



NRA

BLUE-GREEN ALGAL MONITORING 1992

TOXIC ALGAE TASK GROUP

OCTOBER 1993

*National Rivers Authority
Anglian Region*

NRA REPORT OF BLUE-GREEN ALGAL MONITORING 1992

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NRA REPORT OF BLUE-GREEN ALGAL MONITORING 1992

1. INTRODUCTION

- 1.1 This report describes the work which has been carried out by the NRA on blue-green algae in 1992. Information from the 1992 monitoring programme has been collated via a questionnaire in order that the Toxic Algae Task Group can appraise the 1992 situation and decide whether any changes need to be made to the blue-green algal monitoring programme.
- 1.2 The Toxic Algae Task Group was set up in 1989 to assess the incidence of toxic blue-green algae and to make recommendations for monitoring and control measures to be taken in the future.
- 1.3 Routine monitoring programmes were established in 1989 and 1990 to investigate the occurrence of potentially toxic blue-green algae. These programmes effectively identified the high priority waters that are most likely to develop blue-green algal problems in later years. Lake ecology does not change greatly from year to year and fluctuations in algal populations are largely weather dependent, so the Task Group considered it unnecessary to repeat extensive routine monitoring programmes each year. It was considered that algal problems are likely to reoccur each year and that owners should take the necessary precautions to prevent recreational and amenity users from coming into contact with blooms and scums and to contact the NRA when they do arise.
- 1.4 In 1991 a reactive sampling strategy was adopted which involved sampling of those waters that were not sampled, or did not contain "abundant" populations of blue-green algae, during the routine monitoring programmes of 1989 and 1990. This reduced the repetitiveness of the previous extensive routine monitoring programmes and allowed resources to be diverted into developing methods and recommendations for resolving blue-green algal problems. Further details of the 1991 programme are given in the Policy Implementation Guidance Note No. SC/EQ/005.
- 1.5 The 1991 sampling programme was effective and so the Task Group recommended that it be adopted on an annual basis. The programme was consequently repeated in 1992. A questionnaire was issued to the Regions in order to gain information on the 1992 monitoring programme and to evaluate its effectiveness. In addition to reactive monitoring, several regions have conducted their own routine monitoring programmes, some of which are in preparation for the blue-green algae action plans.
- 1.6 In "Toxic Blue-Green Algae" Water Quality Series No. 2, the Task Group recommended the development of management strategies for each water body affected by blue-green algae. The resulting "Action Plans" are

being developed to provide the best option for control in an individual water body. A document entitled "Guidelines for the Development and Implementation of Action Plans to Combat and Review the Incidence of Blue-Green Algal Blooms" has been produced by the Task Group together with a computer package called "PacGap", to assist with the production of action plans. A final version of the guidance note and PacGap will be issued in the near future.

1.7 National media coverage was not as widespread as in previous years, with many press reports concerning marine algae rather than blue-green algae. The lack of media coverage is perhaps testimony to the fact that blue-green algae did not attract as much public attention as in previous years. There is now a greater awareness of the issue and it is becoming accepted as a natural phenomenon which has the potential to reoccur each year. Another factor is that the weather conditions did not give rise to as many blue-green algal incidents worthy of media attention as in previous years. However, there is still a need to maintain detailed records of the occurrence of blue-green algal problems and the events of toxicity.

1.8 The questionnaire was sent out to the Blue-Green Algae Contacts in each NRA Region on the 31st of July 1992. It was sent out early to ensure that the Regions were aware of the data requirements for the year. A further copy of the questionnaire was sent out on the 30th of November 1992 as a reference. Replies were received by the 18th of February 1993. The questionnaire is reproduced in Appendix 1 for information.

2. 1992 BLUE-GREEN ALGAL MONITORING

2.1 Waters Sampled Reactively for the First Time in 1992

2.1.1 A total of 216 waters were sampled reactively for the first time in 1992. Of these 216 waters 119 (55%) contained blue-green algal populations that exceeded the warning level, and 113 (52%) had scums and/or blooms present.

2.1.2 A complete list of the waters which were sampled together with details of the usage of the water body, the dominant blue-green algae taxa which were present, whether the warning level was exceeded and whether a bloom and/or a scum was present is provided in Appendix 2. Table 1 summarises the number of waters sampled in each Region.

2.2 Waters Sampled Reactively in 1992 that were either Sampled Reactively and/or Contained Significant Populations of Algae in Previous Years

2.2.1 A number of waters which were sampled reactively in 1991 and/or which contained significant populations of algae in 1990 were also sampled on a reactive basis in 1992. 112 such waters were

Table 1. Regional Summary of the Waters Sampled Reactively for the First Time in 1992

Region	No. of Waters Sampled on a Reactive Basis	Warning Level Exceeded	Bloom and/or Scum Present
Anglian	43	21	24
Northumbria	13	3	5
North West	19	15	11
Severn-Trent	55	26	26
Southern	6	6	4
South West	8	8	6
Thames	25	13	11
Welsh	22	15	15
Wessex	5	4	4
Yorkshire	20	8	7
Total	216	119	113

Table 2. Regional Summary of the Waters Sampled Reactively in 1992 that were either Sampled Reactively and/or Contained Significant Populations of Algae in Previous Years

Region	No. of Waters Sampled on a Reactive Basis	Warning Level Exceeded	Bloom and/or Scum Present
Anglian	20	11	14
Northumbria	7	3	3
North West	16	14	14
Severn-Trent	35	26	26
Southern	0	0	0
South West	7	6	5
Thames	6	2	3
Welsh	8	7	7
Wessex	1	0	0
Yorkshire	12	8	5
Total	112	77	77

sampled, with 77 (69%) exceeding the warning level and 77 (69%) containing blooms and/or scums. Appendix 3 provides details of the waters which were sampled. Table 2 summarises the number of waters sampled in each Region.

- 2.2.2 In North West Region, Tatton Mere was sampled as part of a eutrophication study. This was a one off exercise to give staff experience of dealing with a blue-green algal incident.
- 2.2.3 In Yorkshire Region, Brickyard Pond was sampled in response to a request by the owners with respect to fishing the water. Primrose Valley Lake was sampled in relation to the development of an action plan with the owners. This was in response to the local EHOs concern about health issues and the need for a management policy as the lake is a central attraction in the Primrose Valley Holiday Park.

2.3 Waters Sampled Routinely in 1992

- 2.3.1 Four Regions have conducted their own routine sampling programmes. Appendix 4 details the samples which have been taken.
- 2.3.2 49 waters were subject to routine sampling in 1992. This is compared to 124 waters which were sampled routinely by six Regions in 1991. Of these 49 waters, 13 (26%) exceeded the warning level and 11 (22%) contained blooms and/or scums. In 1991, of the 124 waters routinely sampled, 64 (52%) exceeded the warning level and 39 (32%) contained blooms and/or scums.
- 2.3.3 Severn Trent Region sampled 11 water bodies routinely in 1992. All the water bodies had been previously affected by blue-green algae and were sampled in preparation for the blue-green algae action plans.
- 2.3.4 Thames Region were requested by the Royal Parks Office to sample the 33 lakes and ponds located in the Royal Parks in London. This was carried out over a two year period from 1991 to 1992, with sampling runs occurring in April, July and October. 16 of these lakes were sampled in 1991 and the results were reviewed in the NRA Report of Blue-Green Algal Monitoring 1991. In 1992 the 19 lakes in Appendix 4 were sampled. Of these 19 waters, four were found to contain blue-green algal species. Over the two year period, nine of the 33 lakes sampled had blue-green algae present. Notably the larger lakes in the Royal Parks had blue-green algae present in abundance. Further details of the monitoring programme are contained in "The Final Report of Sampling a Selection of Lakes in the Royal Parks, London for Potentially Toxic Blue-Green Algae". In addition, four other waters in Thames Region were routinely sampled.

2.3.5 In Welsh Region four water bodies were routinely sampled, mainly in one area due to pressure from the lake owners or the local authority.

2.3.6 Wessex Region sampled 11 waters routinely. The Region did not conduct a routine sampling programme in 1991. In 1992 it was decided that waters which were identified as containing regular algal growths should be routinely inspected several times a year in 1992. This would provide a better indication of the problem of blue-green algae than reactive sampling alone.

2.4 Waters Sampled as part of Ongoing Investigations

2.4.1 Two Regions have routinely sampled waters as part of ongoing investigative work. Appendix 5 details the waters which have been sampled.

2.4.2 In Anglian Region four waters were routinely sampled as part of the ongoing R&D work in the Region. Covenham Reservoir, Grafham Water, Pitsford Reservoir and Rutland Water were all sampled to monitor the effects of ferric sulphate dosing by Anglian Water Services. Ferric sulphate is added to control the level of phosphates in the water by precipitating it to the reservoir sediments as a ferric floc. The effect of dosing on the reservoir ecology has been investigated by monitoring the benthic invertebrates and the plankton. In addition to the biological sampling, total phosphorus, ortho-phosphate, chlorophyll a and iron levels have been analysed.

2.4.3 South West Region sampled 16 waters as part of their Enclosed Waters Monitoring Programme. The aim of this programme is to assess the water quality of the major standing waters in the Region. The reservoirs were sampled monthly throughout the year with a sample taken at three depths in the deepest area of each water. Chlorophyll a was analysed at the three depths and a qualitative surface phytoplankton sample was taken.

2.5 Visual Inspections

2.5.1 All Regions except Southern carried out visual inspections for the presence of blue-green algal blooms and scums.

2.5.2 In Anglian Region visual inspections were made of waters which were in the routine monitoring programme. Some waters were also inspected on an ad hoc basis when field staff were in an area where blue-green algae have been confirmed in the past, or suspect this to be the source of a reported problem.

- 2.5.3 In Northumbria and North West Regions visual inspections were made in response to reports from the public as part of reactive monitoring investigations.
- 2.5.4 In Severn Trent Region a visual inspection was carried out if a site was being visited. Similarly in Thames Region visual inspections were made if a biologist, and sometimes a technical officer, visited a water.
- 2.5.5 In the South West and Wessex Regions visual inspections were made on routine sites. Yorkshire Region inspected Primrose Valley Lake, Sawley Upper Lake and Hay-a-park Lake.
- 2.5.6 In some areas, Welsh Region inspected sites which had blooms in 1991 at approximately six weekly intervals. Otherwise inspections were only carried out in response to queries and problems.

2.6 Counting Methodology

- 2.6.1 Three Regions solely used the 1991 method for assessing algal abundance. Northumbria, South West and Welsh Regions used the "warning level" as outlined in the sampling provisions of the Policy Implementation Guidance Note no. SC/EQ/005. Northumbria Region also analysed chlorophyll *a* concentrations.
- 2.6.2 North West, Southern and Wessex Regions continued to use the 1990 methodology of "presence" and "abundance" with a count based on a two minute scan of 0.5ml.
- 2.6.3 Four Regions reported that different methods were used in the various areas of their Regions. In Anglian Region the 1990, 1991 and a cells/ml count were used. The cells/ml count was used to give an abundance description. In Thames Region the 1990 and 1991 methodologies were both used. In Yorkshire Region one area used the 1991 warning level procedure and the other area used a mixture of the 1990 and 1991 methods, depending on the requirements of the owner. Severn Trent Region generally used the 1991 warning level method but some counting was carried out.
- 2.6.4 Yorkshire Region commented that in general the 1991 warning level procedure was preferred to the 1990 methodology. This was also the view of the consultants Yorkshire Region had dealt with who had experienced the use of both techniques by different Regions.

