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NRA REPORT OF THE BLUE-GREEN ALGAL MONITORING 1990.

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Anglian Region

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A REPORT BY THE TOXIC BLUE-GREEN ALGAE TASK GROUP

Reports obtainable from:
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NRA REPORT OF THE BLUE-GREEN ALGAL MONITORING 1990

1 INTRODUCTION

1.1 Questionnaire

1.1.2 In order to assess the efficacy and effectiveness of the NRAs 1990 routine monitoring programme,to obtain a general overview of the incidence of blue-green algae and any possible cases of toxicity during 1990, a questionnaire was distributed to each region. The questionnaire was divided into four sections, as outlined below, covering a period from 1st January to 30th November:

1.1.3 Section 1. Algal monitoring from the beginning of January to the beginning of May.

Section 2. Algal monitoring from the beginning of May to the end of October. This is essentially the routine monitoring programme.

Section 3. Algal monitoring from the end of October to the end of November.

Section 4. General questions.

1.2.1 All ten questionnaires were completed and received by the beginning of January 1991. This report summarises the content of the questionnaires and aims to provide a basis on which further monitoring recommendations can be made in order to enhance a more effective monitoring programme for 1991.

1.2 Toxicity Tests

1.2.2 During 1990 blue-green algal toxicity testing was not carried out as part of the routine monitoring programme. It was considered that if a water contained a blue-green algal scum, whether of Microcystis, Anabaena, Oscillatoria or other buoyant blue-green algal genera, there was a 60-70% chance of it being toxic. However as part of the long-term R&D programme on blue-green algal toxins, scum samples were collected between October 1990 and January 1991 and sent to Dundee University. These scums are being used for the isolation and cultivation of "new" strains and, after freeze-drying, for toxicity assessment and toxin identification. A total of 67 samples were sent to Dundee (table 1.) So far, 36 scums have been tested of which 21 were lethal by mouse bioassay. A number of samples are still to be tested. A list of toxicity assessments and identification of the algal species within the 1990 scums, received from the NRA regions, will be produced when the data are available.

Table 1. Samples received by Dundee University for toxin analysis:

Anglian	-11
Northumbrian	- 0
North West	- 2
Severn Trent	- 7
Southern	- 0
South West	- 6
Thames	- 3
Welsh	- 8
Wessex	-27
Yorkshire	- 3
Total =	67

A list of those waters where samples were collected is given in Appendix 1.

2 MONITORING FROM THE BEGINNING OF JANUARY TO THE BEGINNING OF MAY

For details of the protocol for the routine monitoring programme refer to Appendix B of the Toxic Blue-Green Algae Report, Water Quality Series No. 2.

2.1 Waters Sampled

2.1.1 During this period six regions (table 2.) sampled a total of 56 waters for blue-green algae from which 106 samples were collected (table 3.).

Table 2. Number of waters inspected for visual evidence of blue-green algae:

Anglian	- 4
Northumbrian	- 0
North West	- 2
Severn Trent	- 39
Southern	- 1
South West	- 2
Thames	- 0
Welsh	- 8
Wessex	- 0
Yorkshire	- 0
Total =	56

Table 3. Number of individual algal samples collected:

Anglian	- 4
Northumbrian	- N/A
North West	- 2
Severn Trent	- 81
Southern	- 1
South West	- 4
Thames	- N/A
Welsh	- 14
Wessex	- N/A
Yorkshire	- N/A
Total =	106

2.1.2 The presence of blue-green algae were observed in 25 waters (table 4.) of which 19 had significantly large populations considered capable of forming blooms or scums (table 5.) Blooms and scums were actually observed in 17 of these waters, but it is not known how persistent these populations were.

Table 4. Number of <u>waters</u> that contained blue-green algae:

Anglian	- 4
Northumbrian	- N/A
North West	- 2
Severn Trent	- 10
Southern	- 1
South West	- 2
Thames	- N/A
Welsh	- 6
Wessex	- N/A
Yorkshire	- N/A
Total =	25

Table 5. Waters considered likely to produce large populations of blue-green algae during the period January to May.

