attempt to collect stress data using a simple spreadsheet program. SRS retained the successful and familiar 'look and feel' of the River Biology Monitoring System (RBMS) the Agency previously used.

2. A categorisation of stresses was devised that resolved many of the shortcomings identified in the system used for collecting 1995 stress data.

3. Stress data was collected for 2000 with notes indicating changes in stresses in 2001-2003.

Further objectives were only partially achieved as there were significant delays in receiving data from the areas. In many cases, no stress data was received before November 2003 so that the scope of this project, and consequently the depth of this Technical Report, was reduced.

The value and utility of stress data is, though, such that it is important for the work to be completed. At the time of writing, outstanding data continues to be collected and recorded. The unfulfilled objectives now form part of a new project *Development of an Integrated Classification System for Rivers and Lakes*, funded by the Environment Agency's Environmental Monitoring, Classification and Reporting Project for the Water Framework Directive. This project also extends the work to collection of information on stresses at GQA sites in 2004.

2. DEVELOPMENT OF STRESS RECORDING SYSTEM (SRS)

2.1. Background to SRS

SRS was developed to collect stress information in a better format than the spreadsheets used in 1998 for the 1995 survey. This earlier survey, as reported in R&D Technical Report E126, suffered a number of problems related to the use of spreadsheets. In particular, users were able to enter data for one site and then, using the 'copy and paste' facility of the spreadsheet, enter the same data to other sites, irrespective of whether it was applicable to those sites. The Environment Agency's Computer Information Systems (CIS) representative on the project board held a meeting with the Agency at Millbank Tower, London, on 10 May 2001 to demonstrate a prototype program capable of being used to collect stress data. The functionality of the programme was considered with user representatives, as was the suitability of the Agency's network with a representative from CIS Testing and Integration. At the same time, it was agreed that the list of stress categories and types should be revised to remove some of the anomalies discovered during the 1995 data collection. The categories were revised in close collaboration with Water Quality (in particular, Ashley Holt), to ensure compatibility with categories used for reasons for water quality objective (WQO) failure. Hydro-ecology, ecology and flood defence staff were consulted. The final list of stress categories and types is given in Appendix A.

An updated SRS program was supplied incorporating a number of additions and modifications that had been requested at the Millbank meeting to the Agency in October 2001. Unfortunately, this coincided with a freeze on testing and integration of new software with the Agency's computer network when CIS staff were diverted to work on the introduction of Windows 2000. Further delays were caused by a new policy and approval process (termed 'convergence') to reduce the inventory of software on the Agency's network. This process was not completed until August 2002, and SRS was not installed on the Agency's computer network until October 2002. Even then, installation was patchy and biologists in many areas did not have access to SRS software until much later.

On 16 May 2003, the project board held a meeting in Reading in order to revive the SRS project following installation of the software on regional PCs. As there had been a number of changes to the GQA network of sites to be assessed for stress since the lists were originally compiled, updated site files for SRS were produced and supplied to the Agency at the beginning of June 2003. At the beginning of September 2003, when users began to enter data, problems with these updated site files surfaced. A corrected set of files was supplied to the Agency two days later.

Instructions for checking and installing the latest site and data files on the Agency network and Regional or Area shared drivers were incorporated in the user guide in July 2003 (Versions 2 and 2.1), September 2003 (Version 2.2) and October 2003 (Version 2.3). To supplement the support to users from CIES and the Agency's project manager, a page was written with details of SRS for the Environment Agency's Intranet in September 2003 (see Appendix E). This enabled users to download the latest version of the user manual and other supporting information (for example, Appendix F).

2.2. Summary of SRS development

A comprehensive list of the development dates for SRS is given in Table 2.1.

Table 2.1. Significant dates within SRS development and use by Environment Agency

Date	Item
15-Aug-00	Initial development of SRS program.
10-May-01	Meeting at Millbank Tower, London with Agency to demonstrate prototype SRS program.
18-Sep-01	Adopted final list of Stresses to be used within SRS.
16-Oct-01	Updated SRS program, incorporating changes requested on 10 May 2001, supplied to Agency.
05-Nov-01	Contract RC944 from Agency awarded to Staffordshire University for three phase SRS program.
05-Nov-01	SRS Manual and Software Installation Guidance Notes produced.
04-Dec-01	Invoice raised upon completion of first phase of SRS sent to Agency.
22-Jan-02	SRS awaiting tests for 'harmonisation' before release to regions.
	SRS data will probably not be collected until March 2002.
28-Feb-02	Invoice raised to cover additional work on SRS, including use via network servers.
30-Jul-02	SRS being tested for 'harmonisation'.
06-Aug-02	SRS approved for delivery to regions.
15-Oct-02	SRS rolled-out onto the Agency's computer network.
21-Oct-02	Updated SRS Manual produced.
16-May-03	Project Meeting at Reading to 'revive' SRS.
27-May-03	Updated GQA sites file received from Agency.
03-Jun-03	Updated SRS site and blank data files supplied to Agency.
01-Sep-03	Problems reported when entering stress data into SRS when using 3 June 2003 files.
03-Sep-03	Updated SRS site files supplied to Agency to correct data entry problems.
29-Oct-03	Invoice raised to cover extended delays in returning data for analysis in SRS second phase.
02-Sep-03	First set of SRS data returned from Welsh Region, South West Area using 2002 Sites file.

The operation and use of SRS is documented in the SRS manual, included as Appendix B.

3. DATA COLLECTION

Table 3.1. Dates of receiving data from Regions

Date	Region	Area	Comments
02-Sep-03	Welsh	South West	Used 2000 sites file
09-Sep-03	Welsh	North	
15-Sep-03	Welsh	South East	
15-Oct-03	Thames	North East	
	Southern	Kent	
20-Oct-03	North East	Ridings	
	Southern	Isle of Wight	
	Southern	Hampshire	
30-Oct-03	North West	Central	Used 2000 sites file
03-Nov-03	North East	Dales	
	North West	Northern	
06-Nov-03	North East	Northumbrian	Limited number of sites
	Southern	Kent (update)	
07-Nov-03	Southern	Isle of Wight (update)	
	Southern	Hampshire (update)	Cut-off point for received data
21-Nov-03	Southern	Sussex	Added to complete Southern Region
28-Nov-03	Anglian	Central	Additional data received since cut-off
08-Dec-03	Midlands	Upper Trent	date set as mid November 2003
	Midlands	Lower Trent	
19-Dec-03	Thames	West	
	Thames	South East	
05-Jan-04	Anglian	Eastern	
	Anglian	Eastern (update 1)	
09-Jan-04	Anglian	Eastern (update 2)	
22-Jan-04	South West	Cornwall	
	Anglian	Northern	No data received by end of March 2004
	North West	Southern	
	Midlands	Upper Severn	
	Midlands	Lower Severn	
	South West	Devon	
	South West	North Wessex	
	South West	South Wessex	

Table 3.1 summarises the dates on which data was received from each of the areas. The first file of collected data was received at Stafford on 2 September 2003, this coming from the Welsh Region, South West Area. The data, though, related to the original site file installed in October 2002, not the updated site file of September 2003. A deadline was set requiring all data to be collected by mid-November 2003. By 21 November 2003, data had been received from 12 areas, and a limited set of data had been received from one area (Northumbria).

Though further data has since been received, the summaries presented in this section refer only to the data received before the deadline.

The data files received from the areas were checked against the list of sites on the supplied SRS sites file to determine the completeness of the data. The sites were then matched with the 1995 stress sites to determine the number of matched sites with data for 1995 and 2003. These results are given in table 3.2 below.

Table 3.2. Number of sites with received stress data by Region and Area

Region	Area	2003 Sites	2003 Received	Matched with 1995
Anglian	North	191		
	Central	256		
	East	306		
North East	Northumbria	249	39	30
	Dales	203	203	153
	Ridings	396	396	359
North West	North	278	272	238
	Central *	252	248	232
	South	357		
Midlands	Upper Severn	260		
	Lower Severn	319		
	Upper Trent	280		
	Lower Trent	419		
Southern	Hampshire	139	139	132
	Isle of Wight	21	21	19
	Sussex	138	138	128
	Kent	240	240	238
South West	North Wessex	367		
	South Wessex	175		
	Devon	317		
	Cornwall	320		
Thames	North East	160	160	114
	South East	123		
	West	289		
Welsh	North	212	212	207
	South East	350	349	335
	South West *	299	281	272
Totals		6916	2698	2457

* These areas used the original 2000 sites file, not the updated 2002 file.

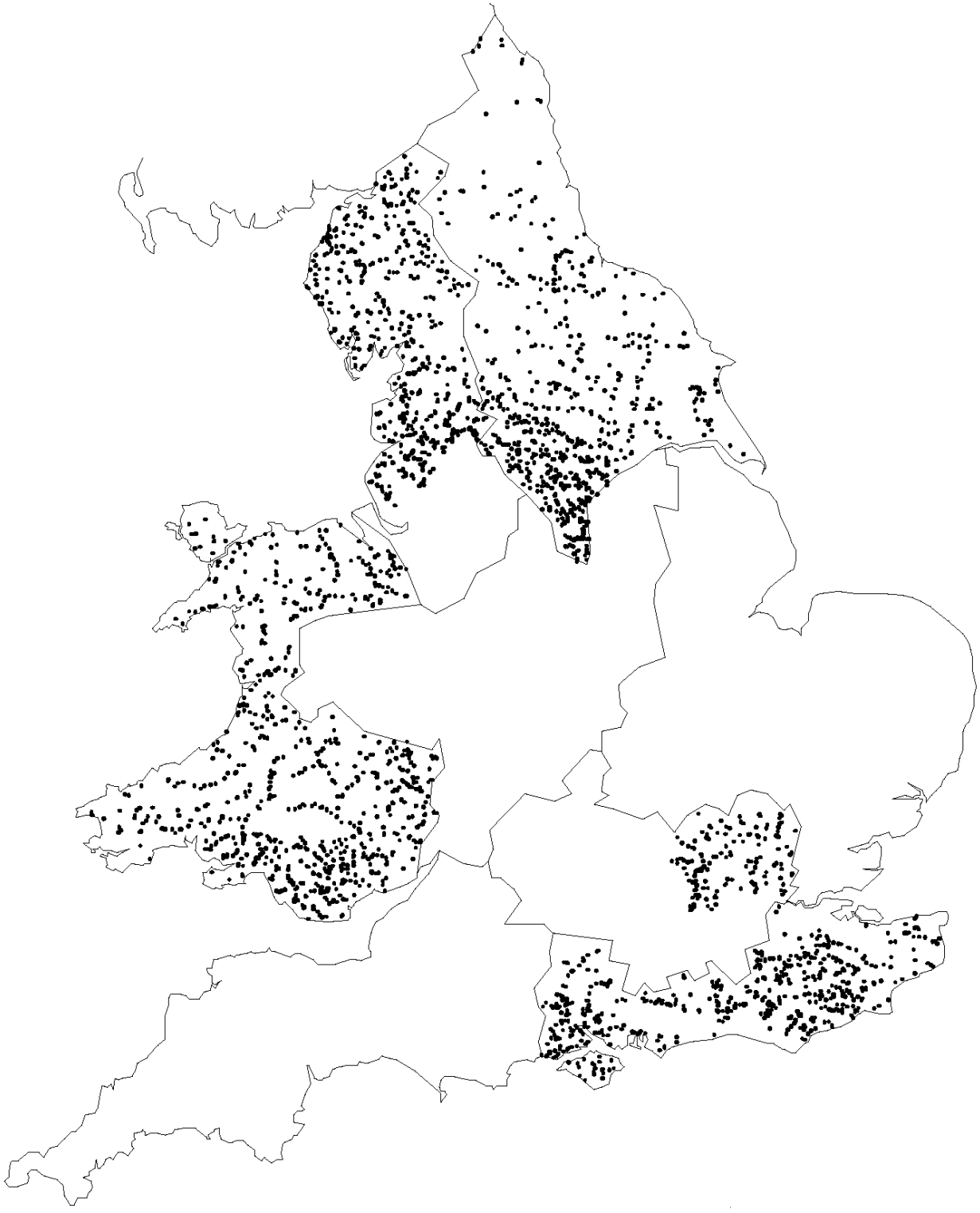


Figure 3.1. Map showing sites with stress data for 2000-03, provided by November 2003

4. RESULTS

Table 4.1 gives a summary of the stress data recorded in 1995 and 2000-03. It was hoped that stress data for all of the 6038 sites with validated spring and autumn 1995 data could be obtained and stored on the M2R database for use by the River Pollution Diagnostic System (RPDS). After validation, however, data for only 5870 sites were accepted as valid. Further details of the 1995 stress analysis were given in R&D Technical Report E-126. Using the limited amount of stress data returned before the November 2003 cut-off date, 2698 sites were recorded with stress data. Of these, 2457 matched sites for which stress data had been recorded for 1995. Most of the subsequent data analysis has been made on the two sets of 2457 matched sites.

Table 4.1. Summary of number of stresses recorded 1995 and 2000-2003

	Total sites		Matched sites	
	1995	2000-03	1995	2000-03
Number of sites	6250	6916		
Sites with data	5938	2698	2457	2457
Validated sites	5870			
Number of stresses	16941	6209	5439	5669
Maximum stresses / site	19	10	11	10
Minimum stresses / site	1	1	1	1
Average stresses / site	2.71	2.30	2.21	2.31

Appendices B and C include tables showing the number of instances at each stress intensity for all stress categories and types at the 1995 and 2000-03 matched sites. Summary tables for the stresses with 75 or more recorded instances in 1995 or 2000-03 and given below, in tables 4.2 and 4.3. Table 4.4 shows the total numbers for each stress from these two tables ranked according to the 1995 totals. This shows that the topmost stress in 1995 ‘STW – treated STW effluent’, retained the top position in 2000-03. Other stresses varied their ranking position slightly, but most of the top ten stresses from 1995 were within the top ten in 2000-03.

Of interest are the positions of ‘Farming – general’ and ‘Farming – fertilisers’: in 1995, these two stresses held fourth and eleventh positions respectively. In 2000-03, ‘Farming – other’ had dropped to ninth, while ‘Farming – fertilisers’ had risen to fifth position. This could be explained by an increased awareness of fertiliser related stresses, or could be due to SRS requesting further information if ‘other’ was selected during data input. It may have simply been easier to select an existing stress type instead of having to enter text into the comments field. The stress ‘Low flow – general’ also showed a drop, from tenth position in 1995 to seventeenth position in 2000-03. This could, again, be due to better data entry, or annual weather variations.

The three stresses at the bottom of table 4.4, namely ‘Artificial bank’, ‘Coal mine drainage’ and ‘Impoundment upstream’ all rose in the ranking order from 1995 to 2000-03. Whether more banks have been artificially strengthened or more impoundments created is unknown. It could also be that the results simply show more accurate recording of existing conditions not recorded in 1995.