2.7 The Extent of Blooms and Scums in 1992 Compared to Previous Years

- 2.7.1 With no national routine monitoring programme it is difficult to determine the incidence of blue-green algae in comparison to previous years. There was a general opinion that the extent of blooms and scums in 1992 was less frequent compared to 1991. The most popular suggested reason for this was the weather.
- 2.7.2 Anglian Region generally considered that blooms and scums were less abundant than in the previous two years because of the weather conditions. Another warm summer would be expected to produce an increased number of blooms and scums.
- 2.7.3 Northumbria Region did not consider it possible to estimate the extent of blooms and scums compared to previous years due to a lack of routine monitoring and because of the reluctance of private owners to notify the NRA of blooms.
- 2.7.4 North West Region stated that although the incidence appears to be lower than in previous years, blooms occurred as early as January at Derwent Water. Very high rainfall occurred in late summer and autumn which is usually peak time for blue-green algal growth. The lower incidence could be a direct impact of the weather or that people kept away from water so they did not see any blooms and/or scums.
- 2.7.5 In Severn Trent Region the extent of blooms and scums was generally less but there was some activity early in the year in June and in September, probably corresponding to calm periods. There was less sunshine and heavy cloud cover for much of the year, and there were high winds in the spring and high rainfall in the autumn.
- 2.7.6 Southern Region commented that one more water was reported than in 1991, presumably due to the weather conditions.
- 2.7.7 South West, Thames and Wessex Regions all considered that the occurrence of blooms and scums was probably less frequent due to the unsettled summer weather.
- 2.7.8 Welsh Region generally considered that blooms were less numerous and less problematic in 1992 and that they occurred later in the year, extending into October and November. However, there is no direct evidence to prove this because of the cessation of monitoring.
- 2.7.9 Yorkshire Region stated that it is impossible to report on the extent of blooms because the same waters have not been monitored each year and because the Public Relations input also

varies. The impression is that they were less frequent but there is no evidence to substantiate this.

2.8 Summary of the 1992 Blue-Green Algal Reactive Monitoring Programme

2.8.1 Table 3 summarises the number of waters which have been reactively sampled for blue-green algae in 1992 and, for comparison, in 1991.

2.8.2 In 1992, 328 waters were reactively sampled for blue-green algae. This is 22 more waters than were reactively sampled in 1991. However, the warning level was exceeded in 60% of the waters sampled in 1992 compared to 73% of waters in 1991. The incidence of blooms and/or scums was also lower in 1992 compared to 1991 but the difference between the percentages is low. 58% of waters contained a bloom and/or a scum in 1992 compared to 61% of waters in 1991.

Table 3. Summary of the Number of Waters Sampled Reactively in 1992 in Comparison to 1991

Year	Category of Reactive Sampling	Number of Waters Sampled	Number With No Blue-Green Algae	Warning Level Exceeded	Bloom and/or Scum Present
1991	Waters Sampled Reactively for the First Time	216	35 (16%)	151 (70%)	127 (59%)
	Waters Sampled Reactively that Contained "Abundant" Algae in 1990	90	2 (2%)	74 (82%)	61 (68%)
	Total Number Sampled in 1991	306	37 (12%)	225 (73%)	188 (61%)
1992	Waters Sampled Reactively for the First Time	216	67 (31%)	119 (55%)	113 (52%)
	Waters Sampled Reactively that were either Sampled Reactively in 1991 and /or Contained "Abundant" Algae in 1990	112	13 (12%)	77 (69%)	77 (69%)
	Total Number Sampled in 1992	328	80 (24%)	196 (60%)	190 (58%)

2.8.3 The results verify the comments of the Regions that there were fewer blue-green algal incidents in 1992 than in previous years.

2.8.4 The fact that more waters were reactively sampled in 1992 suggests that the public is aware of the phenomenon of blue-green algae and is reporting their existence to the NRA. However, Table 3 also details the number of waters which were

reactively sampled in 1991 and 1992 but did not contain any blue-green algal taxa. In 1991 12% of the total number of waters reactively sampled contained no blue-green algae. In 1992 this percentage increased to 24% of waters. This suggests that the public are reporting green algae and other growths, such as pond weed, as blue-green algae.

- 2.8.5 Table 3 also highlights the waters that were sampled reactively for the first time and those which were sampled in previous years, which did not contain any blue-green algae. In 1991 and 1992, 16% and 31% respectively of waters sampled reactively for the first time did not contain blue-green algae. For waters which were sampled in previous years the number was 2% and 12% in 1991 and 1992 respectively.

3. TOXICITY

3.1 Waters Sampled for Toxicity in 1992

- 3.1.1 Five Regions sent samples to the University of Dundee for toxicity testing. Table 4 describes the 14 samples taken from Northumbria, North West, Thames and Yorkshire Regions detailing the location where the sample was taken, the result of the toxicity analysis and the species of blue-green algae that was present at the time the samples were taken. Six of the waters sampled had positive results.
- 3.1.2 Severn Trent Region sent samples from Rosehill Fisheries and Kyre Pools to Dundee University for toxicity analysis early in 1992. However, apparently no location was recorded for the samples.
- 3.1.3 Following notification of the toxicity of the scum sample from Primrose Valley Lake in Yorkshire Region, Scarborough Environmental Health Officers served a prohibition notice for the holiday camp lake for a few days. Subsequently the owners and their consultants worked together with the EHOs to formulate a procedure for the lake which resulted in the lake opening again for the bank holiday weekend. It was agreed that the consultants would regularly monitor the lake and should an algal scum form in the lake it would be isolated using a floating boom and warning notices erected. Permanent notices have been erected around the lake advising the public of the potential dangers of toxic blue-green algae. The lake was sampled again by the NRA in late September when a scum was still evident in local areas but it was not thick enough to obtain another sample.

Table 4. The Waters Sampled for Toxicity in 1992

Name of Water Body	Result of Toxicity Test and Comments
<u>NORTHUMBRIA REGION:</u>	
Cawfields Quarry Pond	Highly hepatotoxic. A scum and bloom of <u>Anabaena flos-aquae</u> was present.
Haggerston Castle Lake	Insufficient biomass to test.
Hollywell Pond	Insufficient scum to test.
Long Newton West Pond and Long Newton East Pond	Extremely toxic. Tested by Dundee University for Northumbrian Water plc.
Raby Castle Lake	Insufficient scum to test.
Scoby Scaur Pond	Non toxic.
<u>NORTH WEST REGION:</u>	
Coniston Water, NW shore	Toxic. Scum of <u>Anabaena lemmermanni</u> , <u>A. circinalis</u> and <u>A. flos-aqua</u> was present.
Crosby Pond	Non toxic. Anatoxin was not found. <u>Anabaena</u> and <u>Microcystis</u> were present.
Lancaster Moor Hospital Reservoir	Hepatotoxic, <u>Microcystis</u> present. A small scale fish mortality occurred, probably due to a lack of oxygen and not because of the toxicity.
Leeds-Liverpool Canal, Aintree	Non toxic. Anatoxin was not found but an unidentified peak suggesting a toxin structure was located by Bath University. <u>Anabaena</u> and <u>Oscillatoria</u> were present.
Oakenclough Fish Holding Tanks	Non toxic. Anatoxin was not found. <u>Anabaena</u> and <u>Oscillatoria</u> were present.
<u>THAMES REGION:</u>	
Far Moor II	Hepatotoxic.
Pond at Salfords	Non toxic. <u>Microcystis</u> , <u>Coelosphaerium</u> and <u>Anabaena</u> were present with a bloom and scum. The sample was tested for toxicity due to the death of swans. They actually died from malnutrition.
<u>YORKSHIRE REGION:</u>	
Primrose Valley Lake	A scum sample was collected on 20th August and sent to Dundee University. <u>Aphanizomenon flos-aqua</u> was dominant with some <u>Microcystis</u> . The sample was highly toxic containing neurotoxins and hepatotoxins. The <u>Aphanizomenon</u> filaments occurred singly, rather than as bundles; apparently it is often more toxic in this form. The scum was restricted to the north west corner of the lake covering approximately 4 x 0.5m at the time of sampling.

3.2 Incidents due to Toxicity

- 3.2.1 Five Regions have reported a total of 9 incidents which may have been related to blue-green algal toxicity.
- 3.2.2 In Northumbria Region a vet informed the NRA of a dog which collapsed after having drunk some water from a pond while on the 35 mile Derwent Walk. The dog was taken to a vet in Newcastle who performed tests which suggested that blue-green algal toxins may have caused the sickness. Once this had been established the vet informed the NRA but this was three weeks after the incident. Investigations in the area did not reveal any algal material although blue-green algae were being looked for and not any benthic species.
- 3.2.3 North West Region reported three toxicity related incidents. At Killington Reservoir, Cumbria, more than 100 gulls and one Canada goose died. The bodies were too decayed for a post mortem and it was considered to be more likely to be due to botulism than to blue-green algae. There was little algal scum at the time of investigation and no toxicity test was carried out. At Lancaster Moor Hospital Reservoir there was a small scale mortality of carp. A toxicity test was taken and was found to be positive but the fish deaths were probably due to a lack of oxygen rather than the blue-green algal toxins. Finally, at the Leeds-Liverpool Canal at Aintree several dead ducks were reported but were not found. A toxicity sample was sent to Bath University for analysis where no anatoxin was found but an unidentified peak suggesting a toxin structure was located.
- 3.2.4 In August the warden of Daneshill Lake in Severn Trent Region reported that a boy on a camping holiday with other young people had disobeyed warning notices and swam in the lake. The following day he was hospitalised suffering from stomach pains and sickness. The lake contained Aphanizomenon but a toxicity sample was not taken. The incident was not thought to be linked to the presence of blue-green algae.
- 3.2.5 In Thames Region a number of swans died at the pond at Salfords. Microcystis, Coelosphaerium and Anabaena were present with a bloom and scum. The sample was tested for toxicity due to the death of the swans and was found to be non toxic. The swans were later identified as having died from malnutrition. The NRA was informed that a dog had hepatitis but there was no proven link with blue-green algae. It was suspected as a result of the raised perception of blue-green algae.
- 3.2.6 At Hartleton Lakes in Welsh Region two unconfirmed reports of swan deaths associated with blue-green algal blooms were

received. At one site no blue-green algae were found, at the other, traces of a bloom/scum of Oscillatoria sp. were present but were insufficient to confirm toxicity.

4. EXTERNAL COMMUNICATION

4.1 Standard Letters

4.1.1 Standard letters were sent out to owners of affected waters, Chief Environmental Health Officers, MAFF Regional Offices and Medical Officers of Environmental Health when waters were identified as likely to develop potentially toxic algal blooms. Table 5 gives the number of standard letters sent out to the respective bodies by each Region.

Table 5. The Number of Standard Letters Sent Out by each Region

Region	Owners	CEHO	MAFF	MOEH	TOTAL
Anglian	23	23	19	19	84
Northumbria	5	5	5	5	20
North West	24	24	24	24	96
Severn Trent	36	36	36	36	144
Southern	5	5	5	5	20
South West	4	4	4	4	16
Thames	26	29	26	28	109
Welsh	22	18	10	11	61
Wessex	4	4	4	0	12
Yorkshire	6	6	6	6	24
Total	155	154	139	138	586

4.1.2 A total of 586 standard letters were sent out by the ten Regions. This is 244 fewer letters than 1991, when 830 letters were sent out.

4.1.3 Welsh and Yorkshire Regions sent standard letters to owners of lakes with algal blooms in 1991 at the beginning of 1992 informing them of the potential problem.