Lake/Reservoir	Dominant Genera	Scums or Blooms
Anglian		
Turnbulls Pit	Aphanizomenon	Scum & Bloom
Apex Lake	Aphanizomenon	Scum & Bloom
North West		
Bassenthwaite	Anabaena	Scum
Talking Tarn	Gleotrichia	Bloom
Severn Trent		
Bomere	Microcystis	Scum
Colemere	Anabaena	Scum
Hermitage Lake	Oscillatoria	Scum
Kings Mill Res	Oscillatoria	Bloom
Lower Bittell Res	Oscillatoria	Bloom
Mill Shrub	Oscillatoria	Bloom
Thornton Res	Aphanizomenon & Anabaena	Scum & Bloom
Upper Bittell Res	Oscillatoria	Bloom
Water mead country-(Park Lake 2)	Oscillatoria agardhii & other Oscillatoria	Scum & Bloom
Whitemere	Microcystis	Scum
Southern		
Peckham Copse	Anabaena	Scum & Bloom
South West		
Meldon Pit	Oscillatoria	Bloom
Lower Clicker Quarry	Oscillatoria	Bloom
Welsh		
Llandegfedd	Aphanizomenon	None
Talley Lakes	Gleotrichia	None

3 ROUTINE MONITORING FROM THE BEGINNING OF MAY TO END OF OCTOBER

3.1 Waters Sampled

3.1.1 A total of 1372 waters (table 6.) were sampled by the ten regions during the routine monitoring programme. A greater number of waters were sampled reactively than on a routine basis as can be seen in table 7. For regional comparison this has also been represented graphically (Appendix 2.).

Table 6. Total number of waters sampled for blue-green algae during the routine monitoring programme:

Anglian	- 227
Northumbrian	- 91
North West	- 112
Severn Trent	- 379
Southern	- 25
South West	- 128
Thames	- 133
Welsh	- 77
Wessex	- 56
Yorkshire	- 144
Total =	1372

Table 7. Total number of waters sampled routinely and reactively during the routine monitoring programme:

Routine Monitoring		Reactive Monitoring	
Anglian	- 88	Anglian	- 139
Northumbrian	- 51	Northumbrian	- 40
North West	- 66	North West	- 46
Severn Trent	- 201	Severn Trent	- 178
Southern	- 10	Southern	- 15
South West	- 66	South West	- 62
Thames	- 36	Thames	- 97
Welsh	- 64	Welsh	- 13
Wessex	- 31	Wessex	- 25
Yorkshire	- 70	Yorkshire	- 74
Total =	683	Total =	689

3.2 Number of Samples Containing 'Abundant' (>6 units/2min scan) Blue-Green Algae

3.2.1 In total 5543 individual samples (table 8.) were collected from the 1372 waters, of which 1472 (27%) (table 9.) contained 'abundant' (i.e. >6 Units per 2 min scan) populations of blue-green algae.

Table 8. Number of individual samples collected during the routine monitoring programme:

Anglian	-	796
Northumbrian	-	317
North West	-	552
Severn Trent	-	1542
Southern	-	80
South West	-	383
Thames	-	458
Welsh	-	605
Wessex	-	188
Yorkshire	-	622
Total =		5543

Table 9. Number of samples that contained 'abundant' blue-green algae:

Anglian	-	113
Northumbrian	-	55
North West	-	123
Severn Trent	-	609
Southern	-	27
South West	-	80
Thames	-	160
Welsh	-	94
Wessex	-	109
Yorkshire	-	102
Total =		1472 = 27%

3.3 Number of Waters Containing 'Abundant' Blue-Green Algae

3.3.1 During the routine monitoring programme a total of 512 waters contained 'abundant' blue-green algae (table 10.), a list of these waters is provided in Appendix 3. As can be seen from table 11, and figure 1, the number of waters with 'abundant' algae varied from month to month. Population numbers progressively increased from May reaching major peaks in August and September. This pattern is characteristic of blue-green algal development in temperate lakes during the summer months.

Table 10. Number of waters that contained 'abundant' blue-green algae during the routine monitoring programme:

Anglian	-	106
Northumbrian	-	14
North West	-	57
Severn Trent	-	129
Southern	-	18
South West	-	34
Thames	-	56
Welsh	-	25
Wessex	-	31
Yorkshire	-	42
Total =		512