Table 4.2. Stresses with 75 or more records for 1995

Stress description	Stress intensity				
Category – Type	Unknown	Light	Mod.	Severe	Total
STW – treated STW effluent	4	90	165	220	479
No perceived problem *	388	0	0	1	389
STW – combined sewer overflow	11	36	136	151	334
Farming – general	23	25	162	108	318
Run-off – urban	6	76	102	88	272
Sediment at the site – inert siltation	1	31	73	100	205
Channel at the site – channelisation	3	47	80	28	158
Waste – slurry	113	3	8	26	150
Other indicators – *Cladophora*	2	22	66	40	130
Low flow – general	9	11	34	49	103
Farming – fertilisers	11	12	33	45	101
Run-off – general	1	0	2	97	100
Other indicators – ochre	10	22	26	32	90
Bank practices at site – livestock	1	5	30	53	89
Low flow – drought	7	10	36	29	82
Run-off - highway (including salt)	9	3	26	39	77
Sampling difficulty – dredge *	56	4	11	5	76

Table 4.3. Stresses with 75 records or more for 2000-03

Stress description	Stress intensity			
Category – Type	Light	Mod.	Severe	Total
STW to river - treated STW effluent	52	208	219	479
STW to river - combined sewer overflow (CSO)	17	173	203	393
Run-off (non-agric.)/Leachate – urban/suburban	37	146	206	389
No perceived stress * - no perceived stress	341	-	-	341
Farming – fertilisers	9	108	102	219
Eroded material in channel - inert siltation	34	84	87	205
Channel at the site - canalised stream/river (non-navig.)	52	112	36	200
Agricultural run-off - livestock slurry	6	41	126	173
Farming – other	10	99	58	167
Artificial bank at site - consolid.(stone/brick/concrete)	30	54	29	113
Other indicators – *Cladophora*	18	39	49	106
Run-off (non-agric.)/Leachate – highway (incl. salt)	5	33	62	100
Natural features – drought	13	52	33	98
Bank practices at site - livestock poaching/overgrazing	5	36	47	88
Mines, quarries & extractions - coal mine drainage	9	31	46	86
Flow-related - regulated flow (lake/resv. u/s)	14	34	35	83
Flow-related – other	8	39	34	81
Other indicators – ochre	13	28	34	75

Table 4.4. Stress rankings for 2000-03 based on 1995 ranking

Stress description	1995			2003		
Category – Type	No.	%	Rank.	No.	%	Rank.
STW – treated STW effluent	479	8.8	1	479	8.4	1
No perceived problem	389	7.2	2	341	6.0	4
STW – combined sewer overflow	334	6.1	3	393	6.9	2
Farming – general ('other' in 2003)	318	5.8	4	167	2.9	9
Run-off – urban	272	5.0	5	389	6.9	3
Sediment at the site – inert siltation	205	3.8	6	205	3.6	6
Channel at the site – channelisation	158	2.9	7	200	3.5	7
Waste – slurry	150	2.8	8	173	3.1	8
Other indicators – *Cladophora*	130	2.4	9	106	1.9	11
Low flow – general ('other' in 2003)	103	1.9	10	81	1.4	17
Farming – fertilisers	101	1.9	11	219	3.9	5
Run-off – general *	100	1.8	12	15	0.3	67*
Other indicators – ochre	90	1.7	13	75	1.3	18
Bank practices at site – livestock	89	1.6	14	88	1.6	14
Low flow – drought	82	1.5	15	98	1.7	13
Run-off – highway (including salt)	77	1.4	16	100	1.8	12
Sampling difficulty – dredge	76	1.4	17	55	1.0	32
Artific. bank at site – consolid.(stone/brick/con.)	67	1.2	20	113	2.0	10
Mines, quarries & extract. – coal mine drain.	67	1.2	21	86	1.5	15
Impoundments – lake or pond close u/s	44	0.8	36	83	1.5	16
Total number of perceived stresses	5439			5669		

* Run-off category for 2000-03 was for non-agricultural sources, and it also included leachate sources, e.g. 'Run-off (non-agric.)/Leachate – other'

To show the stresses with the greatest changes from 1995 to 2003, the 40 stresses with the largest frequency of records in 1995 were expressed as a percentage of the total number of 1995 recorded stresses. The frequency of the same stress recorded in 2003 was then expressed as a percentage of the 2003 total. Because of changes in the classification of the stresses in 2003 as compared to 1995, two of the 1995 stresses were combined into one stress equivalent to the 2000-03 stress type. The 2003 percentage was then divided by the equivalent 1995 percentage to give a ratio, showing the change between the two years. These ratios have been plotted as histograms and are shown in Figure 4.1. The bars with a value greater than one are stresses that have increased in 2003 compared to 1995, while those with low values are stresses that have decreased in 2003.

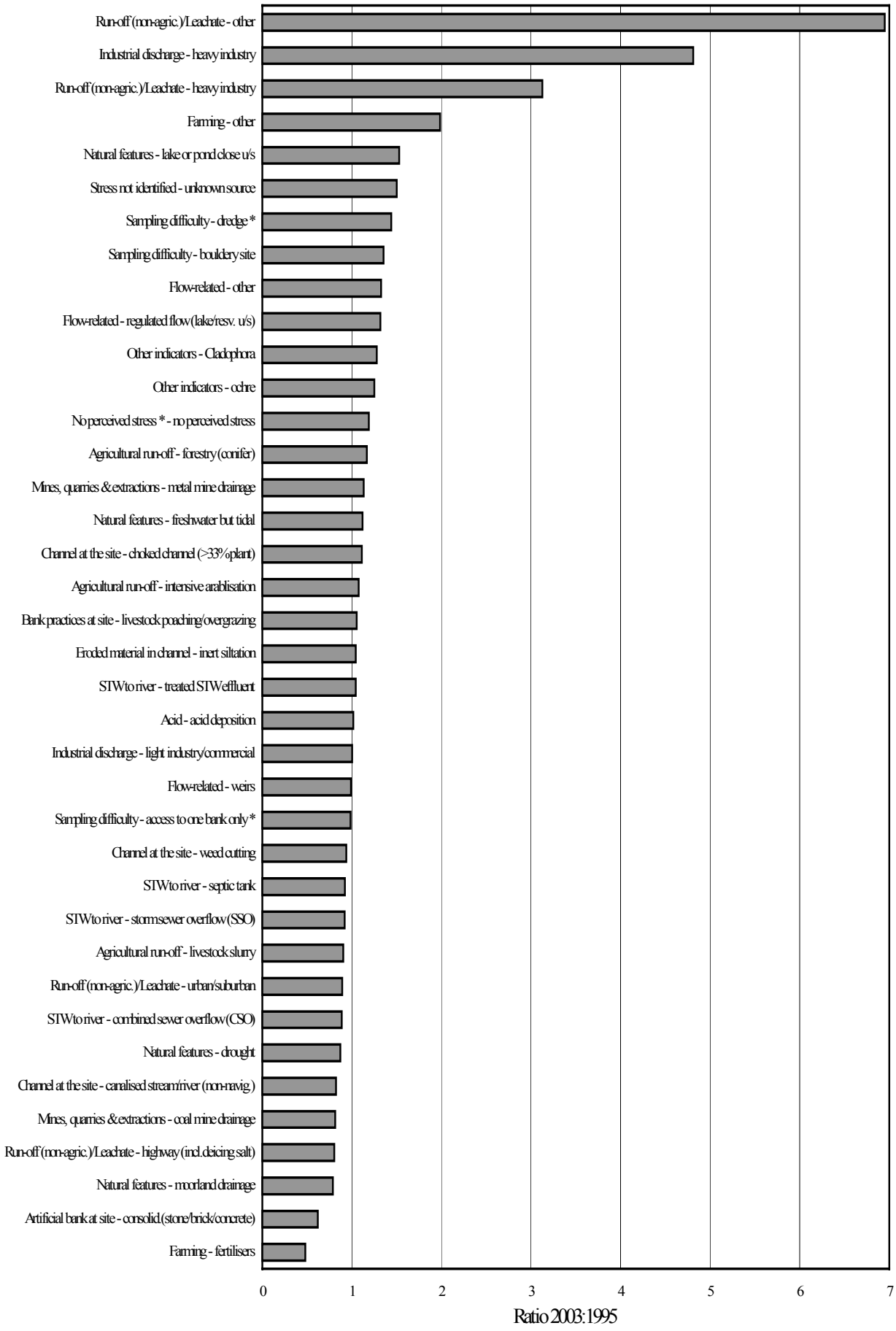


Figure 4.1. Ratio of 2003:1995 percentages of total stresses

5. SUMMARY AND CONCLUSIONS

5.1. Summary of outcomes

A revised set of stress codes (Appendix A) was formulated to overcome the difficulties encountered in the previous attempt to collect stress data for GQA sites. Stress Recording System (SRS) was developed and delivered to the Agency and used to collect stress data from each of the Areas. Only 12 of the 27 Areas provided complete or nearly complete data within the allocated time, that is, by November 2003. One Area (Northumbria, in North East Region) provided partial data. The data was collated and checked and basic analyses were carried out comparing the stresses recorded for 1995 with those recorded for 2000-03. Because much of the data was delivered late or incomplete, a more rigorous analysis and a comprehensive report on the distribution of stresses and quality of stress data were not possible.

5.2. Recommendations for further work

The potential utility of stress data has been clearly demonstrated in previous work. Stress data has been used to help river basin characterisation for Water Framework Directive (WFD). It is proving to be very useful as an alternative source of data about pressures for River Basin Characterisation and the Programme of Measures. It has also been used a number of times to screen sites, most recently to identify sites suitable for WFD Intercalibration. Stress data is used in the diagnostic software (River Pollution Diagnostic System, RPDS) developed by Staffordshire University and described in Technical Report E1-056/TR. RPDS will help Agency biologists to identify the likely environmental pressures and causes of poor biological quality based on the biological data. The potential of stress data for determining and reporting non-compliance with biological quality objectives (BQOs) was demonstrated in a prototype report produced for the Agency's Water Quality Function in 2001 (Appendix G). The stress data enabled non-compliance with BQOs to be reported in the same way as the reasons for non-compliance with chemical quality objectives. The prototype BQOs report demonstrated that BQOs could be used to help interpret the reasons for failure of chemical river quality objectives (RQOs). The stress data enabled the two types of objective to be used in an integrated and complementary way. Stress data would also be valuable for interpreting biological data and determining the sensitivities of individual taxa.

Given the proven utility of stress data, it would be useful if such data were routinely collected at GQA sites. A checklist would make this relatively straightforward, and SRS then provides a simple means of recording the data. The design of this checklist has been incorporated in the WFD EMCAR project 'Development of an Integrated Classification System for Rivers and Lakes'. The problems of failure to collect or deliver stress data can largely be attributed to the lack of integration between the GQA survey and the stress survey. When undertaken as a separate exercise, the recording of stress data has proved to be an onerous task for the areas.

The collection of stress data has continued past the November 2003 deadline. By the end of 2004, stress data had been received from 26 of the 27 Areas, only the Devon Area in South West Region not having supplied data by then. However, because of the incomplete data at the time of analysis, the scope of this project was considerably reduced. The collection and analysis of stress data continues as part of a new project, *Development of an Integrated Classification System for Rivers and Lakes*, which started in February 2004 and extends for 42 months. It is hoped that the systems developed in this new project will further demonstrate the value of stress data and will encourage the routine collection of data as part of future GQA surveys.

6. ACKNOWLEDGEMENTS

This study was funded by the Environment Agency. The authors are grateful to Dr John Murray-Bligh, who was the Environment Agency's Project Manager. His assistance and support throughout the project were much appreciated. Thanks are also due to all of the biologists and other staff in the Agency's regional offices who tested software, provided valuable feedback and provided the data.

APPENDIX A: List of stress categories and types

Source	Code	Stress Category	Stress Type
Pollution	DF	Farming	disinfectant
Pollution	FE	Farming	fertilisers
Pollution	FF	Farming	fish farming
Pollution	HE	Farming	herbicides
Pollution	IN	Farming	insecticides
Pollution	SD	Farming	sheep-dip
Pollution	WC	Farming	water cress beds
Pollution	FA	Farming	other (specify)
Pollution	CF	Agricultural run-off	forestry (conifer)
Pollution	IA	Agricultural run-off	intensive arablisation
Pollution	SL	Agricultural run-off	livestock slurry
Pollution	SI	Agricultural run-off	silage
Pollution	AO	Agricultural run-off	other (specify)
Pollution	AB	Agri-industry	abattoir/meat processing/rendering
Pollution	BR	Agri-industry	brewery
Pollution	DA	Agri-industry	dairy
Pollution	FL	Agri-industry	flour mill
Pollution	MF	Agri-industry	mushroom farm
Pollution	SU	Agri-industry	sugar refinery
Pollution	TA	Agri-industry	tanning/leather
Pollution	VE	Agri-industry	vegetable processing
Pollution	WO	Agri-industry	wool
Pollution	AI	Agri-industry	other (specify)
Pollution	GR	STW to aquifer	via groundwater recharge
Pollution	CS	STW to river	combined sewer overflow (CSO)
Pollution	SE	STW to river	septic tank
Pollution	SS	STW to river	storm sewer overflow (SSO)
Pollution	TS	STW to river	treated STW effluent
Pollution	ST	STW to river	other (specify)
Pollution	AS	WTW	aluminium sulphate
Pollution	FS	WTW	iron sulphate
Pollution	SW	WTW	swimming pool
Pollution	WT	WTW	other (specify)
Pollution	BW	Industrial discharge	brick works
Pollution	CE	Industrial discharge	cement works
Pollution	DY	Industrial discharge	colouration (dye)
Pollution	CW	Industrial discharge	cooling water (warm)
Pollution	DE	Industrial discharge	detergent
Pollution	HI	Industrial discharge	heavy industry
Pollution	LI	Industrial discharge	light industry/commercial
Pollution	PC	Industrial discharge	petrochemicals (mfr & distribution)
Pollution	PM	Industrial discharge	paper mill
Pollution	PL	Industrial discharge	plating
Pollution	ID	Industrial discharge	other (specify)

Source	Code	Stress category	Stress type
Pollution	AF	Run-off (non-agric.)/Leachate	aircraft/airfield de-icing (specify)
Pollution	BU	Run-off (non-agric.)/Leachate	building/road construction
Pollution	DL	Run-off (non-agric.)/Leachate	domestic landfill
Pollution	FY	Run-off (non-agric.)/Leachate	fly-tipping
Pollution	HR	Run-off (non-agric.)/Leachate	heavy industry
Pollution	HY	Run-off (non-agric.)/Leachate	highway (incl. De-icing salt)
Pollution	LR	Run-off (non-agric.)/Leachate	light industry/commercial
Pollution	RU	Run-off (non-agric.)/Leachate	motorway (incl. de-icing urea)
Pollution	RR	Run-off (non-agric.)/Leachate	railway
Pollution	SY	Run-off (non-agric.)/Leachate	scrap yard
Pollution	SH	Run-off (non-agric.)/Leachate	slag heap
Pollution	TI	Run-off (non-agric.)/Leachate	toxic/industrial landfill
Pollution	TY	Run-off (non-agric.)/Leachate	tyres
Pollution	UR	Run-off (non-agric.)/Leachate	urban/suburban
Pollution	RO	Run-off (non-agric.)/Leachate	other (specify)
Pollution	AD	Acid	acid deposition
Pollution	EX	Acid	rock exposed by construction
Pollution	CB	Mines, quarries & extractions	brick-clay extraction
Pollution	CC	Mines, quarries & extractions	china-clay extraction
Pollution	CM	Mines, quarries & extractions	coal mine drainage
Pollution	MM	Mines, quarries & extractions	metal mine drainage
Pollution	QA	Mines, quarries & extractions	quarry (acid rock)
Pollution	QB	Mines, quarries & extractions	quarry (limestone/chalk)
Pollution	SG	Mines, quarries & extractions	sand & gravel
Pollution	MI	Mines, quarries & extractions	other (specify)
Activities	SB	Artificial bank at site	consolid. (stone/brick/concrete)
Activities	GA	Artificial bank at site	gabions
Activities	SP	Artificial bank at site	metal piling
Activities	UC	Artificial bank at site	unconsolid. (rip-rap/boulders)
Activities	AT	Artificial bank at site	other (specify)
Activities	BM	Bank practices at site	boat moorings
Activities	LV	Bank practices at site	livestk poaching/overgrazing
Activities	MO	Bank practices at site	mown/managed riparian zone
Activities	BP	Bank practices at site	other (specify)
Activities	DI	Channel at the site	artificial ditch or dyke
Activities	BE	Channel at the site	bedrock
Activities	BG	Channel at the site	bridge
Activities	CN	Channel at the site	canal (artificial navigation)
Activities	CA	Channel at the site	canalised stream/river (non-navig.)
Activities	CH	Channel at the site	choked channel (>33% plant)
Activities	BD	Channel at the site	concrete stream bed
Activities	CU	Channel at the site	culvert
Activities	DN	Channel at the site	dredging
Activities	RN	Channel at the site	river navigation (locks etc)
Activities	RA	Channel at the site	river restoration
Activities	WD	Channel at the site	weed cutting
Activities	AN	Channel at the site	other (specify)
Activities	GS	Eroded material in channel	gravel, boulder
Activities	IS	Eroded material in channel	inert siltation