4.1.4 In Yorkshire Region the results of some samples were reported verbally or by a local letter.

4.2 Liaison with Owners, CEHOs, MAFF and MOEH Concerning the NRA's Approach to Dealing with Toxic Blue-Green Algae

- 4.2.1 Nine Regions provided comments on liaison with owners, CEHOs, MAFF and MOEH.
- 4.2.2 In Anglian Region queries were received from Castle Point District Council regarding the pond adjacent to Newland Civic Amenity Site, Canvey Island. Problems were resolved by the District Quality Officers.
- 4.2.3 In Northumbria Region the owners of Hollywell Pond did not expect their pond to be closed to fishing because of blue-green algae. The owners of Airy Holm Reservoir, Long Newton East and Long Newton West Ponds enquired about how/when they could drain them to remove blue-green algae from potential potable water supplies.
- 4.2.4 In North West Region no complaints were recorded but the EHOs at times seem unsure what to do, they seem to want the NRA to act as health advisers.
- 4.2.5 Severn Trent Region reported that EHOs occasionally ask the NRA for advice but there has been little feedback.
- 4.2.6 In Southern Region there was a general concern over what to do if blue-green algae were present. Queries were directed towards local EHOs and NRA leaflets were sent for information.
- 4.2.7 In South West Region, Bridgerule Parish Council felt that there was confusion following a blue-green algal incident in the River Tamar. Riparian owners were referred by the NRA to MAFF and the EHO for livestock and health related queries, but MAFF and the EHO referred them back to the NRA.
- 4.2.8 Thames Region received no written complaints or queries. There were a number of requests for additional leaflets but no records were kept of where the requests originated. Telephone enquiries were passed to local biologists to deal with.
- 4.2.9 Wessex Region received some general queries and gave advice on affected waters.
- 4.2.10 In Yorkshire Region, Wakefield EHOs and Hemsworth Council were initially concerned that there was not going to be a regular monitoring service. After discussion it was accepted that day to day water management was the council's responsibility.

4.3 Reactions from Owners and Water Users

- 4.3.1 Eight Regions reported that owners and water users had enquired about blue-green algae. Most people expressed concern about the presence of the algae and asked what action was required to alleviate the problem.
- 4.3.2 In Anglian Region, the owners at Fen Drayton Lake were already aware of the problem of blue-green algae and warning notices were erected. Overall, there is a very good level of general awareness. Responsible owners and users are concerned if blue-green algae are found and ask, or often know, what to do. There was initial concern from those members of the public who were not previously aware of the problem but in these cases a discussion with field staff and a copy of the standard leaflet was usually all that was required to alleviate concerns.
- 4.3.3 In Northumbria Region the owners of Haggerston Castle Caravan Park Lake were concerned about public safety. In Welsh Region warning signs were erected at Bosherton Lakes. There was no response to the others.
- 4.3.4 North West Region reported that reactions vary considerably from complete indifference to very concerned. Local authority owned waters and North West Water reservoirs erected warning notices. Esthwaite Water, which is known to contain toxic strains, has never had notices posted. Private owners usually ask what they can do to deal with the problem.
- 4.3.5 In Severn Trent Region there has been little feedback this year, people are more generally understanding. A few have enquired about control methods. Anglers have been the most concerned, mainly on aesthetic aspects and the potential danger to dogs. Farmers were concerned for livestock.
- 4.3.6 In Southern Region there was general concern over what to do if blue-green algae were present. Queries were directed towards local EHOs and NRA leaflets were sent for information. Concern was expressed over Heath Pond, Petersfield, a public bathing and boating lake and over a windsurfing lake near Chichester (Hall Aggregates).
- 4.3.7 In South West Region owners were worried initially, but were reassured when provided with more information. In Wessex Region owners and users were generally cooperative following an on site explanation of the problem. Advice is often asked on control measures.
- 4.3.8 In Thames Region many owners were aware of the situation before receiving the warning letters because the local biologist had

already been in contact with them. Some telephoned asking for advice on what they should do and were referred to the local biologist for more information.

4.3.9 In Yorkshire Region the owner of Primrose Valley Lake found it difficult to understand the situation because he had never received any reports of illness from the lake users, and he assumed that the algae had been around for some years. Consultants were employed to deal with the matter.

4.3.10 Swinton Estate lakes in Yorkshire Region were monitored at the request of the Outdoor Pursuit Centre. This led to Lady Masham contacting Yorkshire Region for information on methods of controlling blue-green algae to assist her in formulating a question to put in the House of Commons/Lords.

4.4 Queries Received from Sources External to the NRA

4.4.1 Eight Regions were able to comment on the number of queries received from sources external to the NRA. One problem is that enquiries are taken by various functions within the NRA and that records are rarely kept of them.

4.4.2 Anglian Region received about 55 queries with many resulting in reactive sampling.

4.4.3 In Northumbria Region four fishermen enquired whether fish die in ponds with blooms. A vet asked whether a sick dog could have eaten scum in a country park and a cat owner enquired whether blue-green algae cause cat flu. A National Park warden asked whether scuba diving could resume when scum had dispersed. There were other general enquiries from garden pond owners, students and school children.

4.4.4 Most queries in North West Region have resulted in reactive sampling. It is unknown how many were received as many were telephone requests to Public Relations or other functions such as conservation, fisheries and pollution control. The number has been less than in 1991 probably due to the poor summer weather.

4.4.5 Around 100 queries were received in Severn Trent Region but records were not kept. Many were due to blooms of green algae and blanketweed. The queries were mainly from private owners of small water bodies.

4.4.6 In South West Region around 10 queries were received. All were concerned by discoloured water and wanted to know the cause.

4.4.7 Thames Region dealt with 60 to 80 incoming calls, mainly from EHOs and the general public, asking for advice on blue-green algae. Information was sent out and samples were taken on request. It was commented that the public find it difficult to distinguish blue-green algae from other algae.

4.4.8 Welsh Region received less than ten queries. They were mostly from members of the public or owners which in most cases led to reactive sampling. Similarly Wessex Region received approximately ten general queries.

4.4.9 Yorkshire Region received very few queries. Some resulted in reactive sampling, for example, Hay-a-park Lake was sampled due to a complaint by a member of the public.

5. WATERS CLOSED FOR RECREATIONAL ACTIVITIES

5.1 Waters where all Recreational Activities were Suspended

5.1.1 The NRA is not responsible for closing down waters. Once a water body has been identified as having a blue-green algal problem the matter is taken over by the EHOs, owners and local Councils. The NRA is not necessarily told what decision is made and it is therefore difficult to establish whether recreational activities have been suspended. This was commented by Anglian and Yorkshire Regions.

5.1.2 A total of nine water bodies are known to have had all recreational activities suspended. This is compared to 14 waters where all activities were suspended in 1991. Table 6 below lists the waters which were closed and provides more details on the closures.

Table 6. Waters where all Recreational Activities were Suspended

Name of Water Body	Comments
<u>ANGLIAN REGION:</u> Pond adjacent to Newland Civic Amenity Site, Canvey Island	The area was fenced off to prevent public access for a period of two months from June.
<u>NORTHUMBRIA REGION:</u> Cawfields Quarry Pond	A bloom developed in April and samples taken were highly toxic. Recreation was consequently suspended, including diving.
Hollywell Pond	The pond is an SSSI and is a high profile water body with easy access. The owners erected warning notices after the algal warning level was exceeded. A fishing competition was almost cancelled.

Table 6 (Continued)

<u>SEVERN TRENT REGION:</u>	
Hatfield Marina	Closed during period of scums and high algal counts
Sandhills Lake	Closed during period of scums and high algal counts
Daneshill Lakes - Main Lake and Car Park Lake	Closed during period of scums and high algal counts
<u>SOUTH WEST REGION:</u>	
Bicton Lake	The lake is at Bicton Agricultural College where it is used for canoeing and rowing. These activities were suspended for about four weeks in July/August.
<u>WELSH REGION:</u>	
Linton Pool Bromyard	Angling was suspended during the bloom.
<u>YORKSHIRE REGION:</u>	
Home Pond, Swinton	All recreational activity on the pond was suspended for the duration of the bloom from June to September.
Primrose Valley Lake	All recreational activities were suspended for a few days only.

5.2 Waters where some Recreational Activities were Suspended

5.2.1 At some water bodies only the higher risk recreational activities were suspended and the lower risk activities were allowed to continue. 16 water bodies had some recreational activities suspended. These are listed, together with further details, in Table 7. In 1991 10 waters had some recreational activities suspended.

Table 7. Waters where Some Recreational Activities were Suspended

Name of Water Body	Comments
<u>ANGLIAN REGION:</u>	
Ferry Meadows	Details unknown.
Tattershall Country Club	Details unknown.
<u>NORTH WEST REGION:</u>	
Pennington Flash	Users were advised to keep dogs out of the water and to avoid contact. Scum was washed into the stream below and owners were warned. A sailing club cautiously used the water.

Table 7 (Continued)

<u>SEVERN TRENT REGION:</u>	
Branston Water Park	Windsurfing was suspended due to benthic <u>Oscillatoria</u> .
Colemere, Shropshire	School sailing was stopped when algal levels exceeded the warning level. Angling was continued.
Colwick Park Main (Trout) Lake	Sailing may have been suspended. Angling was continued.
Colwick Park West Lake	Swimming and windsurfing were suspended.
Kings Mill Reservoir, Mansfield	School sailing and canoeing was stopped. A private sailing club continued to use the water.
Staunton Harold Hall, Upper Lake	Canoeing was temporarily suspended.
Stratford-on-Avon Canal, Dickins Heath	Livestock were moved from the canal area.
Willows Farm Lake, Leicester	Sailing was temporarily suspended.
<u>SOUTHERN REGION:</u>	
Butlins Paddling Pool, Bognor Regis	Paddling was suspended.
Heath Pond, Petersfield	Warning notices were erected around this popular lake and children were prevented from paddling. Boating and canoeing continued.
<u>SOUTH WEST REGION:</u>	
Exeter Canal	Canoeing was suspended for about four weeks in July/August by Exeter City Council.
<u>WELSH REGION:</u>	
Cwmbran Boating Lake	Boating was temporarily suspended but angling continued.
Roath Park Lake	Some boating activity (paddle boats) was temporarily suspended during the bloom.
<u>WESSEX REGION:</u>	
Westrow House Lake	The owner was advised to stop swimming in the lake and the activity was temporarily suspended.

5.3 Feedback due to the Closure of a Water Body

- 5.3.1 Four Regions commented on the feedback which had been received following the closure of a water body.
- 5.3.2 In Anglian Region a wind surfer enquired how long a water body would be closed.

5.3.3 The warden of Hollywell Pond in Northumbria Region requested that a sample was taken because the lake had contained a bloom the previous year and concern was expressed that a fishing competition may have to be cancelled. A second sample was requested to be taken some time later which did not exceed the warning level and so the fishing competition proceeded as planned.

5.3.4 In Severn Trent Region queries were received relating to the possible length of closure of lakes for recreation, particularly by Colemere Sailing Club. Organisers of a triathlon requested that a sample be taken 8 days before the event in September. They also asked for a prediction for the most likely time that the race could take place so that there would be no blue-green algae present.

5.3.5 Some queries were received in South West Region concerning the part closure of Exeter Canal.

6. PUBLICITY

6.1 Publicity Used

6.1.1 There was a general view that the level of publicity in 1992 was not as extensive as in previous years. This is probably due to a combination of a lower incidence of blue-green algal problems in 1992, a low profile reactive monitoring programme and an increased public awareness of the phenomenon. The blue-green algae leaflet was distributed to interested parties.