Source	Code	Stress Category	Stress Type
Activities	GW	Flow-related	augmentation from groundwater
Activities	RT	Flow-related	augmentation from river transfer
Activities	CD	Flow-related	cessation of STW discharge
Activities	AG	Flow-related	groundwater abstraction
Activities	HW	Flow-related	hypolimnic water
Activities	PF	Flow-related	ponded flow (lake/resv. d/s)
Activities	RF	Flow-related	regulated flow (lake/resv. u/s)
Activities	AR	Flow-related	river abstraction
Activities	PN	Flow-related	summer penning
Activities	WE	Flow-related	weirs
Activities	FR	Flow-related	other (specify)
Activities	RI	Reclaimed land	industrial
Activities	OC	Reclaimed land	opencast
Activities	RL	Reclaimed land	other (specify)
Activities	EC	Bank erosion at site	clay
Activities	EG	Bank erosion at site	gravel, boulder
Activities	ES	Bank erosion at site	sand
Natural	CV	Natural features	cave
Natural	MD	Natural features	moorland drainage
Natural	RB	Natural features	reedbed at the site
Natural	HS	Natural features	heavily shaded site
Natural	LP	Natural features	lake or pond close u/s
Natural	FT	Natural features	freshwater but tidal
Natural	DT	Natural features	drought
Natural	FD	Natural features	flood
Natural	WI	Natural features	winterbourne/non-permanent stream
Natural	LU	Natural features	other (specify)
Survey	AC	Sampling difficulty	access to one bank only *
Survey	AL	Sampling difficulty	air-lift *
Survey	BO	Sampling difficulty	bouldery site
Survey	DR	Sampling difficulty	dredge *
Survey	MS	Sampling difficulty	mobile substrate
Survey	DS	Sampling difficulty	other (specify)
Survey	BS	Sorting problem	bank-side sort *
Survey	PR	Sorting problem	poorly preserved sample
Negatives	NP	No perceived stress *	no perceived stress
Negatives	MY	Stress not identified	unknown source
Negatives	NI	No information *	no information

Effects			
Effects are qualifiers to sources of stress that are reported in the same way as sources (i.e. qualifiers are applied to them in the same way as sources). They must be related back to a source or sources using the 'comments' field.			
Effects	EF	Eutrophication	agriculture
Effects	EA	Eutrophication	angling
Effects	EE	Eutrophication	sewage
Effects	EW	Eutrophication	wildfowl
Effects	EO	Eutrophication	other (specify)
Effects	CO	Oils, petrochemicals	crude
Effects	FO	Oils, petrochemicals	fuel (diesel/petrol)
Effects	LO	Oils, petrochemicals	lubricating
Effects	TO	Oils, petrochemicals	tar/bitumen
Effects	VO	Oils, petrochemicals	vegetable
Effects	OI	Oils, petrochemicals	other (specify)
Effects	TX	Historical activity (now ceased)	toxic sediment
Effects	DC	No flow	dry channel (caused by man)
Effects	IL	Saline	industrial discharge
Effects	IG	Saline	inland geological
Effects	MA	Saline	marine or estuarine origin
Effects	SA	Saline	other (specify)
Effects	CL	Other indicators	Cladophora
Effects	OH	Other indicators	ochre
Effects	SF	Other indicators	sewage fungus

Qualifiers				
Qualifiers	1	Severity	Severe	Severity is mandatory, except for stresses marked *
Qualifiers	2	Severity	Moderate	
Qualifiers	3	Severity	Light	
Qualifiers	?	Agency intelligence	suspected/possible/unconfirmed	Mandatory when applicable
Qualifiers	f	Agency intelligence	confirmed	Mandatory when known, specify source and location
Qualifiers	x	Agency intelligence	unknown	
Qualifiers	a	Duration	acute	
Qualifiers	s	Duration	seasonal	
Qualifiers	c	Duration	chronic	
Qualifiers	y	Duration	unknown	
Qualifiers	p	Nature of source	point	
Qualifiers	m	Nature of source	multiple source	
Qualifiers	d	Nature of source	diffuse	
Qualifiers	z	Nature of source	unknown	

APPENDIX B

SRS manual

Stress Recording System (SRS)

Instruction manual

Index **page**

1. INTRODUCTION

The Stress Recording System (SRS) has been designed specifically to collect and record perceived environmental stress data for use in conjunction with the 2000 National River Survey. SRS is based on the Environment Agency's eight Regions and 27 Areas. It is designed to be used by multiple users on a file server system, and it incorporates features to minimise the possibility of one user overwriting data being simultaneously entered by another user for the same sample site.

Stress data related to the 1995 biological survey are included for all surveyed sites and can be plotted on an outline map of England and Wales. Stress data for individual sites surveyed as part of the 1995 survey is, though, restricted to biological sample sites that have also been designated as GQA sites for the purpose of the 2000 survey. The input of the stress data for 2000 is made on an individual site basis and saved in separate files for each Agency area. Additional sample sites can be created for sites that were sampled in 2000 but excluded from the designated GQA sites lists, with the stress data being subsequently added for the site. The codes used to record the stress data are displayed by SRS but are generated automatically, after selection of appropriate options from lists or check boxes, in order to minimise errors.

2. USING SRS

The operation of SRS has been designed to be similar to RBMS. Anyone who has used RBMS should have little difficulty using SRS.

2.1 Basic features

You can select the various display panels by clicking buttons on the button bar (Figure 1) across the top of the screen. If a button is grey, it is not enabled or live. If you hold the pointer over a live button, a brief description of it will appear below it. If this does not happen, the facility may simply be switched off. You can switch it back on, or off, by clicking in the little white square in the ***Show Hints*** box at the far right of the button bar. When switched on, a small black cross will appear in this square.

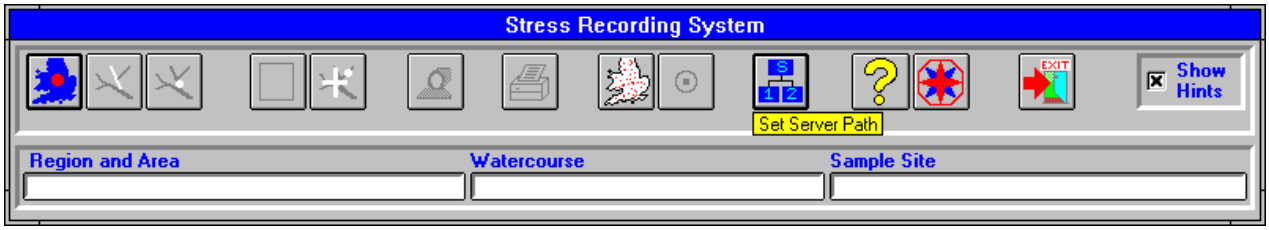


Figure 1. The selection button bar. A total of six buttons are currently live. ***Show Hints*** is switched on, and the cursor (not shown) is over the ***Set Server Path*** button so the hint for this button is displayed.

An instructions bar (Figure 2) is displayed at the foot of the screen giving hints about what to do next. The current date and time are shown at the right end of the bar. Depending on the operating system of your PC, this bar may be obscured by the operating system status bar. If this occurs, you can 'push' the status bar down using the cursor to reveal the instruction bar.

Figure 2. The instruction bar at the foot of the display screen.

2.2 Getting started and finishing

Before you can view or record any stress data, you will need to connect to your file server to ensure that SRS has access to the data files. You should only need to do this once when first using SRS. Users of SRS may find it has already been done during SRS installation process.

When you have finished using SRS, you must click the ***Exit*** button to leave the program. The normal window icon in the top right of the screen will not do this, as it is not live.

2.3 Set Server Path

This button must be used to set the path to the file server that holds the SRS data files. Until this is done, no data files can be accessed. It should only be necessary to set this option once as the path is saved and re-accessed whenever SRS is restarted. Additional step-by-step instructions are given on the panel displayed when the ***Set Server Path*** button is selected. Users of SRS may find the path has already been set when the SRS program and data files were installed.

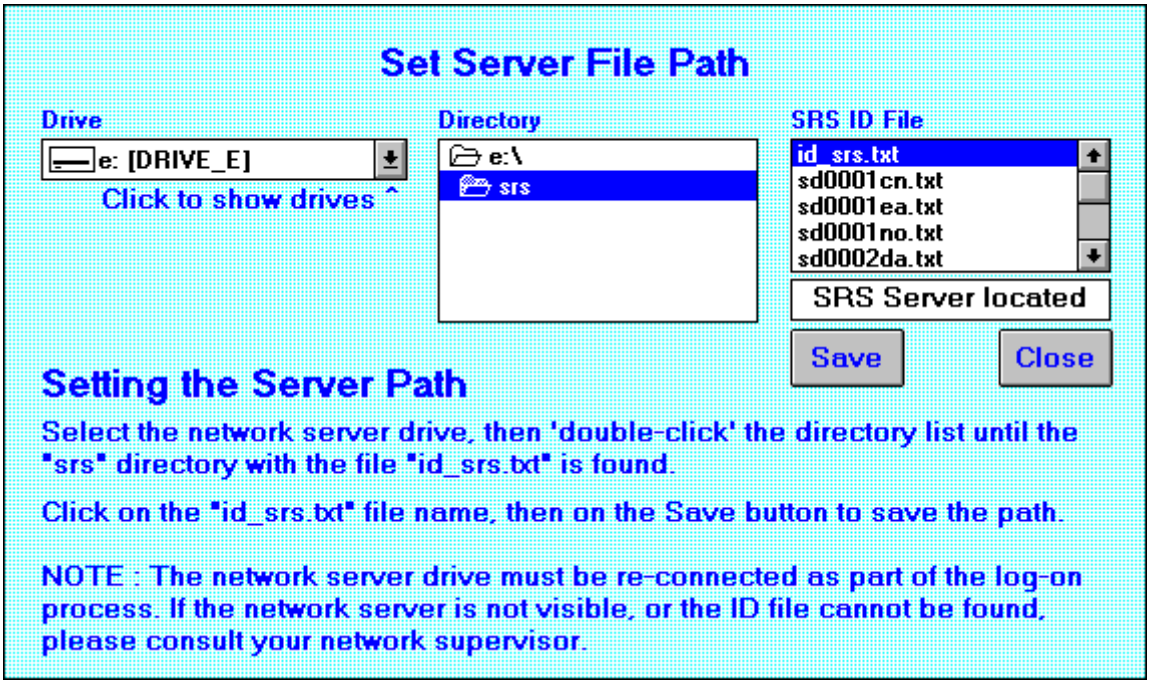


Figure 3. The **Set Server File Path** panel.

2.4 Select Region

This button allows the user to select the Environment Agency region and area, necessary before data can be accessed or recorded (Figure 4). Unlike RBMS, SRS is based on the current eight Authority regions, each sub-divided into areas. It is unlikely that the data files for all the Authority's Regions and Areas will be installed on any one SRS server, and the list of regions and areas displayed by this button will therefore be restricted to the installed files. If separate area servers are used for SRS, it is possible that users will only have access to data for their own area. Once a region and area have been selected, the details will be displayed on the lower part of the button bar. At the same time, the **Watercourse and Sample Site** panel will be displayed on the left side of the screen and a panel showing **Sites without Stress Data** on the right. To change to an alternative area within a region, click on

the ***Select Region*** button again. If you find that you need to access a region or area that is not displayed on the lists, you will need to discuss this with your data officer and ask for the appropriate files to be installed. The SRS server path is displayed, as set by the ***Set Server Path*** button, at the bottom of the panel.

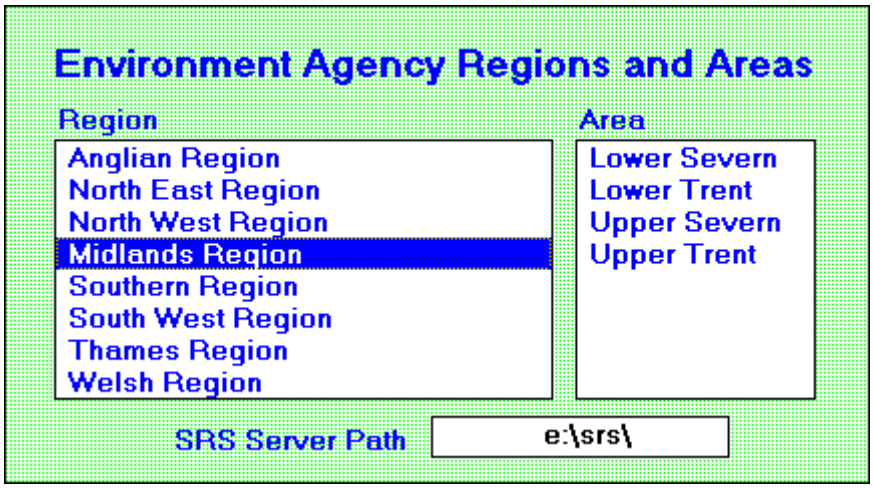
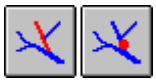


Figure 4. The regions and areas selection panel, also showing the SRS server path.

2.5 Watercourse and Sample Site



These buttons allows the user to access the data for particular watercourses and sample sites, similar to RBMS. The ***Enter Watercourse Name*** button displays the **Watercourse and Sample Sites** panel with the cursor initially located in the **Watercourse Name** input box (Figure 5).

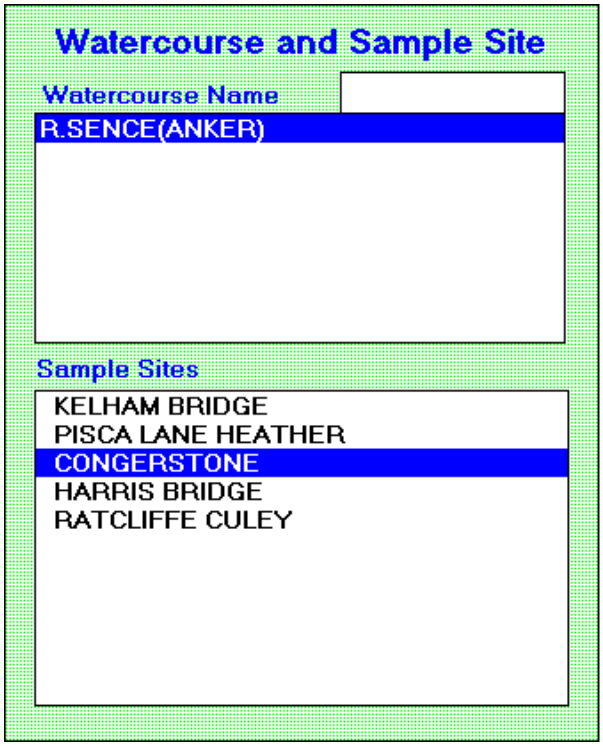


Figure 5. The **Watercourse and Site** selection panel.