6.1.2 In Anglian Region staff in the Eastern Area were involved with publicity following the detection of blue-green algae at the pond adjacent to Newland Civic Amenity Site, Canvey Island. Geoff Phillips gave a radio interview on general aspects of blue-green algae and Steve Bowers appeared on TV Southern with regard to the algae at Canvey Island. Press releases were issued for incidents at Ferry Meadows and Canvey Island.

6.1.3 Northumbria Region issued minimal publicity to remind the public that blue-green algal scums and blooms can be toxic. Press releases were issued for specific incidents, such as for Cawfields Quarry and Hollywell Pond.

6.1.4 In North West Region all local authorities, and some owners, were sent letters in early spring to remind them of waters in their districts where blooms/scums have been found before. Press and radio interviews were held in relation to specific incidents. Similarly Thames Region wrote to all owners, CEHOs, MAFF and MOEH previously notified.

- 6.1.5 In Southern Region an interview was given by a member of NRA staff for the Petersfield Herald in association with the blue-green algae at Heath Pond, Petersfield. Welsh Region issued press releases on a local basis for specific problems such as the scum at Roath Park Lake in Cardiff.
- 6.1.6 The South West Region provided a speaker at two seminars for the Public Health Service Laboratories at Salisbury and Portsmouth. These covered general aspects of blue-green algae and the potential risk of toxicity.
- 6.1.7 Yorkshire Region sent leaflets to owners of newly affected waters and they were also available at outside talks given by staff and in office reception areas. One such talk was given on the "Riverside Environment" for the Rotary Club. This was a general talk on the subject but the leaflets were made available for attendees.

6.2 The Effects of Publicity

- 6.2.1 Anglian, Northumbria, Thames, Southern and Welsh Regions commented that the publicity used provided the necessary information and had the desired effect. There have been relatively few queries in 1992 and the information appears to have been understood. There have been no further queries from the public after receiving the leaflet.
- 6.2.2 North West Region commented that it is difficult to assess the effect of publicity. Some owners do not want to know any further details.
- 6.2.3 Severn Trent Region believe that the public appear to be more aware of the situation.

6.3 Suggested Methods for Increasing Publicity

- 6.3.1 Many Regions have commented that the blue-green algae leaflet should continue to be made available. In addition there are a number of suggested approaches which could be made to increase publicity.
- 6.3.2 Anglian Region suggests that public awareness could be increased by education at school level. The number of notices put up near waters which are affected by blue-green algae could be increased.
- 6.3.3 North West Region commented that the public that are interested in blue-green algae seem aware of the potential problems, but because of the concern the publicity has created, any growths from duck weed to Cladophora are reported as blue-green algae.

A better description of blue-green algae might reduce the number of false alarms.

- 6.3.4 Severn Trent and Welsh Regions suggested that a press release is issued at the beginning of the season forewarning of potential problems. Welsh Region also suggest that owners could be advised to have leaflets available for public use at problem lakes.
- 6.3.5 Southern Region consider that the public now seem to be aware that blue-green algae are a natural phenomenon and suggest that informed sources are made available to whom people can be directed for enquiries.
- 6.3.6 South West Region suggest that leaflets could be distributed to local schools. Talks to local societies are generally well received although the message reaches a small audience. An article in a magazine such as "BBC Wildlife" would perhaps reach a wider audience.
- 6.3.7 Thames Region suggest that large posters could be placed where water users meet such as in club houses.
- 6.3.8 Yorkshire Region consider that public awareness does not need to be raised any further.

7. ALGAL CONTROL METHODS

7.1 Algal Control Methods in Operation

- 7.1.1 Eight Regions reported on the algal control methods used in their Region. All eight Regions have suggested the use of straw bales; ferric sulphate dosing is being carried out in two Regions; copper sulphate is apparently being used in Welsh Region and dredging has been carried out in Yorkshire Region.
- 7.1.2 In Anglian Region, Anglian Water Services have dosed a number of water supply reservoirs with ferric sulphate in order to reduce the phosphate load available in the water column. There are a number of Anglian Region NRA R&D projects which are investigating the impact of ferric dosing on the benthic macroinvertebrate and phytoplankton communities. Straw bales have also been used but their success has not been monitored.
- 7.1.3 In Northumbria Region straw bales were used at Cawfields Quarry Pond apparently with some success. Further details are provided in section 7.2.
- 7.1.4 North West Region suggested the use of straw bales where it was felt that they might offer some algal control. When giving

advice on weed control, owners are advised to leave stands of macrophytes in waters to compete for nutrients and to act as a refuge for grazing organisms.

- 7.1.5 In Severn Trent Region straw bales were used in Kings Mill Reservoir. Holme Pierrepont 200m Rowing Course was treated by flushing from the River Trent. This was started in 1991 and was continued in 1992. Counts were much lower than in 1990 but the Oscillatoria warning level was occasionally exceeded. Flushing was dependent on the visual appearance of the water and on the results of routine samples. In addition straw bales were used in the shallows but it is not possible to separate the effects from the flushing regime.
- 7.1.6 Some owners in Severn Trent Region have tried ferric dosing, straw bales or a mixture of the two. There are no conclusive results from the treatments.
- 7.1.7 In Thames Region some enquirers were advised on the use of straw bales. It was suggested that they contact Pip Barrett at the Aquatic Weeds Research Unit.
- 7.1.8 In Welsh Region barley straw treatment experiments were carried out by the owners of Greenfield Ponds and Cwmbran Boating Lake. This work is described in section 7.2. Copper sulphate was apparently used by Welsh Water plc at Plas Uchaf and Dolwen reservoirs.
- 7.1.9 In Wessex Region control measures were suggested to the owners of Westrow House Lake. Straw bales were recommended but it is unknown whether they were actually used. The lake was heavily stocked with young fish and it was suggested that they should be controlled, especially as the lake was not used for fishing. In late 1992 a consultant drained the lake and removed the fish. The lake will be monitored in 1993.
- 7.1.10 In Yorkshire Region barley straw was used at Thrybergh Reservoir, Primrose Valley Lake, Hemsworth Water Park and Allerton Park Lakes. Section 7.2 provides more detail on these treatments.
- 7.1.11 A combination of approaches have been used at Primrose Valley Lake in Yorkshire Region. Barley straw was introduced in early 1992 but did not appear to be effective. Investigative biological and pollution control work on the incoming streams revealed polluting inputs, which are being dealt with. The lake was drained in December 1992 and dredging is being carried out in January/February 1993 to remove the large quantities of silt, which have accumulated over the years. Fish restocking and planting will follow in spring 1993. Monitoring will be

continued but it is not known whether the straw trials will be resumed.

7.2 Barley Straw Bales

- 7.2.1 The use of barley straw bales as an algal control method has been suggested by eight Regions. Five Regions were able to provide additional information on where straw bales had been used and whether its use had resulted in any blue-green algal control. In the majority of cases there is very little information available on where in the country straw is being used and whether it has been used successfully.
- 7.2.2 Anglian Region has received several enquiries on the use of straw bales and has sent out leaflets produced by the Aquatic Weed Research Unit. Informal feedback has indicated some limited success, but this is largely unsubstantiated. In most instances there has been no monitoring of sites where straw has been used.
- 7.2.3 At Cawfields Quarry Pond in Northumbria Region blue-green algae were present at concentrations above the "warning level" throughout the winter of 1991/1992. The owner of the pond was put into contact with Pip Barrett of the Aquatic Weeds Research Unit who then applied straw bales in February 1992. Concentrations of blue-green algae have remained below the "warning level" since 30th April 1992. Monitoring is hoped to be carried out in 1993.
- 7.2.4 North West Region has carried out a straw bale trial with Blackpool Borough Council on amenity lakes. There have been problems with the distribution of the bales due to the shallow water and the intensive boating which is carried out. The results for 1992 have yet to be evaluated but the council did not report any problems with blue-green algal scum. North West commented that it is often difficult to get feed back on the use of straw bales.
- 7.2.5 In Severn Trent Region a controlled experiment is being carried out at Sambourne Trout Pool. 22 straw bales were placed in the pool in November. Chemical and algal samples have been taken over the winter of 1992 and will be continued in 1993.
- 7.2.6 Straw bales have been used in conjunction with increased flow at Knighton Hall, Adbaston in Severn Trent Region. Straw bales were put into the lake in the autumn of 1991 and the spring of 1992. The lake was not monitored but the local angling club informed the NRA in late 1992 that blue-green algae were no longer a problem. Additional bales will be put into the lake in 1993 and monitoring will be carried out.

- 7.2.7 In Thames Region the use of straw bales was recommended to individual enquirers but it is not known where it has been used and whether its use has been successful.
- 7.2.8 Welsh Region monitored the use of straw bales at two lakes in the Region. Cwmbran Boating Lake is a man made ornamental lake which is intensively used for recreation. In the summer of 1990 the lake was closed to the public due to extensive blue-green algal blooms and scums. The District Council received advice from the NRA based on guidance from the Aquatic Weeds Research Unit and began an experimental treatment using barley straw. 15 bales were applied to the lake in May 1991, with repeat applications in December 1991 and April and October 1992. Welsh Region biologically and chemically monitored the lake to assess the effectiveness of the treatment.
- 7.2.9 The results of the experiments at Cwmbran Lake are not conclusive. The straw appeared to be effective in controlling or limiting blue-green algal blooms during 1991 and the majority of 1992. A bloom of Anabaena did occur in late August 1992. The experiment cannot be considered to be conclusive because of other potentially limiting factors which are evident in the lake, such as a lack of information on residence time and the cessation of groundbait usage by anglers.
- 7.2.10 Straw will continue to be used at Cwmbran Lake as a control measure for the future and other options such as the reintroduction of macrophytes and continued restrictions on the use of ground bait have been suggested. Welsh Region will regularly monitor the algal community in 1993.
- 7.2.11 At Greenfield Ponds in Welsh Region the owners have begun treatment with straw bales after taking advice from the NRA. Welsh Region began monitoring in December 1992 and will continue in 1993. Algal samples will be taken fortnightly and the water quality of the ponds will be assessed weekly. Results of the monitoring are due at the end of 1993.
- 7.2.12 In Yorkshire Region barley straw appeared to work at Thrybergh Reservoir in 1991 but the owners did not continue the experiment in 1992 and blue-green algae reappeared. Straw was used at Primrose Valley Lake, but the bales were only introduced in January 1992 and green algae persisted through the winter. Straw was introduced at Allerton Park Lakes in 1991 but no further information is available. At Hemsworth Water Park straw bale trials were due to begin in late 1992.

8. RESEARCH AND DEVELOPMENT (R&D)

8.1 NRA R&D Projects and Project Proposals

- 8.1.1 Three Regions have ongoing R&D projects concerning blue-green algae and eutrophication. South West Region have resubmitted a project proposal which was turned down in 1991.
- 8.1.2 Anglian Region have funded a number of R&D projects concerning eutrophication control. Covenham Reservoir, Grafham Water, Pitsford Reservoir and Rutland Water were sampled to monitor the effects of ferric sulphate dosing by Anglian Water Services. Biological sampling of the benthic invertebrates and the plankton has been carried out together with analysis of total phosphorus, ortho-phosphate, chlorophyll *a* and iron levels. In addition, the benthic invertebrates of Foxcote Reservoir have been sampled.
- 8.1.3 Five PhD students have been funded by Anglian Region at Leicester University to research aspects related to eutrophication at Rutland Water. The projects are detailed below:
- a) To calculate nutrient budgets and investigate the cycling of nutrients (nitrogen and phosphorus) in Rutland Water.
 - b) To establish the flow of carbon in Rutland Water to present a budget of carbon cycling and to produce basic carbon models.
 - c) To determine the effects of ferric dosing on the zooplankton population dynamics and to determine the possible effects on the rest of the biota.
 - d) To investigate the possible effects of ferric sulphate dosing on the life history of zooplankton.
 - e) To investigate the effects of ferric sulphate dosing at Rutland Water on benthic invertebrates.
- 8.1.4 A project entitled the "River Nar Eutrophication Control Study" has recently begun in Anglian Region. A phosphate consent has been issued for a sewage treatment works discharging to the River Nar to protect the SSSI and salmonid fishery objectives. The study will quantify the changes to the biology, fisheries and water quality following installation of the phosphate removal plant and will be valuable in the development of future monitoring strategies for such plants.
- 8.1.5 A project to identify the mesotrophic streams in Anglian Region has recently started. This type of water course is uncommon in

the Region and is known to support rare species of plants and invertebrates. The study will identify the nature and extent of mesotrophic streams in Anglian Region and will develop protocols for their identification.

- 8.1.6 Anglian Region continued the NRA Broad's Research Programme, looking at the restoration of the Norfolk Broad's. In 1992 there were three main topics of research. The first examined the importance of iron in the control of phosphorus release from the sediment of shallow lakes. This involved assessing the potential for the addition of iron salts direct to the sediment to reduce the release of phosphorus to the overlying anoxic water. The second project is studying the effect of the control of phosphorus in the catchments of the Rivers Bure and Ant. This is assessing the impact of phosphate stripping from sewage treatment works on the ecology and recovery of the Norfolk Broad's. Finally, work is continuing on biomanipulation, looking at the re-establishment of macrophytes and associated fish and invertebrate communities in the Broad's.
- 8.1.7 In Severn Trent Region routine monitoring of algal populations was carried out in Shropshire Meres. A controlled experiment is being carried out at Sambourne Trout Pool. 22 straw bales were placed in the pool in November. Chemical and algal samples have been taken over the winter of 1992 and will be continued in 1993.
- 8.1.8 In Yorkshire Region a sandwich student will carry out a project at Scout Dike Reservoir including an assessment of the quality of the inlet streams. The case study is linked to the development of an "Action Plan" for the reservoir.
- 8.1.9 South West Region proposed a project in October 1991 entitled "The effect of storm events on the re-mobilisation of phosphorus from sediments in shallow lakes, and the impact on algal blooms." The project did not proceed due to a lack of money. It is hoped that money may be available in 1993.
- 8.1.10 Biocode Ltd. are attempting to develop a field test kit for the immunodetection of blue-green algal microcystins.
- 8.1.11 The University of Dundee is carrying out research into the production of microcystins by planktonic blue-green algae and the fate of these toxins. Research is also in progress on the production of anatoxin-a by benthic Oscillatoria species; the occurrence of toxic benthic blue-green algae in Scottish water bodies; the use of protein phosphatase inhibition assays for toxin detection and quantification; the monitoring of microcystins and neurotoxins in potable waters in Scotland and Sweden.

8.1.12 The Freshwater Biological Association is carrying out work on the modelling of algal blooms. A model is being produced which predicts the algal species and their distribution in a lake according to the physical and chemical variables entered.

8.2 Non-NRA R&D Projects

8.2.1 A number of non-NRA organisations, including Universities, have been identified as carrying out R&D concerning blue-green algae and toxicity.

8.2.2 Anglian Water Services have funded a PhD student based at Birmingham University to investigate the effects of ferric sulphate dosing on the phosphorus dynamics of eutrophic reservoirs.

8.2.3 A consultancy entitled Aquatic Pollution and Environmental Management (APEM), which is based at the University of Manchester, is carrying out work mainly on reclaimed docks at Salford Quays using barley straw, filter feeding bivalves and carbon dioxide to control blue-green algae. APEM put forward an R&D proposal for laboratory and field scale trials on the use of carbon dioxide as a potential control strategy for blue-green algae. The Toxic Algae Task Group decided that NRA funding was not appropriate.

8.2.4 The Aquatic Weeds Research Unit, based at Reading is carrying out work on the inhibition of algal growth by barley straw.

8.2.5 At the University of Bath, Dr Jefferies is involved with the development of analytical methods for algal derived toxins such as anatoxin-a and microcystin-LR. The NRA was approached for funding for a three year PhD student to develop the techniques further. Funding was not considered to be applicable.

8.2.6 At Liverpool University, the Environmental and Evolutionary Biology department have carried out investigations into the mechanism of algal control using barley straw. Senior Lecturer Dr John Eaton has been supervising the work. Students gave presentations on the work at the West Midlands and North West England Freshwater Biology Group meeting.

8.2.7 At the Open University, Irene Ridge has been investigating the use of brown rotted wood as an algal prohibiter. Wood has been contained in netting and placed in small ornamental ponds where it has appeared to control algal growth.

8.2.8 At the University College, Swansea, Dr K.J. Flynn has varied research interests in both freshwater and marine toxic algae.

The college hosted the British Phycological Society Winter Meeting in January 1993.

8.2.9 The University of Warwick and Severn Trent Water plc are conducting a three year research project on blue-green algal toxins. The following two papers have been published:-

a) Characterisation of Cyanobacterial Toxins, by Dr C.S. Dow, Dr U.K. Swoboda and Vince Howells.

b) Environmental Monitoring of Toxic Cyanobacteria, by Dr U.K. Swoboda, C.S. Dow and Anne Wilson.

9. CONCLUSIONS

- 9.1 A total of 216 waters were sampled reactively for the first time in 1992. Of these 216 waters, 119 (55%) contained blue-green algal populations that exceeded the warning level, and 113 (52%) had scums and/or blooms present.
- 9.2 A number of waters which were sampled reactively in 1991 and/or which contained significant populations of algae in 1990 were also sampled on a reactive basis in 1992. 112 such waters were sampled, with 77 (69%) exceeding the warning level and 77 (69%) containing blooms and/or scums.
- 9.3 Four Regions have conducted their own routine monitoring programmes. Severn Trent, Thames, Welsh and Wessex Regions routinely sampled 49 waters in 1992. Of these 49 waters, 13 (26%) exceeded the warning level and 11 (22%) contained blooms and/or scums. Anglian and South West Regions routinely sampled 20 waters as part of ongoing investigations.
- 9.4 All Regions except Southern carried out visual inspections for the presence of blue-green algal blooms and scums.
- 9.5 A mixture of counting methodologies were used throughout the Regions. Northumbria, South West and Welsh Regions used the 1991 "warning level" procedure. North West, Southern and Wessex Regions used the 1990 "presence" and "abundance" method. Anglian, Severn Trent, Thames and Yorkshire used a mixture of the 1990 and 1991 methods.
- 9.6 The extent of blue-green algal blooms and scums was generally considered to be less in 1992 than in previous years. Many Regions hypothesised that this was due to the cooler and unsettled weather conditions. It was commented that with no national routine monitoring programme, it cannot be said with certainty that 1992 was a less problematic year. Analysis of the total number of waters which were reactively sampled in 1992 showed that 328 waters were sampled, 22 more than in 1991. However, the percentage of waters which exceeded

the warning level was slightly lower in 1992 than in 1991 and the incidence of blooms and/or scums was also lower. This verifies the comments of the Regions that there were fewer blue-green algal blooms and scums in 1992 than in previous years.

- 9.7 The percentage of waters which were reactively sampled but did not contain any blue-green algal taxa in 1992 was twice the percentage than that in 1991. This indicates that the public are increasingly reporting green algae and other growths as blue-green algae.
- 9.8 Five Regions sent samples from 14 waters for toxicity analysis to the University of Dundee. Of the sources from which material was tested, six yielded positive results.
- 9.9 There were nine reported incidents which may have been related to blue-green algal toxicity. However, none of them were proven, either because the NRA was informed of the incident too late to take a toxicity sample, or because there was another definite reason such as death by botulism or malnutrition.
- 9.10 Communication with owners, CEHOs, MAFF and MOEH was not as extensive as in previous years. 586 standard letters were sent out by the Regions. There were several reports of confusion amongst EHOs, often asking the NRA for advice on health aspects. Owners and water users have enquired about possible control methods for blue-green algae. The general public has shown a good awareness of the issue and queries have often resulted in reactive sampling.
- 9.11 A total of nine water bodies in six Regions were known to have had all recreational activities suspended in 1992 due to the presence of blue-green algae. A further 16 waters in seven Regions had some high risk recreational activities suspended.
- 9.12 Publicity was considered to have been less extensive compared to previous years. The blue-green algae leaflet was widely circulated on request and press releases were made for specific incidents. Several Regions commented that the public appear to be more aware of the phenomenon of blue-green algae.
- 9.13 Eight Regions reported on the algal control methods used in their Region. Straw bales have been used in all these eight Regions; ferric sulphate dosing has been carried out in Anglian and Severn Trent Regions; it is believed that copper sulphate has been used in Welsh Region; flushing has been used in Severn Trent Region and dredging has been carried out in Yorkshire Region.
- 9.14 Barley straw bales have been suggested by eight Regions. Five of these were able to provide additional information on its use. Northumbria, North West, Severn Trent, Welsh and Yorkshire Regions all

monitored the effect of using straw bales. The results were not conclusive.

9.15 There have been very few waters where the use of straw bales has been monitored. The Toxic Algae Task Group recommends that barley straw should only be used when monitoring is carried out and that it is determined where in each Region straw has been, and is being, used.

9.16 In addition to the National programme of research on algal toxins, modelling and field test kit development, Anglian Region in particular has continued extensive R&D on eutrophication. Severn Trent and Yorkshire Regions also conducted R&D projects. Some universities and organisations have carried out research into blue-green algal toxins and methods of control. It is evident that there is continued interest in blue-green algae and that there are several groups around the country working on this expanding area of study.

9.17 In 1992 the perceived extent of blue-green algal incidents in England and Wales was lower than in previous years. By contrast, dog deaths caused by blue-green algal toxins were recorded for the third consecutive summer in Scotland, where major fish kills associated with, and attributed in part, to blue-green algal toxins also occurred. It is vital that the NRA continues to investigate the occurrence of blue-green algae and to develop control strategies for the future. The blue-green algae "Action Plans" will begin to be implemented in 1993 and will provide management options for individual water bodies.

A.J. Frogley
October 1993

APPENDIX 1
Toxic Blue-Green Algae Questionnaire 1992

1. Please complete table 1 for waters which you sampled on a reactive basis during 1992. For usage, please refer to list "A" below and for species present refer to list "B".

List "A"

- a. Swimming
- b. Water Skiing
- c. Board Sailing
- d. Dinghy and boat Sailing
- e. Motor Cruising
- f. Scuba Diving
- g. Angling
- h. General Public Amenity
- i. Irrigation of Crops
- j. Livestock Watering
- k. Canoeing
- l. Potable Water Supply
- m. Paddling
- n. Jet Skiing
- o. Private Garden Pond
- p. Rowing

List "B"

- a. Microcystis aeruginosa
- b. Microcystis spp
- c. Anabaena flos-aquae
- d. Anabaena circinalis
- e. Anabaena spp
- f. Aphanizomenon flos-aquae
- g. Aphanizomenon spp
- h. Oscillatoria agardhii
- i. Oscillatoria rubescens
- j. Oscillatoria spp
- k. Gloeotrichia spp
- l. Coelosphaerium spp
- m. Gomphosphaeria lacustris
- n. Gomphosphaeria naegeliana
- o. Gomphosphaeria spp
- p. Merismopedia spp
- q. Nostoc spp
- r. Lyngbya spp
- s. Nodularia spumigena
- t. Nodularia spp
- u. Synechocystis spp
- v. Synechococcus spp
- w. Spirulina spp
- x. Aphanocapsa spp
- y. Any other species or genus
please specify.