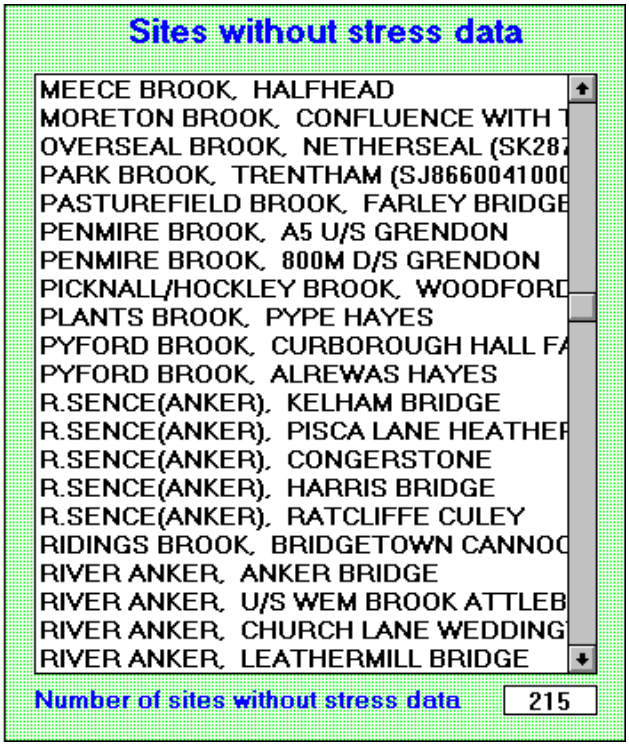


Figure 6. The **Sites without stress** data panel.

Type in the watercourse name and press <Enter>. You can type in the whole name, or if you are unsure, only part of a name to display a list of watercourse names beginning with the letters that you have typed-in. Alternatively, just pressing <Enter> without typing anything will display a list of available watercourses in that region. Select from this list, then click on the name. Once you have selected a watercourse, a list of the sites on it will be listed automatically in the **Sample Sites** part of the panel. The sites are listed in order of their distance from source; click on a site to select it. The selected site will then be highlighted and the site details shown in the **Sample Site Details** panel on the right of the screen. When a site has been selected, more buttons on the button bar will become live, indicated by turning from black and white to colour. The selected region, watercourse and site names are displayed in a panel immediately below the button bar. The names of the watercourses and sample sites displayed by SRS have been taken from the B4W national database. Any anomalies within the listed names reflect the B4W database entries. An asterisk in the **Sample Sites** list will precede sites that have already had stress data added for 2000.

The ***Select Sample Site/Display Details*** button displays the **Watercourse and Sample Sites** and the **Sample Site Details** panels. To select an alternative site from the selected watercourse, just click on the sample site name to change the details in the **Sample Site Details** panel.

2.6 Display Incomplete Sites

Whenever this button, or the ***Enter Watercourse Name*** button, is clicked, a panel titled **Sites without stress data** is displayed on the right side of the screen (Figure 6). The sites listed, given in order of watercourse and distance from source, are those that still need the stress data for 2000 to be added. Clicking on any name within the list will transfer the watercourse name to the **Watercourse and Sample Sites** panel, with a list of all sample sites to the sample sites list on the same panel. This panel therefore becomes an easy way to identify and select any sample site within the area still awaiting stress data. A box at the bottom of the panel gives the number of GQA sites without stress data. Sites that have already had 2000 stress data added will, of course, not appear on the **Sites without stress data** list. To access these, you will need to click on the ***Enter Watercourse Name*** button, enter the watercourse name and select the site name.

2.7 New Sample Sites

This button enables new sample sites to be added to the data collected by SRS. The list of sites displayed by the ***Display Incomplete Sites*** button includes only those that had been designated as GQA sites in the ((acronym in full)) (B4W) national database. Any site that was not indicated to be a GQA site does not appear in the lists. In order to enter the stress data for any site not designated a GQA site, it is first necessary to create the site on SRS. This is done in two stages. First, create the site, then enter the stress data, though the stages can be done in sequence for any one site.

The **New Sample Sites** panel (Figure 7) is divided into two portions, the left being the **New Site Details** portion, the right the **New Site Stresses**. At the top of the **Details** side, a list gives the watercourse and sample site for any sites already added; initially this will be blank. To create a new site, the following mandatory details are required:

Watercourse	Enter the watercourse name (3-45 characters in length).
Sample site	Enter the sample site name (5-55 characters in length).
Grid reference	Grid square, eastings and northings are entered separately.

B4W site ID	Obtained by a query on B4W sites database.
Distance from source (km)	Enter kilometres from most distant source.

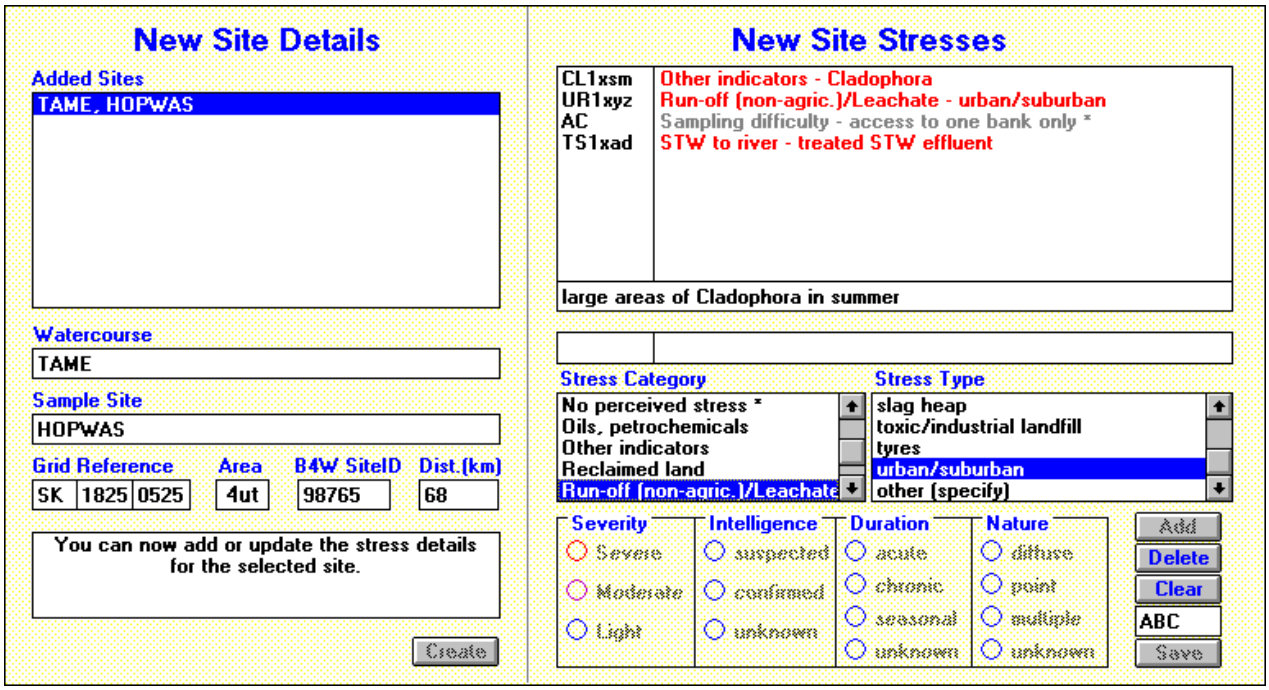


Figure 7. The **New Sample Sites** panel.

All sites that have been biologically sampled should already have been created on the B4W database. The details necessary for the creation of any new sites on SRS should therefore be obtained by a query to this database. The reason for any sample site being excluded from the SRS predefined site lists is probably because they were not indicated as GQA sites on the B4W data input forms; the SRS sites being based on the B4W GQA lists. Please use the watercourse, sample site, grid reference, B4W site ID and distance from source as obtained from the B4W database query. Once a new site has been created on SRS, it is not possible to edit the site details, and attempts to create another site with the same B4W Site ID will be rejected. During the data analysis phase of the SRS project, all user-created sites will be validated against the national B4W database to ensure both accuracy and consistency of the site details. Any queries encountered during the data analysis phase will be referred back to the creator of the new site. If you have any problems obtaining the B4W details, please consult your area data officer.

To create a new site, click the ***New Sample Sites*** button on the button bar. This will display the **New Sample Sites** panel, with the cursor initially located in the Watercourse name input box. Enter the required details (all lower case acceptable) and press the <Enter> key. The name will be converted into capital letters and redisplayed in the input box. At the same time, the cursor will automatically move to the Sample site input box. Add the details and press the <Enter> key. Note that the grid reference is entered in three separate parts: first the 100-kilometre-square letters, then the eastings, and finally the northings. Data validation is employed to minimise the possibility of entering invalid grid squares. The eastings and northings must be four numbers long each. The area code will then be inserted automatically, and the cursor will move onto the B4W Site ID input box. Enter the number you have obtained from the B4W database. Data validation will prevent duplication of B4W Site ID numbers with either predefined or newly created sites. Lastly, enter the distance from source.

Once all the required details have been entered, the <Create> button at the bottom of the panel will be enabled; click it to create the new site. While you are entering these site details, appropriate guidance will be given in the bottom box of the panel.

Once a new site has been created, the stress details can be entered either immediately or can be deferred until all the required new sites have been created. To continue creating new sites, click on the ***New Sample Sites*** button again. This will add the site you have just created to the selection list and clear the input boxes ready for the next site. To add the stress details to the site you have just created, simply move to the **New Site Stresses** on the right side of the panel and select a stress category. The entry of stress data for new sites is similar to entering data for 2000 and is described in more detail in the ***Display/Input Stress Details*** section below.

2.8 Display/Input Stress Details

This button enables users to display existing stress data for 1995 and 2000 or to add new data for 2000 to the selected site. Two panels are displayed adjacent to one another, the 1995 panel on the left, the 2000 panel on the right. The 1995 panel displays the data that was collected as part of the 1995 biological survey and the stress qualifiers. The 1995 data on this panel cannot be edited, though it can be used to assist entry of the 2000 data. Sites added for the 2000 survey, but which were not included in the 1995 survey, will display a 'Data not available for 1995' message in place of the stress list when the site is selected.

When you click the ***Display/Input Stress Details*** button for a site selected from the ***Display Incomplete Sites*** list, the top portion of the 2000 panel on the right will initially be blank. This will also apply to the **New Site Stresses** panel displayed for user-created new sites until stress data are added. To add a stress to the list, start by positioning the cursor on the Stress Category list. Scroll through the list until you find the required category, then click on it. A secondary list showing the available Stress Types will then appear in the right hand box. Select the appropriate type by clicking on it. The code for the selected category and type will appear in the left box of the stress input line. At the same time, the Stress Severity options will be enabled. Select the appropriate severity level by clicking on the circle on it. The stress definition will now appear in the right box of the stress input line, coloured according to the chosen stress severity level. The next three sets of options will each be enabled in turn; click on an option to select it.

Note that if the Confirmed Intelligence option is selected, you will be asked to specify the source and location in the comments box. This box is at the bottom of the 2000 stress list, immediately above the stress input line. Move the cursor onto the box and click the left mouse button to select the box. Now enter the requested details in the box, up to a maximum of 70 characters. Next, select the Stress Duration and Nature from the available options. Once you have completed the selection process and the full stress code has been built up in the stress input line, the ***Add*** button will appear coloured, indicating its active state. Click on it to transfer the stress input line to the entered 2000 stresses. The ***Clear*** button will be activated, and the cursor will move to the input box for the User ID code. This is a two or three character code intended to hold the users initials or other identifying code. Figure 6 shows the display after three stresses and some comments have been entered and the next stress has been completed ready to be added to the stress list.

The ***Clear*** button does what it says; it clears all the stress data, including the comments, from the current site. If instead you wish to remove just one individual stress, you can do this by using the ***Delete*** button. Select the stress to be deleted by moving the cursor onto the stress

code in the left-hand column of the stress list and clicking it. This will highlight the code and enable the ***Delete*** button; click on it to remove the selected stress. The comments will not be changed, so that if any of the comments refer to the deleted stress, the comments field will need editing. You can do this by clicking on the comments box and simply editing the contents. If you wish to save the amended data, move to the User ID input box, enter your ID code and then click the ***Save*** button.

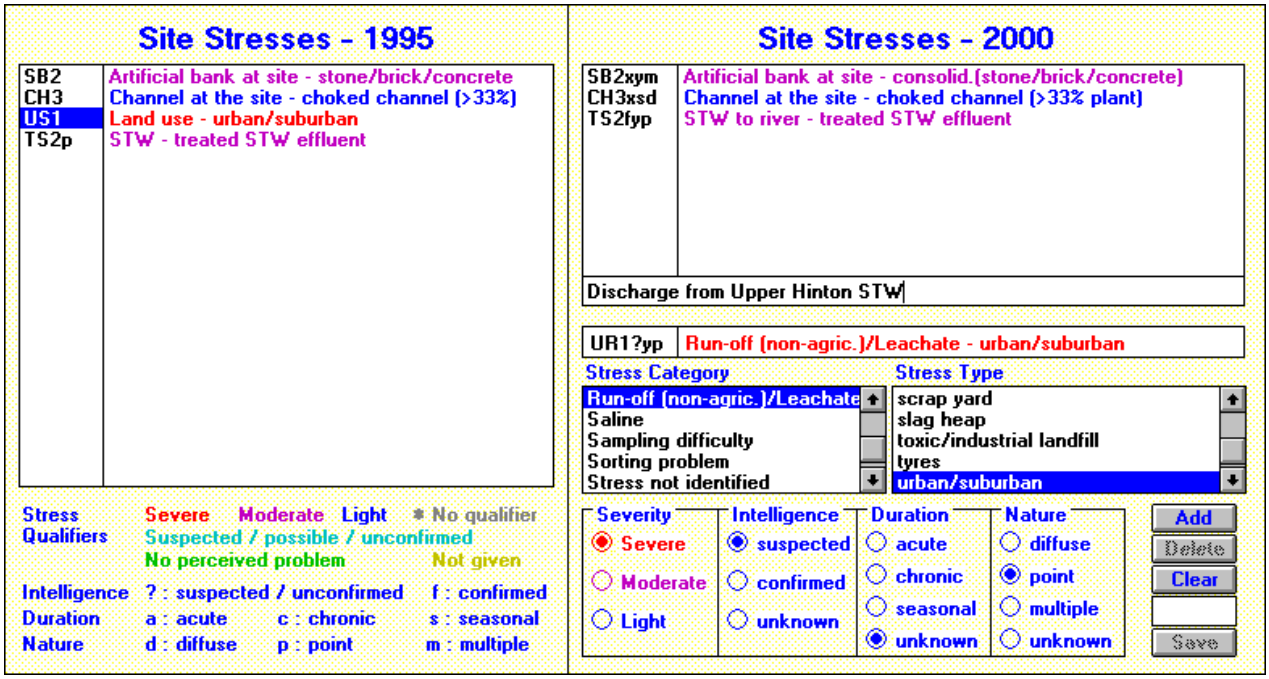


Figure 8. The **Site Stresses 1995 and 2000** panels.