2. Did you sample any waters this year, that have been found to contain significant populations of algae in previous years, due to pressure from the owners or recreational organisations? Please list providing details (table 2).
3. Have any samples been subject to toxicity analysis (table 3)? Please provide details of these cases, i.e. were they hepatotoxic, neurotoxic etc, was toxicity high medium or low etc.
4. If you have followed up a toxicity incidence, please provide details? i.e. name of water body, location, species present, presence of a scum or bloom etc.

5. How many standard letters have been sent out when specific water bodies (sampled routinely and reactively) were identified as being likely to develop potentially toxic algal blooms:
 - a. Owners of affected waters.....:
 - b. Chief Environmental Health Officers.....:
 - c. MAFF Regional Offices.....:
 - d. Medical Officers of Environmental Health.....:
6. Did you receive any complaints or queries from owners of effected waters, CEHOs, MAFF Regional Offices or Medical Officers of Environmental Health concerning the NRAs approach to dealing with the toxic blue-green algae? Please give details:
7. Do you have any idea of the owners or the water users reactions when a water body had been identified as containing large populations of potentially toxic species of blue-green algae. Please provide details:
8. Can you estimate how many queries you have received, from sources outside of the NRA, concerning blue-green algal problems? i.e. unsightly shoreline scums, blooms, unpleasant odours etc. If so please give details:
9. Some regions may of conducted their own routine sampling programmes. Please complete table 4.
10. Have you:
 - a) made any visual inspections for blue-green algal scums and blooms? Please give details:
 - b) Is there any evidence to suggest that surface scums or water blooms were more frequent or less frequent this year than in previous years?
 - c) If so. can you give reasons for this?
11. How many waters were completely closed for water-based recreation due to blue-green algae, please list, (table 5).
12. How many waters had some recreational activities suspended but not others e.g. wind surfing was suspended but fishing was allowed to continue, please list (table 6). Please indicate if some activities were allowed to continue later on in the year.
13. Did you receive any complaints or queries concerning the closure of a water body? Please give details:

14. What sort of publicity did you put out, if any?
15. Did the publicity have the desired effect?
16. Have you any suggestions for increasing public awareness of the potential problems caused by toxic blue-green algae?
17. Did you receive any reports or hear of any illnesses or fatalities caused to livestock, fish, domestic or wild animals or humans, associated with scums and/or blooms this year in your region. If so please provide as much detail as you can including the degree of substantiation if possible? Please provide a name and telephone number of a contact (if possible) so that this can be investigated further.
18. Did you use the algae enumeration technique as described in the 1990 routine monitoring programme (i.e. "abundant" or "present") or did you adopt the "warning level" procedure as developed in 1991?
19. Have you used any particular mechanism for controlling algal populations? If so, what control method[s] did you adopt and was this successful?
20. Many regions recommended the use of straw bales to control algal populations. Do you know of the result of these? Please provide details:
21. Do you have any R&D projects currently running, or any R&D proposals, for blue-green algae and/or their toxins? Please give details:
22. Are you aware of any non-NRA organisations including Universities etc, that are carrying out investigative work concerning blue-green algae and toxicity? If so please give details:

Table 1.

Waters Sampled on a Reactive Basis

Use appropriate lettering, see lists "A" and "B". Please provide species list in order of decreasing abundance. For those waters that had a scum or a bloom, please indicate by placing an "S" and/or a "B". Where the warning level was exceeded, please indicate which species were dominant at the time.

Name of Water Body	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present

Table 2.

Waters That Had Abundant Algae Last
Year But Were Also Sampled This year

Name of Water Body	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present

Table 3.

Waters Sampled For Toxicity Evaluation

Name of Water Body	Result of Toxicity Test and Comments

Table 4.

Waters Sampled as Part of Your Own
Local Routine Monitoring Programme

Name of Water Body	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present

Waters Closed For Recreational Purposes

Table 5

List of Waters Closed due to Blue-green Algae

Table 6

Waters where some of the Recreational Activities were Suspended

Key to Accompany Appendices 2 to 5

Use of the Water Body

- A. Swimming
- B. Water Skiing
- C. Board Sailing
- D. Dinghy and Boat Sailing
- E. Motor Cruising
- F. Scuba Diving
- G. Angling
- H. General Public Amenity
- I. Irrigation of Crops
- J. Livestock Watering
- K. Canoeing
- L. Potable Water Supply
- M. Paddling
- N. Jet Skiing
- O. Private Garden Pond
- P. Rowing

Species Present

- A. *Microcystis aeruginosa*
- B. *Microcystis* spp
- C. *Anabaena flos-aquae*
- D. *Anabaena circinalis*
- E. *Anabaena* spp
- F. *Aphanizomenon flos-aquae*
- G. *Aphanizomenon* spp
- H. *Oscillatoria agardhii*
- I. *Oscillatoria rubescens*
- J. *Oscillatoria* spp
- K. *Gloeotrichia* spp
- L. *Coelosphaerium* spp
- M. *Gomphosphaeria lacustris*
- N. *Gomphosphaeria naegeliana*
- O. *Gomphosphaeria* spp
- P. *Merismopedia* spp
- Q. *Nostoc* spp
- R. *Lyngbya* spp
- S. *Nodularia spumigena*
- T. *Nodularia* spp
- U. *Synechocystis* spp
- V. *Synechococcus* spp
- W. *Spirulina* spp
- X. *Aphanocapsa* spp
- Y. Any other species or genus please specify.

APPENDIX 2
Waters Sampled Reactively for the First Time in 1992

Name of Water Body	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present
ANGLIAN REGION:				
Barton Turf	D,G,H,P	F,E,P,J,H,A	YES	SCUM
Black Fen Trout Lake	G	E	YES	BLOOM & SCUM
Bradley Manor Pond	O	J	NO	-
Broughton Lake	C,D	B,E	YES	SCUM
Cleethorpes Boating Lake	C,D	B	YES	BLOOM
Cleethorpes Country Park	H	F	YES	SCUM
Clifford Hill Pond	-	J	YES	BLOOM & SCUM
Colmans Irrigation Reservoir	I	G	YES	SCUM
Coronation Channel	C,G	NONE	NO	-
East Delph Lakes	G	J,F	YES	BLOOM
Graveley Village Pond	H	D,O	YES	BLOOM
Gunwade Lake	C,G	P,J,A	YES	BLOOM & SCUM
Halcyon Lake, Stitchingham	G	E	YES	-
Heron Lake (D/S)	G	NONE	NO	BLOOM
Highstock Drain	H	NONE	NO	-
Hose Farm Pond	J	E,A	NO	-
Kingfield Pond	G	NONE	NO	-
Kings Dyke Watersports Lake	C,D	F,E	NO	BLOOM
Kyme Eau	G	NONE	NO	BLOOM
Laceby Beck	G,J	NONE	NO	-
Lakeside Caravan Park	G	C,A	YES	-
Leziate Lake	C,H	B	NO	-
Middle Lake, Lake House Farm	G,J	NONE	NO	-
Moat Farm Pond	G	NONE	NO	-
Old Rectory Pond	O	F,J	YES	BLOOM & SCUM
Overton Lake	C,G	P,J	YES	BLOOM & SCUM
Peoples Park	G	NONE	NO	BLOOM
Pond adjacent to Newland Civic Amenity Site, Canvey Island	G,H	J	UNKNOWN	BLOOM & SCUM
Radwell Mill Lake	O,S	NO BLUE-GREENS	-	BLOOM
River Ancholme, South Ferriby	G	NONE	NO	-
South Forty Foot Drain	G	NONE	NO	BLOOM
South Holland Main Drain	G	J	NO	-
South Walsham Marina	D	E,G	UNKNOWN	SCUM
Staunton Pond	-	J	NO	-
Stibbington Lakes	C,G	E,J	YES	SCUM
Tattershall Country Park	C	D	YES	BLOOM

Appendix 2 (Continued)

Tickencote Mill Stream	J	J	NO	-
Trusthorpe Pumping Drain	G	J,E	YES	-
Weybread Pit 2	G	H, <u>O. redekei</u> , <u>O. limnetica</u>	YES	-
Weybread Pit 3	G	H,J,G,E	YES	-
Wolterton Hall Lake	J	G	YES	BLOOM & SCUM
Wooton Pond	G	A	NO	-
Wroxham Rail Bridge	D,G	G,E	YES	BLOOM
<u>NORTHUMBRIA REGION:</u>				
Cresswell Stream	M	NONE	NO	-
Haggerston Castle Caravan Site Lake	H	D, <u>Chroococcus</u> <u>limnetica</u>	NO	BLOOM
Hollywell Pond	G	E,J	YES	BLOOM
Lock Haugh	G	NONE	NO	-
Lone Newton East Pond	L	C,E,B,G	YES	BLOOM & SCUM
Lone Newton West Pond	L	C,E	YES	BLOOM & SCUM
Mr Rodham's Pond	O	NONE	NO	-
Queen Elizabeth II Lake	H	NONE	NO	-
Rothbury Ditch	-	NONE	NO	-
Scoby Scaur Pond	M,H	<u>Gloeocapsa</u>	NO	BLOOM
Seaton Burn	-	NONE	NO	-
Stargate Pond	G	NONE	NO	-
Swallwell Pond	H	NONE	NO	-
<u>NORTH WEST REGION:</u>				
Alsager Mere	G,H	J,F	YES	-
Barrow-in-Furness Park Recreation Pond	H,M	E	YES	SCUM
Chapel House Reservoir	G,H,L	E	NO	-
Cloughton Lake	G	E,B	YES	BLOOM
Coniston Water	A,C,D,E,F,G,H,J K,M,P	E	YES	SCUM
Crosby Boating Lake	H,P	E	YES	BLOOM
Crosby Pond	H	E	YES	BLOOM
Drakes Head Fishing Lake	G	E,G,J	YES	BLOOM
Gingham Brow Lodge	G,H	J	YES	BLOOM
Jubilee Pool	G,H	B	YES	BLOOM & SCUM
Lancaster Moor Hospital Reservoir	G	B	YES	BLOOM

Appendix 2 (Continued)

Meadley Reservoir	G,H,L	E	YES	BLOOM
Oakenclough Fish Holding Tanks	Fish Holding	E,J	YES	-
Oakenclough Lodge	G,H	E	YES	-
Pilling Water	H	J	YES	-
Queens Park Lodge	G,H	E,B	YES	BLOOM
River Douglas	G,H	J	NO	NO
Rydal Water	G,H,J	E	NO	REPORTED BUT NOT FOUND
Walmer Bridge Pond	G,H,J	B	NO	-
<u>SEVERN TRENT REGION:</u>				
Astley Abbots Pool	G	H	ON LIMIT	-
Barnstone Cement Works, Small Lake	G	H,J	YES	BLOOM
Berrington Pool	G	B,C	YES	BLOOM
Birmingham & Fazeley Canal	E,H	NONE	-	-
Borrowbit Lake	D,G	G	YES	BLOOM & SCUM
Branston Water Park	C	J	YES	BLOOM & SCUM
Castle Pool	G	NONE	-	-
Crags Pond	-	NO BLUE-GREENS	NO	-
Damson Lane, Westan Heath	G	B	YES	BLOOM & SCUM
Finger Pond, Holme Pierrepont	G	NONE	NO	-
Flash, Telford	-	NONE	-	-
Forge Farm	G	G	YES	BLOOM & SCUM
Garden Farm	O	NONE	-	-
Gheluvelt, Worcester	O	NONE	-	-
Hagley Drive Pool, Rugeley	O	J	YES	BLOOM & SCUM
Hanley Park Lake	G	NONE	-	-
Hill Farm	G	NONE	-	-
Hope Bowdler Pool	G	B	YES	BLOOM & SCUM
Kingswinford Pool	-	NONE	-	-
Kyre Pool	G	B	YES	BLOOM
Langold Lake	G,H,A	NONE	NO	-
Lindholme Lake	G	B	YES	BLOOM & SCUM
Lodge Farm	G	C	NO	-

Appendix 2 (Continued)

Middle Pool, Trench	G	NONE	-	-
Newark Canoe Club Lake	C,G,H,K,D	NONE	NO	-
New Moor Farm Trailer Park	G,H	H	YES	BLOOM
Osprey Pool	G	B	YES	BLOOM & SCUM
Pirton Pool	G	H	YES	BLOOM
Pinders Pond	G,H	NONE	NO	-
Pond, 50 Old Gate Road, Leicester	O,G	B	YES	BLOOM & SCUM
River Idle, Retford	H	NONE	NO	-
Rosehill Fisheries	G	B	YES	BLOOM & SCUM
Rufford Lake	H	NONE	NO	-
Ryton End Pool	G,H	H,J	YES	BLOOM
Small Heath Park	-	H	YES	BLOOM
Springfield Crescent Pool	H	NONE	-	-
Squilver Activity Centre	O	NONE	-	-
Staunton Harold Hall, Lower Lake	G,H	H	YES	BLOOM & SCUM
Staunton Harold Hall, Middle Lake	G,H	H	YES	BLOOM
Staunton Harold Hall, Upper Lake	G,H,K	H	YES	BLOOM
St. Claires Farm	-	NONE	-	-
Stead Vallets Pool	G	C	YES	BLOOM & SCUM
Stratford-on-Avon Canal, Dickeris Heath	E,G,H,J	H	YES	BLOOM
Sundeston Pool	G	NONE	-	-
Swinbatch, Brosely	O	NONE	-	-
Trout Pool	G	NONE	-	-
Upton Farm	G	H	YES	BLOOM
Vernon Park Lake	G,H	NONE	NO	-
West Park, Wolverhampton	H	NONE	-	-
West Smethwick Park	G	H	YES	BLOOM & SCUM
Wilden Pool	G	NONE	-	-
Willow Bank Pool	G	H	YES	BLOOM & SCUM
Willows Farm Lake	D,G	F	YES	BLOOM & SCUM
Woodend Lake	-	NONE	NO	-

Appendix 2 (Continued)

Woodsetts Lake	-	NONE	NO	-
<u>SOUTHERN REGION:</u>				
NOT GENERALLY IDENTIFIED TO SPECIES LEVEL				
Butlins Lake, Bognor Regis	L	A	YES	SCUM
Chichester Lake	-	E,A	YES	SCUM
Heath Pond, Petersfield	D,L	H,I,G	YES	SCUM
Leabridge Farm	J	F	YES	-
Marwell Activity Centre	A,B,C,D,L,K	L,I,G	YES	SCUM
Winters Hill Hall	G,H,J	F	YES	-
<u>SOUTH WEST REGION:</u>				
ARC Quarry, Trusham	F	J	YES	BLOOM
Clay Pit, Carven	H	A	YES	BLOOM
Dawlish Warren, Dune Pond	H	E	YES	BLOOM
Dawlish Warren, Grebe Pond	H	E	YES	NO
East Lodge Fishery	G	F,N	YES	-
Prispen Pond, Silverton	G,H	E	YES	BLOOM & SCUM
Radford Lake	H	V	YES	BLOOM
River Tamar	H,I,J,L	E	YES	BLOOM
<u>THAMES REGION:</u>				
Aldenham Reservoir	D,H	E,G	YES	BLOOM
Burghfield Sailing Club	B,C,D	C	YES	BLOOM
California Country Park	G	A	YES	BLOOM & SCUM
Chain of Ponds at the Folly, Inkpen	G	C	YES	BLOOM
Duke of Northumberlands River	-	NONE	-	-
Fish Pond Wood Pond	H	NONE	-	-
Grand Union Canal, Slough Arm, Langley	E	J	YES	-
Kingsdon Lane Pond	G	NONE	-	-
Lee Flood Channel, Fishers Green Country Park	G,H	G	YES	BLOOM
Lee Flood Channel, Nazeing New Road	G,H	G	NO	-
Longford River	-	NONE	-	-
Perch Pond	G	J	NO	-

Appendix 2 (Continued)

Pond at Cowly	G,H,K	G	YES	NO
Pond at Salfords	H	A,K,C	YES	BLOOM & SCUM
Pond at Totteridge	-	NONE	-	-
Rodney Meadow Lake	-	NONE	-	-
Tooting Bec Pond (Large)	H	J	YES	BLOOM
Tooting Bec Pond (Small)	H	NONE	-	-
Tykeswater Lake	G	G	YES	BLOOM & SCUM
Waterloo Road Pond	H	K	YES	BLOOM
West End of Dagenham Breach	-	G	NO	-
Widmer Pond, Tylers Green	H	O,A,X	YES	BLOOM
Willow Farm Pond	-	NONE	-	-
Wraysbury Gravel Pit	G	NONE	-	-
Wraysbury Sailing Lake	D	B,E,G	YES	BLOOM & SCUM
<u>WELSH REGION:</u>				
Bodelwyddan	G	E	NO	-
Bryneithn Soar	G,H	B	YES	BLOOM
Burton Towers Pond	G	J	YES	BLOOM
Byr Brook	G,H	B,J	NO	-
Carew Mill Pond	H	J	YES	BLOOM
Freshwater East Stream (Ponded on Beach)	H,M	Q	YES	SCUM
Glan-y-Wern Lake	G	J,E	YES	BLOOM
Hammer Mere	G,H	E,G	YES	BLOOM
Lake House, Pades Wood	G,O	E	YES	BLOOM
Linton Pool	G	L	YES	BLOOM & SCUM
Llyn Padarn	H,K,M,D,A	J	NO	-
Lloysea Farm Pond	J	J	YES	BLOOM & SCUM
Lower Burlton Pond	O	J	YES	BLOOM & SCUM
Manor Farm Lake	G	J	YES	BLOOM
Nantlle Lake	H	J	NO	-
Orielton Mill Pond	H	E,J,L	YES	BLOOM
Pond at "The Sign", Llanbadarn Fynydd	-	NONE	-	-
Rhosghyll Pool	G,H	J	NO	-
Steve Griffith Lake	G	J	YES	BLOOM

Appendix 2 (Continued)

Talysarn Lake	H,G	J	NO	-
Tree Tops Fisheries	G	G	YES	BLOOM & SCUM
Westfield Pill	A,G,H,M	J,P	YES	BLOOM & SCUM
<u>WPSSEX REGION:</u>				
Browns Pond	H	A	NO	-
Dunwear Lakes	G	D	YES	BLOOM
Foxpound Lagoon	J	J	YES	SCUM
Westrow House Lake	A	E	YES	BLOOM & SCUM
Winterbourne Pond	H,G	A	YES	BLOOM & SCUM
<u>YORKSHIRE REGION:</u>				
Coffin Pond, Swinton	J	F	YES	BLOOM
Ex Henry Booth's Mill Dam	-	NONE	-	-
Farnley Balancing Pond	-	NONE	-	-
Fish Pond, Knostrop	G	NONE	-	-
Hollin Hall Lake	-	X	YES	BLOOM
Home Pond, Swinton	K,D,P,C	F,E	YES	BLOOM & SCUM
Lake Superior, Swinton	J	F	YES	BLOOM
Leeds and Liverpool Canal, Bramley	H	E	-	-
Leeds and Liverpool Canal, East Morten	H	E	-	-
Leeds and Liverpool Canal, Swine Lane Bridge	H	E	YES	-
Lily Pond, Swinton	J	F,E	YES	BLOOM
Mill Pond, Honley	-	NONE	-	-
Naylor Jennings Reservoir	-	NONE	-	-
Peel Park	H	NONE	-	-
Pond, Lady Lane, Bingley	-	NONE	-	-
Pugneys Main Lake	C,D,G,H	NONE	-	-
River Calder, Horbury	-	NONE	-	-
Sawley Upper Lake	G	B,E	YES	BLOOM
Spaldington Dyke	Golf Course	NONE	-	-
Square Dam	-	E	YES	SCUM

APPENDIX 3

Waters Sampled Reactively in 1992 that were either Sampled Reactively and/or Contained Significant Populations of Algae in Previous Years

Name of Water Body	Year Previously Sampled	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present
<u>ANGLIAN REGION:</u>					
Bridge Broad	1990	D	G, J	YES	BLOOM
Decoy Broad	1990	G	<u>Aphanothece</u>	NO	BLOOM
Dickerson Lake	1991	G, H	NO BLUE-GREENS	-	BLOOM & SCUM
Fen Drayton Lake	1991	B, C, H	E, G	YES	-
Filby Broad	1990	D, G, P	P	NO	-
Fritton Lake	1990	C, D, G, H, P	E	YES	BLOOM & SCUM
Grafham Water	1990	C, D, E, G, K, L	G	NO	-
Hoveton Great Broad	1990	G	G, E	YES	BLOOM & SCUM
Hoveton Little Broad	1990	D, G, H	E, G, J, L, P, X	YES	BLOOM
Lynch Lake	1990	G, C	P	NO	-
Malthouse Broad	1990	C, D, G, H, P	G, L, P, J <u>Aphanothece</u>	YES	BLOOM & SCUM
Ornamental Pond, Grimsby Hospital	1990	H	<u>Aphanothece</u>	YES	BLOOM
Priory Lake	1991	C, D, G, H	B, C	YES	BLOOM & SCUM
Ranworth Broad	1990	G	G, J, P, E	YES	BLOOM
Rollsby Broad	1990	D, G, P	P, J, G	NO	-
Salhouse Broad	1990	C, D, G, H, P	G	NO	BLOOM & SCUM
South Walsham Broad	1990	C, D, G, H, P	J, H, E, G, P, L	YES	BLOOM & SCUM
Sywell Reservoir	1991	G	E, J	NO	-
West Stow Country Park Lake	1990	H	B	YES	BLOOM & SCUM
Wroxham Broad	1990	C, D, G, H, P	G	NO	BLOOM & SCUM
<u>NORTHUMBRIA REGION:</u>					
Airy Holm	1991	L	C	YES	SCUM
Cawfields Quarry Pond	1991	F, G, J, H, M	C, <u>Gloeocapsa</u>	YES	BLOOM & SCUM
Lockwood Reservoir	1991	G	NONE	NO	-
Raby Castle Lake	1991	J	G	YES	BLOOM & SCUM
Silksworth Boating Lake	1991	D	J	NO	-
Silksworth Fishing Lake	1991	G	NONE	NO	-
Whittle Dene Reservoir	1991	G, L	H	NO	-

Appendix 3 (Continued)