You can enter additional stresses by following the same sequence, namely selecting the category, the type, the various stress options, and finally the ***Add*** button. To save the stress details that you have just entered, first ensure that the cursor is located on the User ID input box, just above the ***Save*** button. Enter a two or three character User ID and press the <Enter> key. The User ID will change to capital letters, and the ***Save*** button will be enabled; click on it to save the updated stress details. Until the data has been saved, clicking on any of the buttons on the button bar will cause a warning message to be displayed. If stress data for a site have been entered and then all cleared by selecting the ***Clear*** button, a User ID will still needed before the updated stress details, i.e. a site with no recorded stresses, can be saved and other program functions selected.

2.9 Print stress report

This button enables users to obtain a printed report of the stress data for 1995 and 2000. The site details are followed by the 1995 and 2000 stress lists, any comments for the 2000 data and finally a list of the stress qualifier codes.

2.10 Plot 1995 stresses

This button enables users to display distribution maps of the stress data recorded for 1995 (Figure 9), irrespective of whether a region, area, watercourse and sample site have been selected. To display a stress distribution, select the Stress Category from the left box, then the Stress Type from the middle box. The distribution will then be displayed on the

outline map of England and Wales. Under the central box are the number of records and an abbreviated list of stress qualifiers. The colour of the plotted stress is shown by the stress qualifiers. Remember, though, that sites very close together will only be represented by the colour of the last plotted site. A button at the bottom right corner of the map panel enables an O.S. 100-kilometre grid to be overlaid on the display. The button has a toggle action; click it again to remove the grid.

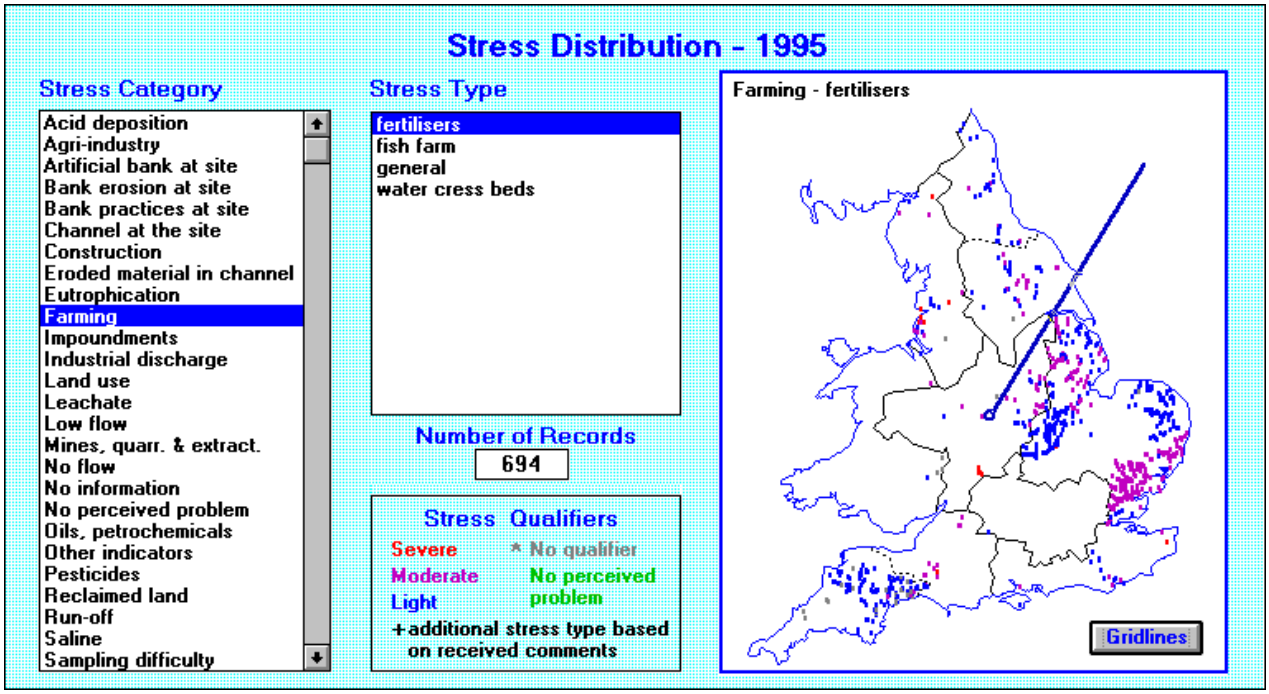


Figure 9. The **Stress Distribution - 1995** panel, with the current site being indicated on the map.

2.11 Show Current Site

Once a sample site has been selected, this button will be enabled and can be used to display the geographical location of the sample site. The button has a toggle action; clicking it again will remove the site marker. Figure 9 shows the current site being indicated.

2.12 Display/Hide Help Page

This button displays a panel (Figure 10) showing the various buttons used in SRS. Clicking on any of the buttons shown on this page will display a brief description of the function of the key in the bottom section of the panel. Clicking on the ***Help*** button on the button bar again will remove the help page and reinstate the previous display.

2.13 Display program copyright and version number

This button displays a panel showing the SRS program copyright details, and, on the bottom line, the SRS program version number. The panel will disappear automatically after a short time period without user intervention.

2.14 Show Hints

If the check box to the left of ***Show Hints*** is checked with a black cross, then when the cursor moved over any enabled, or live, button on the button bar, a small yellow box with the key function will appear under the button. If the

check box is unchecked, no such boxes will appear under the buttons.

2.15 Exit from Program

This button must be used to leave SRS and close all display panels. Clicking on the box at the top right of the button bar will not exit from SRS as this box is not enabled.

3. INSTALLING SRS

The SRS program must be installed before it can be used; it cannot be run from the installation disk. SRS has been designed for use as a multi-user 'Windows' program on a server network system. It has been successfully installed and used on PCs operating Windows 3.x, Windows 98, Windows 2000, and NT4.

The program and some data files for SRS need to be installed on each PC on which SRS will be used. The data files for collection of the 2000 stress data should be installed on a network server if multi-user operation is required. If only single user operation is sufficient, the local PC can be used for both program and data files, though it is a good idea to install the data files and the program files into different directories.

3.1 Installing the SRS program

To install the SRS onto a PC, put the installation disk into the floppy disk drive and run the file **setup.exe.** The set-up process will request a directory for the installation; the suggested directory name is **x:\srs,** where **x** is the required hard disk drive. When the installation process has finished, the directory should contain 13 files: the main **srs.exe** file, a small **srs.ini** file and 11 **.txt** files.

3.2 Installing the SRS data files

It is unlikely that any of the Agency's regions will wish to install SRS data files for areas other than its own. The installation disk therefore has a number of sub-directories, one for each of the regions, each containing a single file, **datafile.zip**. In addition, a sub-directory **serverid** contains a single file, **id_srs.txt**. SRS has been designed to be used in a multi-user network environment, though a single user can also use it on a 'stand-alone' PC. To set up the multi-user environment, you need to have a server directory that is automatically connected as a network drive to the users' PCs upon start-up.

The following stages are given as a guide to the installation of the data files.

1. Create the directory **srsdata** on the network server and designate it as a shared directory.

2. Using File Manager, File Explorer or similar, copy the file **datafile.zip** from the appropriate regional sub-directory on the SRS installation disk to the network directory just created in 1.

3. Unzip the **datafile.zip** into the server directory. This should result in either six or eight files, depending upon the region. If the server is area-based, as opposed to regionally-based, any files not required may be deleted from the server directory. Table 1 shows the files that are required for each region and area.

4. Using File Manager, File Explorer or similar, copy the file **id_srs.txt** from the **serverid** sub-directory on the SRS installation disk to the network directory created in 1. Without this file, SRS will not be able to access the data files you have just installed in 3.

5. Run SRS, either from the program list or from the SRS icon if installed.

Region	Area	Site File	Data File
Anglian	Central	ss0001cn	sd0001cn
	Eastern	ss0001ea	sd0001ea
	Northern	ss0001no	sd0001no
North East	Dales	ss0002da	sd0002da
	Northumbria	ss0002no	sd0002no
	Ridings	ss0002rd	sd0002rd
North West	Central	ss0003cn	sd0003cn
	Eastern	ss0003ea	sd0003ea
	Southern	ss0003so	sd0003so
Midlands	Lower Severn	ss0004ls	sd0004ls
	Lower Trent	ss0004lt	sd0004lt
	Upper Severn	ss0004us	sd0004us
	Upper Trent	ss0004ut	sd0004ut
Southern	Hampshire	ss0005ha	sd0005ha
	Isle of Wight	ss0005iw	sd0005iw
	Kent	ss0005ke	sd0005ke
	Sussex	ss0005sx	sd0005sx
South West	Cornwall	ss0006co	sd0006co
	Devon	ss0006d	sd0006dv
	North Wessex	ss0006nw	sd0006nw
	South Wessex	ss0006sw	sd0006sw
Thames	North East	ss0007ne	sd0007ne
	South East	ss0007se	sd0007se
	West	ss0007we	sd0007we
Welsh	North	ss0008no	sd0008no
	South East	ss0008se	sd0008se
	South West	ss0008sw	sd0008sw

Table 1. Data files required for each region and area.

6. Click on the ***Set Server Path*** button on the top button bar and follow the instructions in section 2.3 of this manual. Once the **id_srs.txt** file has been located and 'saved', click on the ***Select Region*** button at the left end of the button bar. This should display the **Region and Area** panel. Note that only the regions and areas for which you have installed the data files will be displayed. Select a region and area and check that the display changes to one similar to Figures 5 and 6 shown in section 2.5 of this manual. If this happens, the SRS program has been correctly installed and the data files are accessible.

7. If SRS is installed on a single-user PC system, the data files can be installed on the same PC, but preferably in a different directory to the program files.

APPENDIX C: Numbers of stresses in 1995 for matched 1995 and 2003 sites.

Code	Stress Description Category – Type	Stress Intensity					
		Unkn.	Light	Mod.	Severe	Total	%
AD	Acid deposition - conifer woodland	7	15	20	30	72	1.3
AB	Agri-industry – abattoir	0	0	1	1	2	0
BR	Agri-industry – brewery	0	0	0	0	0	0
DA	Agri-industry – dairy	5	1	8	12	26	0.5
FL	Agri-industry - flour mill	0	0	0	0	0	0
AI	Agri-industry – general	0	0	3	1	4	0.1
MF	Agri-industry - mushroom farm	1	0	0	0	1	0
SU	Agri-industry - sugar refinery	0	0	1	0	1	0
TA	Agri-industry - tanning/leather	0	0	0	0	0	0
VE	Agri-industry - vegetable processing	0	2	4	1	7	0.1
WO	Agri-industry – wool	0	0	0	1	1	0
GA	Artificial bank at site – gabions	0	0	2	1	3	0.1
AT	Artificial bank at site – general	0	0	6	1	7	0.1
UC	Artificial bank at site - rip-rap/boulder	0	4	19	7	30	0.6
SP	Artificial bank at site - sheet piling	0	2	2	2	6	0.1
SB	Artificial bank at site - stone/brick/concrete	1	14	26	26	67	1.2
EC	Bank erosion at site – clay	0	0	13	2	15	0.3
EG	Bank erosion at site - gravel/boulder	0	2	10	3	15	0.3
ES	Bank erosion at site – sand	0	5	10	4	19	0.3
BM	Bank practices at site - boat moorings	0	0	2	1	3	0.1
BP	Bank practices at site – general	0	0	0	0	0	0
LV	Bank practices at site – livestock	1	5	30	53	89	1.6
OG	Bank practices at site - over grazing	0	1	5	5	11	0.2
MO	Bank practices at site - riparian zone	1	7	4	19	31	0.6
DI	Channel at the site - artificial ditch/dyke	0	12	4	0	16	0.3
BE	Channel at the site – bedrock	0	7	14	8	29	0.5
BG	Channel at the site – bridge	13	1	5	14	33	0.6
CN	Channel at the site – canal	2	7	7	2	18	0.3
CV	Channel at the site – cave	0	0	0	0	0	0
CA	Channel at the site – channelisation	3	47	80	28	158	2.9
CH	Channel at the site - choked channel (>33%)	2	8	30	24	64	1.2
BD	Channel at the site - concrete bed	1	2	2	2	7	0.1
CU	Channel at the site – culvert	0	5	6	4	15	0.3
DN	Channel at the site – dredging	2	7	14	6	29	0.5
FD	Channel at the site – ford	0	0	0	3	3	0.1
AN	Channel at the site – general	0	0	0	1	1	0
RN	Channel at the site - locks etc	0	0	0	1	1	0
WD	Channel at the site - weed cutting	10	4	20	19	53	1
EX	Construction - acids from exposed rocks	0	0	0	0	0	0
BU	Construction - building & road site	0	0	1	2	3	0.1
CT	Construction – general	0	0	0	0	0	0
GS	Eroded material in channel - gravel/boulders	0	5	6	11	22	0.4
OE	Eutrophication – general	7	0	0	0	7	0.1
WF	Eutrophication - wildfowl/fishing	3	1	0	0	4	0.1
FE	Farming – fertilisers	11	12	33	45	101	1.9
FF	Farming - fish farm	0	2	9	19	30	0.6
FA	Farming – general	23	25	162	108	318	5.8
WC	Farming - water cress beds	0	0	3	3	6	0.1
FT	Impoundments - freshwater but tidal	2	7	22	13	44	0.8
HW	Impoundments - hypolimnic water	0	0	2	2	4	0.1
LP	Impoundments - lake or pond close u/s	6	8	16	14	44	0.8

PF	Impoundments - lake or reservoir d/s	0	2	6	1	9	0.2
RF	Impoundments - regulated flow	2	8	18	34	62	1.1
RE	Impoundments - reservoir u/s catchment	4	6	12	21	43	0.8
RT	Impoundments - river transfer	0	0	0	1	1	0
PN	Impoundments - summer penning	0	0	0	0	0	0
WE	Impoundments – weirs	0	11	17	29	57	1
BW	Industrial discharge - brick works	2	0	1	0	3	0.1
CE	Industrial discharge - cement works	0	2	0	0	2	0
DE	Industrial discharge – detergent	0	0	0	0	0	0
DY	Industrial discharge - dye colour	1	0	0	0	1	0
ID	Industrial discharge – general	2	4	9	7	22	0.4
HI	Industrial discharge - heavy industry	1	33	21	5	60	1.1
LI	Industrial discharge - light indust./commercial	12	6	16	18	52	1
PW	Industrial discharge - meat processing	0	0	0	0	0	0
PM	Industrial discharge - paper mill	1	2	1	7	11	0.2
PL	Industrial discharge – plating	0	1	0	0	1	0
VG	Industrial discharge - vinegar factory *	0	0	0	0	0	0
CW	Industrial discharge - warm water	2	0	1	1	4	0.1
CF	Land use - afforestation (conifer)	2	9	20	16	47	0.9
LU	Land use – general	0	0	1	0	1	0
IA	Land use - intensive arablisation	19	15	21	11	66	1.2
MD	Land use - moorland drainage	0	2	26	12	40	0.7
RB	Land use - reedbed at the site	0	0	0	0	0	0
UO	Land use - upland overgrazing	0	1	3	1	5	0.1
US	Land use - urban/suburban	1	17	26	17	61	1.1
DL	Leachate - domestic landfill	8	4	4	10	26	0.5
LE	Leachate – general	3	1	0	0	4	0.1
SY	Leachate - scrap yard	1	0	1	1	3	0.1
SH	Leachate - slag heap	1	0	0	3	4	0.1
TI	Leachate - toxic/industrial landfill	2	1	12	7	22	0.4
IR	Low flow - abstraction (irrigation)	2	3	2	4	11	0.2
AP	Low flow - abstraction (public supply)	1	2	5	10	18	0.3
CD	Low flow - cessation of STW discharge	0	1	0	0	1	0
DT	Low flow – drought	7	10	36	29	82	1.5
AG	Low flow - from groundwater	1	0	12	5	18	0.3
AR	Low flow - from river	1	4	2	8	15	0.3
LF	Low flow – general	9	11	34	49	103	1.9
QA	Mines, quarries & extractions - acid rock	0	0	2	2	4	0.1
CC	Mines, quarries & extractions - china-clay	0	0	0	0	0	0
CM	Mines, quarries & extractions - coal mine drainage	2	14	22	29	67	1.2
MI	Mines, quarries & extractions – general	1	2	2	3	8	0.1
QB	Mines, quarries & extractions - limestone/chalk	0	1	1	1	3	0.1
MM	Mines, quarries & extractions - metal mine drainage	2	1	15	20	38	0.7
SG	Mines, quarries & extractions - sand/gravel	0	0	0	3	3	0.1
DC	No flow - dry channel (man-made)	0	2	0	0	2	0
NF	No flow – general	1	6	8	2	17	0.3
WI	No flow - winterbourne (natural)	0	1	1	3	5	0.1
NI	No information *	10	0	0	0	10	0.2
NP	No perceived problem *	388	0	0	1	389	7.2
CO	Oils, petrochemicals – crude	0	0	0	0	0	0
FO	Oils, petrochemicals – fuel	4	3	7	8	22	0.4
OI	Oils, petrochemicals – general	2	1	1	7	11	0.2
LO	Oils, petrochemicals – lubricating	0	1	0	0	1	0
TO	Oils, petrochemicals - tar/bitumen	0	0	0	0	0	0
VO	Oils, petrochemicals – vegetable	0	1	0	0	1	0