<u>NORTH WEST REGION:</u>					
Derwent Water	1991	A,C,D,F,G,J M	E	YES	SCUM
Esthwaite Water	1991	G,H,J,P	E,F,B	YES	SCUM
Hawes Water	1991	G,H,L	E	YES	SCUM
Killington Reservoir	1991	D,G,H,I	E,L,B,J	YES	BLOOM & SCUM
Leeds-Liverpool Canal	1991	E,G,H,K	J,E,B	YES	BLOOM & SCUM
Lowes Water	1991	G,H,J	E,O,J	YES	SCUM
Orasgill Reservoir	1990	G,H	E,B	YES	SCUM
Overwater Reservoir	1991	G,H,L	E	NO	-
Pennington Flash	1991	C,D,G,H	D,F,A	YES	SCUM
Preston Dock	1991	B,C,D,E,H,K	J	YES	BLOOM
Stanley Park Lake	1991	G,H,P	B,E,J	YES	BLOOM
Talkin Tarn	1991	G,H	E,G,H	YES	SCUM
Tatton Mere	1991	G,H,J	E	NO	-
Ullawater	1991	A,C,D,E,F,G H,J,K,L,N,P	E,B	YES	SCUM
Wagon Reservoir	1991	D,G,H,L	E	YES	BLOOM
Windermere (South)	1991	A,B,C,D,E,F G,H,J,K,M,P	E,J	YES	BLOOM & SCUM
<u>SEVERN TRENT REGION:</u>					
Betton Pool	1990	B,G	G	YES	BLOOM
B'ham/Worcs Canal	1990, 1991	E,G	H	YES	BLOOM
Bittell Reservoirs	1991	C,D,G,H	H	YES	BLOOM
Blakemere	1991	G	C	YES	BLOOM & SCUM
Colemere	1991	D,G,H	B,C,F,H	YES	BLOOM & SCUM
Colwick Park Main (Trout) Lake	1991	A,B,C,D,G,H K,P	F	YES	BLOOM & SCUM
Colwick Park West Lake	1991	A,B,C,D,G,H K,P	F,C	YES	BLOOM & SCUM
Daneshill Car Park Lake	1991	H	B	YES	BLOOM & SCUM
Daneshill Main Lake	1991	C,D,F,G,H,K	A,F	YES	BLOOM
Daneshill Schools Lake	1991	D,K,A	NONE	NO	-
Earlswood Lakes	1990, 1991	E,D,G,H	H	YES	BLOOM & SCUM
Edgbaston Reservoir	1991	A,C,D,G,H,K	B,G,H	YES	BLOOM & SCUM
Fox Hollies Park	1991	G	H,J	YES	BLOOM

Appendix 3 (Continued)

Frampton Pool	1991	C,D,G,H	H,A	YES	BLOOM
Grand Union Canal	1991	E,G,H	H	NO	-
Hatfield Marina	1991	A,C,D,F,K	F,C	YES	BLOOM
Hermitage Lake	1991	G,H	E	YES	BLOOM
Holme Pierrepont 200m Lake	1991	B,C,D,G,H,K P	H,J <u>O. redekei</u>	YES	BLOOM
JCB North Lake	1991	C,D,K	H,J	YES	BLOOM
Kings Mill Reservoir	1991	G,H,C,D,K	H	YES	BLOOM & SCUM
Kirk Hallam Pond	1991	G,K	H,J	YES	BLOOM
Knighton Hall	1990	G	NONE	-	-
Lifford Reservoir	1990	G	NONE	-	-
Moorlands Farm	1991	G	H	YES	BLOOM
Naseby Reservoir	1991	G	H	NO	-
Rudyard Lake	1991	A,C,D,H,K	B,E	YES	BLOOM & SCUM
Sambourne Trout Pool	1991	G	F	YES	SCUM
Sandhills Lake	1991	C,G,K	H,J	YES	BLOOM
Shostoke Lower Reservoir	1990	L	H	YES	BLOOM
Stanford Reservoir	1991	G	H	NO	-
Stratford-on-Avon Canal, Lepworth	1990	E,G,H	NONE	-	-
Sulby Reservoir	1991	G	H	NO	-
The Mere	1991	D,G,H,P	B,C	YES	BLOOM
Watermead Country Park King Lear Lake	1991	C,G,H	H,J	YES	BLOOM & SCUM
Welford Reservoir	1991	G	H	NO	-
<u>SOUTH WEST REGION:</u>					
Bicton Lake	1991	C,D,J,K,P	F,E,A	YES	BLOOM & SCUM
Exeter Canal	1991	G,H,K	E	YES	-
Exwick Flood Relief Channel	1991	H	E	NO	-
Grand Western Canal	1991	E,G,H,K	E	YES	BLOOM
Lower Tamar Lake	1991	G,H	E	YES	BLOOM
Porth Reservoir	1990	G,H	A	YES	BLOOM
Upper Tamar Lake	1991	C,D,G,H,L	E	YES	BLOOM
<u>THAMES REGION:</u>					
Bray Lake	1991	C	NONE	-	-

Appendix 3 (Continued)

Brent Reservoir	1991	C,D,G,K	E,G,B	YES	BLOOM & SCUM
Coate Water Park	1991	A,B,C,D	F,C,A	YES	BLOOM
Fairlop Lake	1991	C,D,K	NONE	-	-
Serpentine	1990	-	J	-	BLOOM
Verulam Lake	1991	H	NONE	-	-
<u>WELSH REGION:</u>					
Bodenham Sailing Centre	1991	C,D	E	YES	BLOOM
Cefni Reservoir	1991	L,G	E,J	YES	BLOOM & SCUM
Greenfield Ponds	1991	H	J	YES	BLOOM
Hartleton Lake	1991	C,D,G	J,L	YES	BLOOM & SCUM
Llandrindod Wells Lake	1991	G,H,D	J	YES	BLOOM
Llyn Aled Isaf	1991	L,G	B	NO	-
Llyn Syberl	1991	H,G	B	YES	BLOOM & SCUM
Roath Park Lake	1991	G,H,P	E	YES	BLOOM & SCUM
<u>WESSEX REGION:</u>					
Newtown Pond	1991	G,H	NONE	-	-
<u>YORKSHIRE REGION:</u>					
Brickyard Pond Amotherby	1991	G	B, <u>O. limnetica</u> , L	YES	BLOOM & SCUM
Calder and Hebble Canal, Dewsbury Cut	1990	H	J	-	-
Eavestone Lake	1990	G	H,C <u>A. spiroides</u>	YES	BLOOM
Glucose Pond	1990	-	E,J	YES	BLOOM
Greasbrough Dike	1991	-	NONE	-	-
Hay-a-Park Lake	1990	G,H	E	YES	BLOOM & SCUM
Hemsworth Water Park Fishing Lake	1991	G	J	NO	-
Hemsworth Water Park Main Lake	1991	H,M,P	J	YES	NOT KNOWN
Primrose Valley Lake	1991	G,H,P	F, <u>O. limnetica</u> , J,H,E	YES	BLOOM & SCUM
Pugneys Main Lake	1991	C,D,G,H	NONE	-	-
Ravenfield Pond	1991	G	J,B	YES	-
Thrybergh Reservoir	1991	C,D,G,H	G,J	YES	-

APPENDIX 4

Waters Sampled as Part of a Regions Local Routine Monitoring Programme

Name of Water Body	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present
<u>SEVERN TRENT REGION:</u>				
Ball Hill Pool	G	H	YES	BLOOM
Cound Pool	-	NONE	-	-
Crosemere	G	NONE	-	-
Holme Pierrepont 2000m Rowing Course Lake	B,C,D,G,H,K,P	H,J, <u>O. redekei</u>	YES, at intervals	BLOOM, localised and occasional
Llyn Hi'	G	NONE	-	-
Shatterford Lakes, Erics Pool	G,H	G	NO	-
Shatterford Lakes, Gainsborough Pool	G,H	J	YES	-
Shatterford Lakes, Masters Pool	G,H	NONE	-	-
Shatterford Lakes, Stuarts Pool	G,H	G	NO	-
Upton Warren	D,G	H	YES	BLOOM
Whitemere	D,G	B,C	YES	BLOOM & SCUM
<u>THAMES REGION:</u>				
Far Moor I	Abstraction	A,F	YES	-
Far Moor II	B,G	A,F	YES	BLOOM & SCUM
Frensham Great Pond	A,C,D,G,H	C,A	YES	BLOOM
Thames at Teddington	E,G,H,K	G	NO	-
<u>London's Royal Parks:</u>				
<u>Bushy Park:</u>				
Burtons Pond	H	NONE	-	-
Fishers Pond	H	NONE	-	-
Hampton Hill Pond	H	NONE	-	-
Triss's Pond	H	NONE	-	-
Waterhouse Pond	H	NONE	-	-
<u>Greenwich Park:</u>				
Flower Garden Pond	H	NONE	-	-
<u>Regents Park:</u>				
Queen Mary's Garden Pond	H	J	NO	-

Appendix 4 (Continued)

<u>Richmond Park:</u>				
Barnwood Pond	H	NONE	-	-
Conduit Wood Pond	H	NONE	-	-
Gallows Pond	H	NONE	-	-
Ham Dip Pond	H	NONE	-	-
Leg of Mutton Pond	H	NONE	-	-
Martin's Pond	H	NONE	-	-
Pega Pond	H	NONE	-	-
Pen Pond (North)	H	B,E,K	YES	BLOOM & SCUM
Pen Pond (South)	H	K	YES	BLOOM
Still Pond	H	J	NO	-
Thomsons Pond	H	NONE	-	-
White Ash Lodge Pond	H	NONE	-	-
<u>WELSH REGION:</u>				
Bosherston Lilly Ponds	G,H	J,L,B,P	YES	BLOOM
Cumbran Boating Lake	D,G,H	E,J,B	YES	BLOOM & SCUM
Orielton Decoy Pond	G,I	E,O,L	YES	BLOOM
Pembroke Mill Pond	H	NONE	-	-
<u>WESSEX REGION:</u>				
Blashford Lake	G,D	K	NO	-
Emborough Lake	G	B	NO	-
Gasper Lake	G	NONE	-	-
Moons Valley Lake	G,H	B	NO	-
New Forest Water Park	B,C,N	J	NO	-
Sedgemoor Water Park	N	NONE	-	-
Shearwater Lake	D,G,H	J	NO	-
Stourhead	H	NONE	-	-
Tockenham Lake	G	NONE	-	-
Turners Paddock	G	NONE	-	-
Willow Lake	G	NONE	-	-

APPENDIX 5
Waters Sampled as Part of Ongoing Investigations
by the Anglian and South West Regions

Name of Water Body	Use of the Water Body	Species Present	Warning Exceeded	Bloom and/or Scums Present
<u>ANGLIAN REGION:</u>				
Covenham Reservoir	C,B,D,F,L	F,A,E	YES	BLOOM
Grafham Water	C,D,G,E,K,L	G,A,B,C,D,E, F,L,M,P, <u>Chroococcus</u>	YES	BLOOM
Pitsford Reservoir	C,D,G,L	A,F,C	YES	BLOOM & SCUM
Rutland Water	C,D,E,G,H,K,L	F,A,E	YES	BLOOM
<u>SOUTH WEST REGION:</u>				
Argal Reservoir	G,H,L	O	YES	BLOOM
College Reservoir	G,H,L	J,O	YES	-
Colliford Lake	G,H,L	F	NO	-
Drift Reservoir	G,H,L	O,B,E	YES	BLOOM
Kennick Reservoir	G,H,L	B,O	NO	-
Loe Pool	H	A	YES	BLOOM & SCUM
Lower Slade Reservoir	L,G	O,E,B	YES	-
Lower Tamar Lake	G,H	E,J,B	YES	BLOOM
Old Hill Reservoir	G,H	A,O,E	YES	BLOOM
Porth Reservoir	G,H	A,E	YES	BLOOM
Squabmoor Reservoir	G,H,L	B,O,J	YES	-
Stithians Reservoir	C,D,G,H,L	J	YES	-
Siblyback Reservoir	C,D,G,H	O,J	YES	-
Upper Tamar Lake	C,D,G,H,L	O,B,E,F	YES	BLOOM
Wimbleball Reservoir	C,D,G,H,L	O,J,E	YES	BLOOM
Wistlandpound Reservoir	G,H,L	J,E,O	YES	-