CL	Other indicators – *Cladophora*	2	22	66	40	130	2.4
OH	Other indicators – ochre	10	22	26	32	90	1.7
SF	Other indicators - sewage fungus	0	1	7	18	26	0.5
PE	Pesticides – general	14	8	6	3	31	0.6
HE	Pesticides – herbicides	6	1	9	2	18	0.3
IN	Pesticides – insecticides	0	5	4	6	15	0.3
SD	Pesticides - sheep-dip	5	1	7	7	20	0.4
RL	Reclaimed land – general	0	1	2	0	3	0.1
RI	Reclaimed land – industrial	1	0	4	6	11	0.2
OC	Reclaimed land – opencast	0	0	1	4	5	0.1
GY	Run-off - aircraft deicing	0	0	0	0	0	0
AF	Run-off - airfield (general)	1	0	0	1	2	0
RC	Run-off - contaminated surface water	1	0	0	0	1	0
RO	Run-off – general	1	0	2	97	100	1.8
HR	Run-off - heavy industry	7	5	12	12	36	0.7
HY	Run-off - highway (including salt)	9	3	26	39	77	1.4
LR	Run-off - light industry/commercial	5	3	12	12	32	0.6
RU	Run-off - motorway (urea)	0	0	0	0	0	0
RR	Run-off – railway	4	1	0	1	6	0.1
SR	Run-off - spreading to land (china clay ?)	0	0	0	0	0	0
UR	Run-off – urban	6	76	102	88	272	5
SA	Saline – general	0	2	1	1	4	0.1
IL	Saline - industrial discharge	0	0	1	0	1	0
IG	Saline - inland geological	0	0	0	0	0	0
MA	Saline - marine origin	1	4	7	2	14	0.3
AL	Sampling difficulty - air-lift *	14	0	2	2	18	0.3
BO	Sampling difficulty - bouldery site	0	16	23	22	61	1.1
DR	Sampling difficulty - dredge *	56	4	11	5	76	1.4
DS	Sampling difficulty – general	4	0	0	0	4	0.1
MS	Sampling difficulty - mobile substrate	0	0	0	0	0	0
AC	Sampling difficulty - one bank only *	54	6	3	5	68	1.3
TX	Sediment at the site - contaminated sediment	8	7	2	9	26	0.5
SX	Sediment at the site – general	0	6	19	9	34	0.6
IS	Sediment at the site - inert siltation	1	31	73	100	205	3.8
BS	Sorting problem - bank-side sort *	0	0	0	0	0	0
PR	Sorting problem - poorly preserved sample	0	9	0	5	14	0.3
MY	Stress could not be identified (mystery)	17	3	24	15	59	1.1
CS	STW - combined sewer overflow	11	36	136	151	334	6.1
ST	STW – general	4	3	7	5	19	0.3
SE	STW - septic tank	1	8	16	28	53	1
SS	STW - storm sewer overflow	5	17	21	9	52	1
TS	STW - treated STW effluent	4	90	165	220	479	8.8
WA	Waste – general	0	0	4	0	4	0.1
PI	Waste – piggery	1	2	2	2	7	0.1
PO	Waste – poultry	0	0	2	0	2	0
SI	Waste – silage	2	2	1	4	9	0.2
SL	Waste – slurry	113	3	8	26	150	2.8
AS	WTW - aluminium sulphate	1	0	0	1	2	0
WT	WTW – general	2	0	2	7	11	0.2
FS	WTW - iron sulphate	0	0	0	0	0	0
SW	WTW - swimming pool	1	0	1	0	2	0
	Totals	968	805	1785	1881	5439	

Appendix D: Numbers of stresses in 2003 for matched 1995 and 2003 sites.

Code	Stress Description Category – Type	Stress Intensity				
		Light	Mod.	Severe	Total	%
AD	Acid - acid deposition	17	34	23	74	1.3
EX	Acid - rock exposed by construction	0	0	0	0	0
CF	Agricultural run-off - forestry (conifer)	4	19	19	42	0.7
IA	Agricultural run-off - intensive arablisation	14	29	21	64	1.1
SL	Agricultural run-off - livestock slurry	6	41	126	173	3.1
SI	Agricultural run-off – silage	1	5	49	55	1
AO	Agricultural run-off – other	1	25	20	46	0.8
AB	Agri-industry - abattoir/meat processing/rendering	0	1	2	3	0.1
BR	Agri-industry – brewery	0	1	1	2	0
DA	Agri-industry – dairy	0	2	6	8	0.1
FL	Agri-industry - flour mill	0	0	0	0	0
MF	Agri-industry - mushroom farm	0	0	1	1	0
SU	Agri-industry - sugar refinery	0	1	0	1	0
TA	Agri-industry - tanning/leather	0	0	0	0	0
VE	Agri-industry - vegetable processing	2	4	0	6	0.1
WO	Agri-industry – wool	0	0	0	0	0
AI	Agri-industry – other	2	4	6	12	0.2
SB	Artificial bank at site - consolid.(stone/brick/concrete)	30	54	29	113	2
GA	Artificial bank at site – gabions	1	8	4	13	0.2
SP	Artificial bank at site - metal piling	5	4	1	10	0.2
UC	Artificial bank at site - unconsolid. (rip-rap/boulders)	3	18	8	29	0.5
AT	Artificial bank at site – other	0	2	2	4	0.1
EC	Bank erosion at site – clay	0	15	10	25	0.4
EG	Bank erosion at site - gravel, boulder	1	6	3	10	0.2
ES	Bank erosion at site – sand	3	12	9	24	0.4
BM	Bank practices at site - boat moorings	0	2	1	3	0.1
LV	Bank practices at site - livestock poaching/overgrazing	5	36	47	88	1.6
MO	Bank practices at site - mown/managed riparian zone	5	12	22	39	0.7
BP	Bank practices at site – other	2	3	3	8	0.1
DI	Channel at the site - artificial ditch or dyke	14	3	0	17	0.3
BE	Channel at the site – bedrock	8	14	8	30	0.5
BG	Channel at the site – bridge	4	22	12	38	0.7
CN	Channel at the site - canal (artificial navigation)	12	6	1	19	0.3
CA	Channel at the site - canalised stream/river (non-navig.)	52	112	36	200	3.5
CH	Channel at the site - choked channel (>33% plant)	6	39	15	60	1.1
BD	Channel at the site - concrete stream bed	0	2	2	4	0.1
CU	Channel at the site – culvert	7	8	5	20	0.4
DN	Channel at the site – dredging	6	14	9	29	0.5
RN	Channel at the site - river navigation (locks etc)	0	3	5	8	0.1
RA	Channel at the site - river restoration	2	0	0	2	0
WD	Channel at the site - weed cutting	7	22	30	59	1
AN	Channel at the site – other	3	1	5	9	0.2
GS	Eroded material in channel - gravel, boulder	1	7	5	13	0.2
IS	Eroded material in channel - inert siltation	34	84	87	205	3.6
EF	Eutrophication – agriculture	1	8	53	62	1.1
EA	Eutrophication – angling	0	0	0	0	0
EE	Eutrophication – sewage	1	16	50	67	1.2
EW	Eutrophication – wildfowl	0	2	5	7	0.1
EO	Eutrophication – other	0	1	1	2	0
DF	Farming – disinfectant	0	0	1	1	0
FE	Farming – fertilisers	9	108	102	219	3.9

FF	Farming - fish farming	0	10	19	29	0.5
HE	Farming – herbicides	1	8	2	11	0.2
IN	Farming – insecticides	5	7	4	16	0.3
SD	Farming - sheep-dip	3	31	21	55	1
WC	Farming - water cress beds	0	1	3	4	0.1
FA	Farming – other	10	99	58	167	2.9
GW	Flow-related - augmentation from groundwater	0	1	1	2	0
RT	Flow-related - augmentation from river transfer	0	0	1	1	0
CD	Flow-related - cessation of STW discharge	0	0	0	0	0
AG	Flow-related - groundwater abstraction	3	14	14	31	0.5
HW	Flow-related - hypolimnic water	2	2	2	6	0.1
PF	Flow-related - ponded flow (lake/resv. d/s)	5	3	0	8	0.1
RF	Flow-related - regulated flow (lake/resv. u/s)	14	34	35	83	1.5
AR	Flow-related - river abstraction	10	17	34	61	1.1
PN	Flow-related - summer penning	1	4	2	7	0.1
WE	Flow-related – weirs	12	27	21	60	1.1
FR	Flow-related – other	8	39	34	81	1.4
TX	Historical activity (now ceased) - toxic sediment	6	5	8	19	0.3
BW	Industrial discharge - brick works	0	0	2	2	0
CE	Industrial discharge - cement works	0	1	0	1	0
DY	Industrial discharge - colouration (dye)	0	0	1	1	0
CW	Industrial discharge - cooling water (warm)	0	0	4	4	0.1
DE	Industrial discharge – detergent	0	1	0	1	0
HI	Industrial discharge - heavy industry	3	6	4	13	0.2
LI	Industrial discharge - light industry/commercial	8	19	27	54	1
PC	Industrial discharge - petrochemicals (mfr & distribution)	2	8	1	11	0.2
PM	Industrial discharge - paper mill	1	2	6	9	0.2
PL	Industrial discharge – plating	0	0	2	2	0
ID	Industrial discharge – other	2	10	3	15	0.3
CB	Mines, quarries & extractions - brick-clay extraction	0	2	3	5	0.1
CC	Mines, quarries & extractions - china-clay extraction	0	0	0	0	0
CM	Mines, quarries & extractions - coal mine drainage	9	31	46	86	1.5
MM	Mines, quarries & extractions - metal mine drainage	6	21	8	35	0.6
QA	Mines, quarries & extractions - quarry (acid rock)	0	0	3	3	0.1
QB	Mines, quarries & extractions - quarry (limestone/chalk)	1	0	2	3	0.1
SG	Mines, quarries & extractions - sand & gravel	0	0	6	6	0.1
MI	Mines, quarries & extractions – other	0	2	3	5	0.1
CV	Natural features – cave	0	0	1	1	0
MD	Natural features - moorland drainage	0	33	20	53	0.9
RB	Natural features - reedbed at the site	0	0	0	0	0
HS	Natural features - heavily shaded site	2	23	2	27	0.5
LP	Natural features - lake or pond close u/s	6	10	14	30	0.5
FT	Natural features - freshwater but tidal	10	15	16	41	0.7
DT	Natural features – drought	13	52	33	98	1.7
FD	Natural features – flood	0	4	0	4	0.1
WI	Natural features - winterbourne/non-permanent stream	6	1	2	9	0.2
LU	Natural features – other	0	3	1	4	0.1
DC	No flow - dry channel (caused by man)	1	0	1	2	0
NI	No information * - no information	11	-	-	11	0.2
NP	No perceived stress * - no perceived stress	341	-	-	341	6
CO	Oils, petrochemicals – crude	0	0	0	0	0
FO	Oils, petrochemicals - fuel (diesel/petrol)	0	0	3	3	0.1
LO	Oils, petrochemicals – lubricating	0	0	0	0	0
TO	Oils, petrochemicals - tar/bitumen	0	1	0	1	0
VO	Oils, petrochemicals – vegetable	0	1	0	1	0
OI	Oils, petrochemicals – other	1	1	0	2	0

CL	Other indicators – *Cladophora*	18	39	49	106	1.9
OH	Other indicators – ochre	13	28	34	75	1.3
SF	Other indicators - sewage fungus	1	8	23	32	0.6
RI	Reclaimed land – industrial	0	2	5	7	0.1
OC	Reclaimed land – opencast	0	3	3	6	0.1
RL	Reclaimed land – other	1	1	2	4	0.1
AF	Run-off (non-agric.)/Leachate - aircraft/airfield deicing	0	1	0	1	0
BU	Run-off (non-agric.)/Leachate - building/road construction	1	1	4	6	0.1
DL	Run-off (non-agric.)/Leachate - domestic landfill	3	13	15	31	0.5
FY	Run-off (non-agric.)/Leachate - fly tipping	4	15	11	30	0.5
HR	Run-off (non-agric.)/Leachate - heavy industry	1	5	6	12	0.2
HY	Run-off (non-agric.)/Leachate - highway (incl. deicing salt)	5	33	62	100	1.8
LR	Run-off (non-agric.)/Leachate - light industry/commercial	4	13	25	42	0.7
RU	Run-off (non-agric.)/Leachate - motorway (incl. deicing urea)	1	5	10	16	0.3
RR	Run-off (non-agric.)/Leachate – railway	0	2	5	7	0.1
SY	Run-off (non-agric.)/Leachate - scrap yard	0	2	3	5	0.1
SH	Run-off (non-agric.)/Leachate - slag heap	0	1	2	3	0.1
TI	Run-off (non-agric.)/Leachate - toxic/industrial landfill	0	2	8	10	0.2
TY	Run-off (non-agric.)/Leachate – tyres	0	0	0	0	0
UR	Run-off (non-agric.)/Leachate - urban/suburban	37	146	206	389	6.9
RO	Run-off (non-agric.)/Leachate – other	1	6	8	15	0.3
IL	Saline - industrial discharge	0	0	1	1	0
IG	Saline - inland geological	0	0	0	0	0
MA	Saline - marine or estuarine origin	0	5	5	10	0.2
SA	Saline – other	1	0	1	2	0
AC	Sampling difficulty - access to one bank only *	72	-	-	72	1.3
AL	Sampling difficulty - air-lift *	16	-	-	16	0.3
BO	Sampling difficulty - bouldery site	4	27	16	47	0.8
DR	Sampling difficulty - dredge *	55	-	-	55	1
MS	Sampling difficulty - mobile substrate	2	11	4	17	0.3
DS	Sampling difficulty – other	4	11	7	22	0.4
BS	Sorting problem - bank-side sort *	1	-	-	1	0
PR	Sorting problem - poorly preserved sample	0	0	0	0	0
MY	Stress not identified - unknown source	2	21	18	41	0.7
GR	STW to aquifer - via groundwater recharge	0	0	0	0	0
CS	STW to river - combined sewer overflow (CSO)	17	173	203	393	6.9
SE	STW to river - septic tank	8	17	35	60	1.1
SS	STW to river - storm sewer overflow (SSO)	9	33	17	59	1
TS	STW to river - treated STW effluent	52	208	219	479	8.4
ST	STW to river – other	1	16	18	35	0.6
AS	WTW - aluminium sulphate	1	2	4	7	0.1
FS	WTW - iron sulphate	0	0	2	2	0
SW	WTW - swimming pool	0	0	0	0	0
WT	WTW – other	1	2	1	4	0.1
	Totals	1108	2211	2350	5669	

Appendix E: Environment Agency's intranet page for Stress Recording System

Stress Recording System (SRS)

This page provides an overview of SRS, a downloadable user guide and links to further information relating to perceived environmental stresses at biological monitoring sites on rivers.

News
Having problems using SRS? Here's help and advice.

Download the user guide version 2.3 (22 October 2003)

New data files were distributed to all regions and areas on 8 September to correct system crashes caused by the data files updated and distributed in July. Section 3.3 of the user guide (download link below) explains whether you need to update the files or not, and if so, how to do that (see also the help and advice link above). Contact John Murray-Bligh if you need these updated files.

Known bug You can only open SRS once in any Windows session. If you open, close and then try to re-open it within a Windows session, you will have to reverify the application and restart your computer. You will not loose data, but it is inconvenient.

Current Version: 1.0 (Updated data files September 2003)

What does it do?
SRS enables information about perceived environmental stresses at GQA monitoring sites to be recorded in a simple manner that prevents problems encountered with the recording of stresses for 1995, using a revised categorisation of stresses. One half of the main display shows the stresses recorded for 1995. The other half has spaces for recording stresses in 2000/03 using drop-down menus.

What is its main purpose?
To enable perceived environmental stresses to be recorded for 2003 (with notes on 2000-02 where known to be different). This data will be used to report GQA surveys and compliance with (future) biological quality objectives, to develop diagnostic systems (in particular RPDS) and it may help characterisation of waterbodies for the Water Framework Directive.

Who should use SRS and when?
Ecological appraisal teams should use SRS to provide information about stresses perceived at their biological monitoring sites from the end of August 2003.

Who should have SRS and how do I get it?
SRS should have been distributed to all users of B4W biology database. If you have B4W but do not have SRS, contact the help desk, quoting application number 104832. Before doing this, check application explorer in case you have SRS but just need to verify the application. You will then need to obtain updated data files from me (John Murray-Bligh), or from your colleagues in the Area Ecological Appraisal Team. Environment Agency users do not need a licence.

Further information
Download the revised categorised list of stress for 2000/03 used in SRS (also the original list used to categorise stresses in 1995).

Maps of the stresses recorded for 1995 and information about problems in the data and elicitation process that led to the development of SRS are described in an R&D Technical Report:

Martin, R.W. and W. J. Walley (2002) *Distribution of Perceived Stresses in English and Welsh Rivers based on the 1995 Survey: the quality of a preliminary data set.* Environment Agency R&D Technical Report E126. You can download the **executive summary**.

You can view the stresses recorded for each site any watercourse in any region in 1995, with the biological and chemical data, using the River Biological Monitoring System (RBMS).

Information and other useful tools for analysing and interpreting invertebrate samples can be found on the Internet at the Centre for Intelligent Environmental Systems web site.

SRS was produced by Ray Martin of the Centre for Intelligent Environmental Systems as a part of Environment Agency R&D Project E1-114 *The collection and analysis of environmental stresses influencing biological GQA sites in 2000*. Contact John Murray-Bligh for further information.

Author: John Murray-Bligh | **Publisher:** John Murray-Bligh | **Last updated:** 13/04/2004

Appendix F: Help and Advice page for users on the Environment Agency's Intranet

Can't get SRS to start? Having problems getting SRS to work? SRS keeps crashing whenever you try to save data? Help!

John Murray-Bligh
24-7-2004

Unsure about setting server path

I've made a small alteration to Section 2.3 of the User Guide to indicate where the 'id_srs.txt' file is likely to be.

Unsure about unzipping the updated site and data files

Let me know if you don't know how to unzip files – I will send you an unzipped copy of the site and data and site2000 files for your Area.

Unsure about updating the data files

Call me and I will talk you through the process.

SRS keeps crashing

You cannot open, shut-down and then re-open SRS within one Windows session without re-starting your computer. This is a known fault that cannot be rectified. I don't recommend closing SRS down if you intend to use it again before you switch your computer off or re-start it.

If SRS crashes at other times, for instance, whenever you try to save data for a site, the most likely reason is that you are using the June update of the data file or have a mixture or original and updated site files and data file. Check which versions of site2000, data and site files you are using.

Note that if you are using updated data files on the G-drive you will also need to use the updates site2000.txt file on the c-drive of every individual computer that is used with SRS. All three files must match.

Checking which versions of files you are using

Site2000

On your desktop, double-click on the 'My computer' icon Double-click on '(C:)' – this might also be labelled 'Local Drive'. Double-click on 'SRS'. Put the cursor on 'site2000' or 'site200.txt' (you will see one or other, depending on which display you have) and single click to highlight it. Right-click, scroll-down to 'Properties' and click. If the 'Date Created' or 'Date Modified' is September 2003, you have the latest update. If it is June 2003, you have the June update. If 2001, you have the original.

Site and data files

On your desktop, double-click on the 'My computer' icon. Double-click on '(G:)' – this might also be labelled 'Groups' of 'Shared'. Look for a folder called '104832', 'SRS' or a combination of these – if you can't see it, it may be in a folder for your section or department. When you have found it, double-click to open it. If there is a sub-folder '1.02', double-click on that. (If there is more than one sub-folder and both contain site and data files, you will need to make further checks.) Put the cursor on the file you want to check (either the site file 'ss000nxx' or the data file 'sd000nxx' (where n is a number relating to your region and xx is an abbreviation relating to your area – see table 1 in the user manual) and single click to highlight it. Right-click, scroll-down to 'Properties' and click. If the 'Date Created' or 'Date Modified' is September 2003, you have the latest update. If it is June 2003, you have the June update. If 2001, you have the original.

What you need to check

That all three files are either originals or updates and, if they are updates, that they are all September 2003 updates.

If all three are originals, the system should work OK, but SRS will not list your newer sites, introduced since 2000. If you have a mixture of June and September files or the site file 'sd000nxx' is the June update, that is the cause of your problem and you will need to change the files to the September update.

Before you update either the data file on the G-drive, check that there is no data in it (i.e. that no-one else in your area has entered data onto them). If there is a risk that there may be data on this file, copy the data file

‘sd000nxx’ to one of your own folders and e-mail a copy to me before you replace it with the September 2003 update. This will prevent any data being lost.

Checking whether there is data in the data file
On your desktop, double-click on the ‘My computer’ icon. Double-click on ‘(G:)’ – this might also be labelled ‘Groups’ of ‘Shared’. Look for a folder called ‘104832’, ‘SRS’ or a combination of these – if you can’t see it, it may be in a folder for your section or department. When you have found it, double-click to open it. If there is a sub-folder ‘1.02’, double-click on that. Put the cursor on the ‘sd000nxx’ (where n is a number relating to your Region and xx is an abbreviation relating to your area – see table 1 in the user manual) and double-click to open it. (If you get a drop-down menu asking you to choose an application, click on ‘Notepad’.) If there is any data in this file, you will see stress codes after the relevant site codes (nxxyyyyyy, where yyyyyy is a numerical code specific to the site). If only site codes are listed and the rest is blank (apart from two dividers), no data has been saved on this file.

If you have site and data files in more than one folder of the G-drive

Make sure that the site and data files ‘ss000nxx’ and ‘sd000nxx’ that you want to use are in the same folder as the file ‘id_srs.txt’. To do that, you should copy the site and data files to the folder with ‘id_srs.txt’. Before overwriting the site and data files in that folder, make a back-up of them (if there is a risk that data has been entered onto them already) by copying them to one of your own folders and e-mail a copy of the data file to me. If both folders contain a file called ‘id_srs.txt’, you will need to check that the server path is set to the folder containing the site and data files that you want to use and not to the other folder. Do that by opening SRS and checking the path. Alert your colleagues to this and warn them that they may have to re-set the server path when they use SRS. Note that the server path must be re-set on every computer that is used with SRS because the record of the server path is stored in the local C-drive.

Appendix G: Prototype report of non-compliance with Biological Qaulity Objectives, February 2001

BIOLOGICAL RIVER QUALITY OBJECTIVES (BQOs).

What is a Biological Quality Objective (BQO)?:

An agreed target expressed in terms of Biological classification system. With chemical River Quality Objective (RQO), It is used to plan all activities affecting the water quality of a classified stretch of watercourse. The system is intended to reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

Biological classes can be summarised below:
a: biology of very good quality, similar to (or better) than that expected for an average and unpolluted river of this size and type
b: biology of good quality, minor differences to Class a and falls a little short of that expected.
c: Biology of fairly good quality, worse that that expected from a but unpolluted river
d: Biology of fair quality, large differences from that expected for an unpolluted but similar river
e: Biology of poor quality, restricted to those that can tolerate pollution
f: biology of bad quality, restricted to a small number of animals very tolerant of pollution

All our rivers (England and Wales) have BQOs. The Environment Agency aims to consult on and review the BQOs through our Local Environmental Agency Plans (LEAPs). Which are prepared with full public consultation and aim to reach a balance of the views of local people.

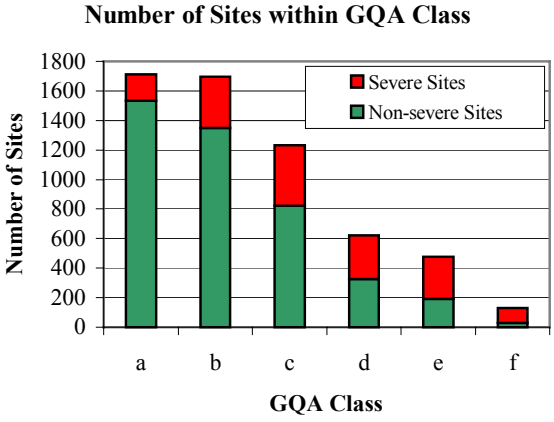
Objectives of the scheme:

To secure existing levels of river quality and where possible and necessary to seek improvements, in accordance with the needs and wishes of local communities.

Measuring our progress:

Figure 1. shows the number of river sites that are in each class We say that a BQO is failed when we are 95% confident that the failure is real, in other words we accept that 1 time in 20 we may say that a stretch of river has failed when it has not. Details of the parameters which form the biological classification are given in Table 1. and details of the statistical basis for the classification are available from the Agency.

The Government has stated that it expects to see a 50% improvement of RQO failures by 2005.



For the purpose of this prototype document, sites failing their BQO are considered to be those that are considered to be suffering from one or more severe stresses.

BIOLOGICAL QUALITY OBJECTIVES : REASONS FOR FAILURE

For every river stretch where measurements show that the Biological Quality Objective has not been met, the reason for that failure has been identified. In many cases, the failure will be due to more than one reason. Collation of this data allows the Agency to target intervention at both local and strategic levels. The following categories have been identified.

A Licensed Abstractions and Point Source Discharges
Failures identified under these headings are those where there is a direct causal linkage between the failure and a specific and readily identifiable licensed activity – for example disposal of wastewaters subject to Consent or Authorisation, or water abstractions subject to a Licence. This group therefore includes those failures capable of control through the exercise of the Agency's existing regulatory powers alone. The categories indicate the specific causes.

A1: Industrial

A2: Septic tanks

A3: Water PLC sewage treatment works.

A4: Intermittent discharges *(combined storm overflows, storm tanks, pumping stations, emergency overflows associated with sewerage networks)*

A5: Associated with current/past waste disposal.

A6: Abstraction/low flow

A7: Impoundments

B **Multiple Source and Land Use**
Failures identified under this duty are likely to be remedied only through concerted action by the Agency and others. They may be addressed in part by the exercise of the Agency's existing powers, but other actions will also need to be taken, for example, changes in working practices. They are failures that are difficult to remedy due to practical considerations and/or difficulties in identifying a means to gain concerted action. In the case of managed water flows in canals, failure is always likely to occur due to slow water movement however this is a characteristic of that type of managed water body.
B1: Agricultural run-off
B2: Urban run-off *(contaminated surface water, construction site drainage, and road/rail run-off)*
B3: Contaminated Land *(leachate)*
B4: Mineworkings
B5: Land drainage practices *(where the river bank or channel is artificial or dredged)*
B7: Acidification *(including the impacts of forestry and /or acid rain)*
B8: By-product of eutrophication *(including excessive weed growth and other indicators)*

D Other

D1: Identified pollution incidents *(where the failure is directly attributable to a single pollution event which has been remedied)*

D2: Unknown *(where theAgency needs to undertake further work to identify the cause of the stress)*

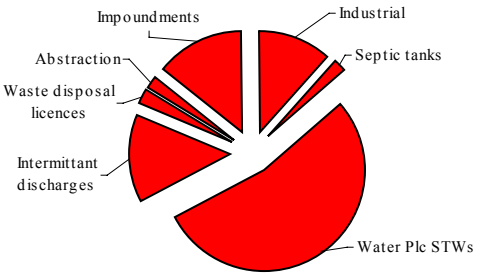
D3: Land / bank use *(includes livestock poaching, boat moorings and saline influences)*

D4: Physical feature or sampling *(where a physical feature in the channel affected the samples, e.g. bedrock, bridge, locks, or there were difficulties sampling e.g. deep, access to one bank only)*

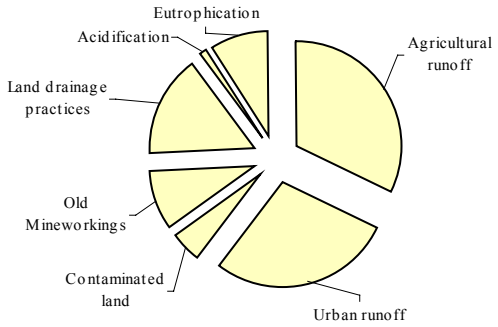
C **Natural Processes**
This includes those failures that are attributable only to natural effects. The need for this category reflects that the River Quality Objectives are primarily used to identify and remedy pollution and it is therefore necessary to identify where pollution is not implicated in a failed result.

C1: Low flow *(drought and low flows not directly ascribable to abstraction)*
C2: Natural Mineralisation *(inland saline geology)*

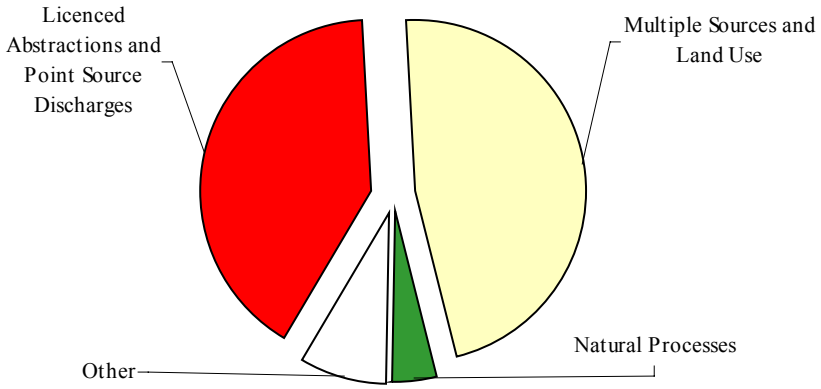
Licenced Abstractions and Point Source Discharges



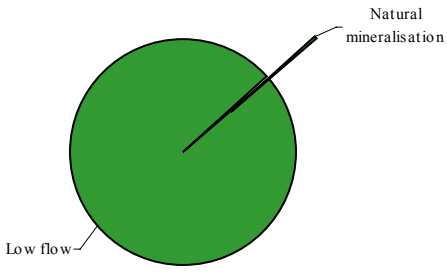
Multiple Sources and Land Use



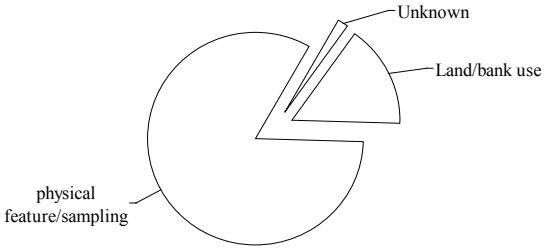
BQO Reasons for failure for England 1997



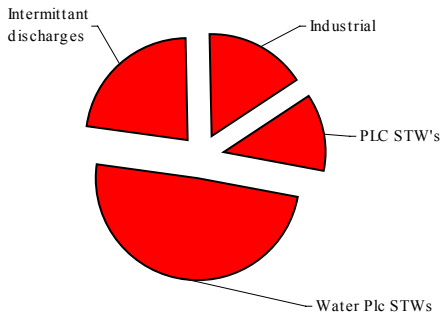
Natural Processes



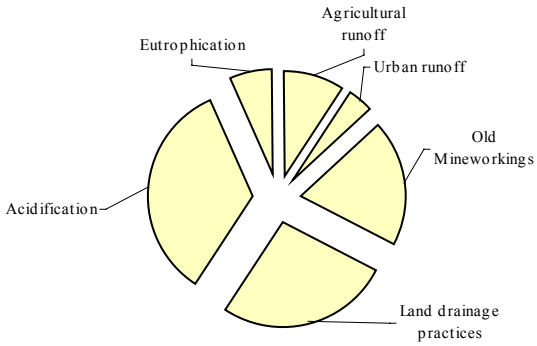
Other



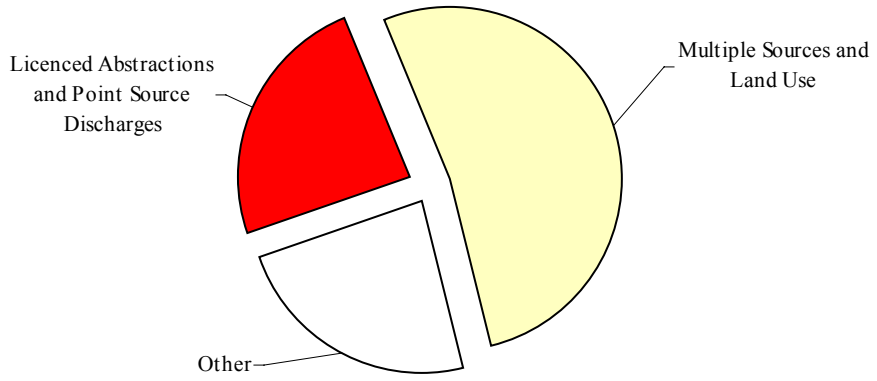
Licenced Abstractions and Point Source Discharges



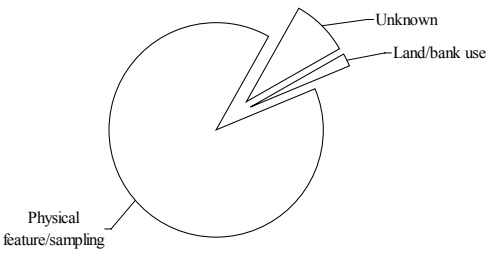
Multiple Sources and Land Use



BQO Reasons for failure for Wales 1997

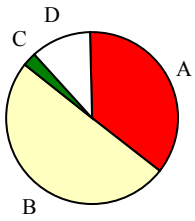


Other

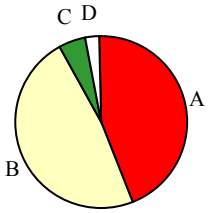


BQO Regional reasons for failure 1997

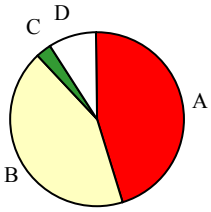
Anglian Region



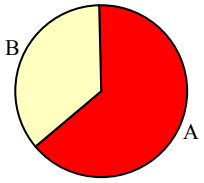
Midlands Region



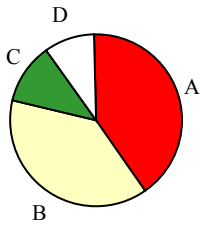
North West Region



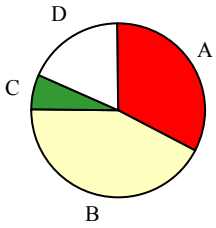
North East Region



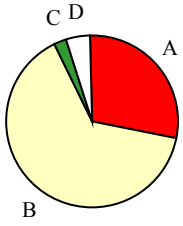
Southern Region



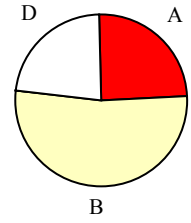
South West Region



Thames Region



EA Wales



A	**Licensed Abstractions and Point Source Discharges**
B	Multiple Source and Land Use
C	Natural Processes
D	Other

Regional BQO Views

Midlands region have a range of climate types and land uses from clean uplands to industrial urban areas with important agriculture.

- 417 (40.3%) of the regions 1033 sites failed to reach their objectives in 1997.
- 44% were due to point source and of these 70% were due to Water Plc and CSO discharges.
- 70% are planned to be improved under AMP 2 & 3.

Southern region has a high population density, resulting in large volumes of effluent entering rivers. To the east of the region the geology and weather are such that the rivers are vulnerable to low flows. In the west rivers are characterised by spring fed chalk rivers which are faster flowing and more oxygenated.

- 493 sites of classified BQO.
- 19% of rivers failed in 1997.
- 40% of which is as a result of water services
- 38% of failures result from diffuse pollution / landuse.

Anglian region has relatively high rates of growth and development and intensive agriculture applies the greatest pressure. Rivers show naturally depressed concentrations of dissolved oxygen and low flows.
In addition to this the algal growth is encouraged by nutrient rich and slow moving flow. Algal growth results in alkalinity and supersaturation.

- 307 (48%) of sites failed in 1997.
- Diffuse pollution and land use were the main cause of failure (50%).
- Agricultural run-off contributes to a large proportion of landuse failures (53%).
- Water plc STWs are the largest contributors to the point source failures (55%).

North East region is made up of contrasts. The Birthplace of the wool textile industry in West Yorkshire and coal industry in the South and North East has left a unique Industrial landscape. Compare this with the rugged landscape of the Yorkshire Dales, the Cheviots and North Yorks Moors National Park.

- 648 sites of classified BQO.
- 106 are failing.
- Of this 33 are attributed to Water Company discharges.

North West region encompasses the birthplace of the modern industrial age, the nationally renowned landscapes of the Lake District and all manner of variations in between.

- 772 classified stretches.
- 264 (34%) sites failed in 1997.
- The main contribution of this failure was discharges from Water Company, sewage works and intermittent discharges from the associated sewerage network.
- AMP3 will deliver improvements to 38% of (RQO-) failing stretches if all other identified actions are carried out.

South West region is predominantly rural area with a rich and varied landscape. The rivers are of generally high quality, which is reflected by the high river quality objectives set.

- 185 (17%) failed to reach their objectives.
- The major factor that resulted in this failure was diffuse pollution / landuse.
- 9.2% of the failures cannot be resolved due to failures being caused be natural processes. Mine workings (18% of failures) are mostly beyond our regulatory powers as many are old workings.

Thames – region covers the basin of the River Thames, its tributaries and the Thames Estuary. The region has population of 12 million people, the highest and most dense of all the Agency's Regions. This puts its water environment and resources under severe pressure. Protection of water quality is therefore a vital issue, not only for the good quality rivers in less crowded areas but also the urban rivers, which can provide a focus for urban recreation.

- 484 classified BQO sites.
- Diffuse source and land-land use were the main reasons for failure with 95 failures
- Water plc sewage works discharges were the second major reason for failure with 27 failures.

Wales is a predominantly rural region with freshwater of a generally very high quality. 80% of the area is used for agricultural production (mostly rough grazing / permanent grassland) with a further 12% covered by woodland. Urban areas cover only 3%, much of which is concentrated around the coastal area.

- 795 sites are classified and 82% by river length has an objective of either Class a or Class b. 101 (13) sites failed their BQO.
- 18% sites failed as a result of mine workings.
- 10% have derived from the effects forestry land use with atmospheric acidification.
- A small proportion of failures (5%) are Water Company discharges, however the investment contribute to the protection of around 300km of river and help maintain high quality of welsh rivers long term.

Actions that the Agency can take:

We seek to achieve improvements in water quality and corrections to stretches that have failed their RQO. Primary means include:

- Discharge regulation – via consent set by the Environment Agency.
- Pollution prevention activity – education, partnership and legislative powers are used to try promote pollution prevention issues.
- Education – via information sheets such as these, the Internet and television.
- Economic incentive (currently being discussed).

BIOLOGICAL (GQA) CLASSIFICATION (WATER QUALITY CRITERIA):

The biological classification depends on two attributes of the invertebrates (small animals such as insects, snails and worms) found in the river. N-taxa (number of taxa) is the number of different major groups of related animals (these groups are mostly biological families). The sensitivity to pollution of every taxon has been given a numerical value (BMWP-score) from 1 (tolerant) to 10 (intolerant). ASPT (average BMWP-score per taxon) is the average of the sensitivity to pollution of each taxon found in the river. A high ASPT indicates clean water; a low ASPT indicates polluted water. Because the animals found in different types of river or stream differ naturally, so N-taxa and ASPT may differ naturally. This is taken into account using computer software (RIVPACS) to express the values of N-taxa and ASPT as proportions (or percentages) of what they would be in a good quality stream of that size, type and location. These measures are called EQIs (environmental quality indices). The class allocated to a site is the lowest of either its EQI N-taxa or EQI ASPT.

Class	Description	EQI N-taxa	EQI ASPT
a	Very Good	85 % +	100% +
b	Good	70 – 84%	90 - 99%
c	Fairly Good	55 – 69%	77 - 89%
d	Fair	45 – 54%	65 – 78%
e	Poor	30 – 44%	50 – 64%
f	Bad	0 – 29%	0 – 50%

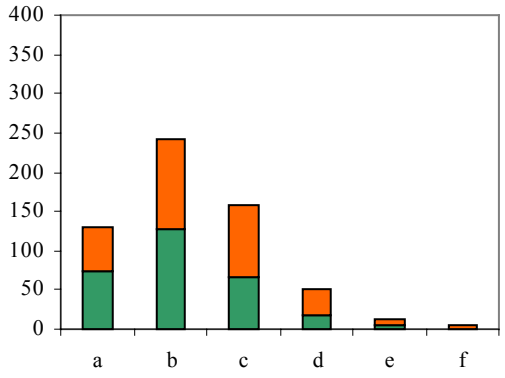
What can you do to help?

Local Environment Agency Plans (LEAPs) are used to consult and review the targets set for BQOs. These LEAPs are prepared with full public consultation and aim to reach a balance of the views of local people. You can get in contact with your local LEAP by contacting your regional Environment Agency office (see contact numbers and addresses below).

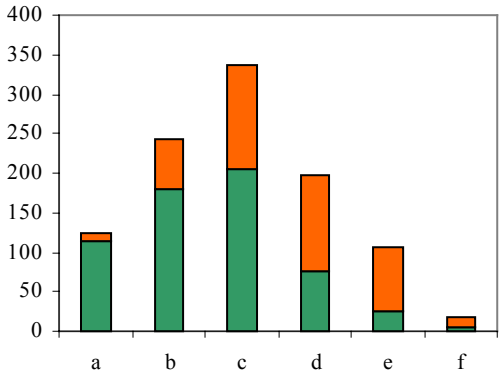
Or you can contact us on our Web page: http://www.environment–agency.gov.uk and follow 'what's in your backyard' where more details about BQO, RQO and other environmental issues can be found.

Number of severely and non-severely stressed biological sites by Region

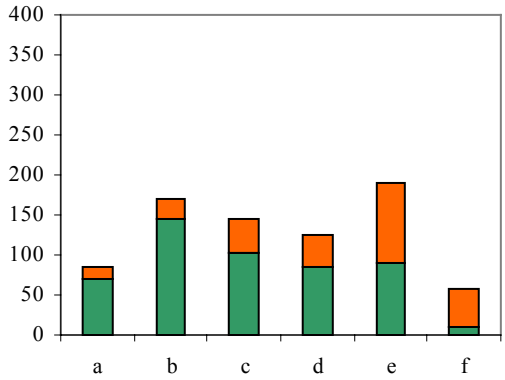
Anglian Region



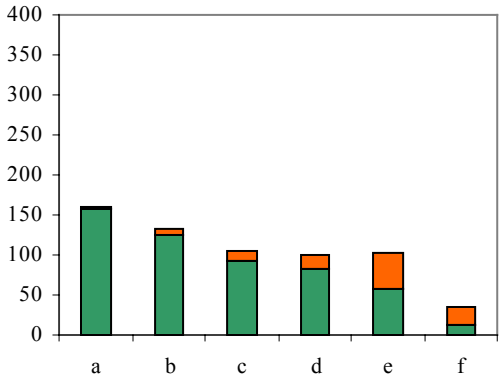
Midlands Region



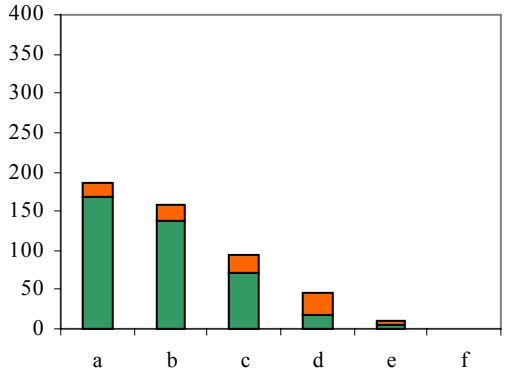
North West Region



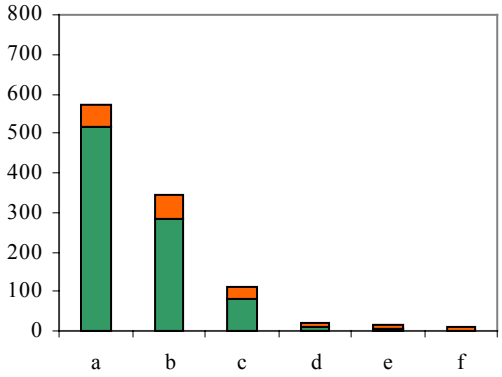
North East Region



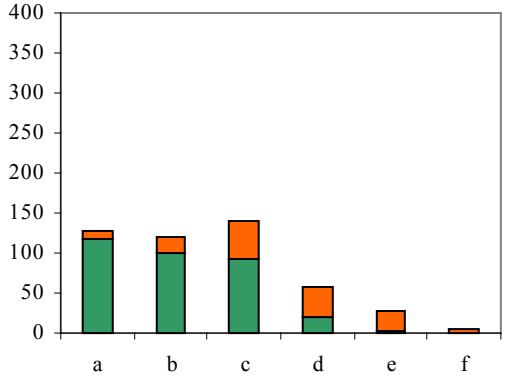
Southern Region



South West Region



Thames Region



EA Wales