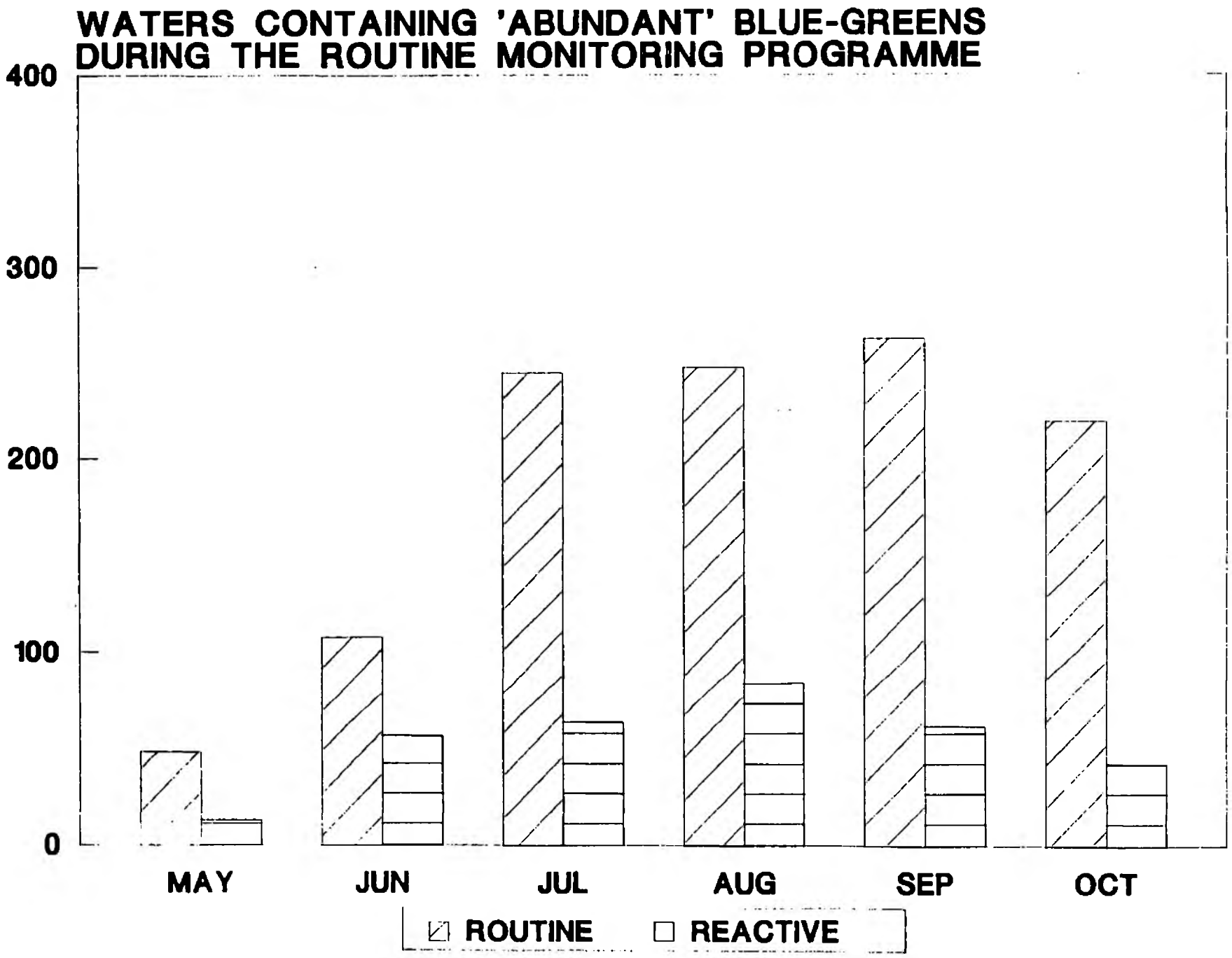

WATERS CONTAINING 'ABUNDANT' BLUE-GREENS
DURING THE ROUTINE MONITORING PROGRAMME
400
300
200
100
0
MAY
JUN
JUL
AUG
SEP
OCT
ROUTINE
REACTIVE

Figure 1.

Table 11. Waters found to contain 'abundant' levels of blue-green algae during each month of the routine monitoring programme.

	MAY	JUN	JUL	AUG	SEP	OCT
Routine	48	108	245	248	263	220
Reactive (ad-hoc)	13	56	63	84	61	42

3.4 Waters Containing Blooms and Scums

3.4.1 Of the 1372 waters sampled during the routine monitoring programme, 512 (37%) contained 'abundant' blue-green algae and 422 (31%) had blooms and/or scums. The two most common occurring genera associated with these blooms and scums is given in table 12.. It should be noted that the Thames Region did not record scums on a routine basis and blooms were only recorded when samples were found to be thick and green, thus it is likely that 422 is an under-estimation.

Table 12. Total number of scums and blooms identified during the routine monitoring programme and two most common occurring genera associated with these.

Region	No. of waters containing scums and blooms	Most Common Genera
Anglian	91	Aphanizomenon/Microcystis
Northumbria	7	Anabaena
North West	59	Oscillatoria/Anabaena
Severn Trent	128	Oscillatoria/Anabaena
Southern	17	Microcystis/Aphanizomenon
South West	32	Gomphosphaeria/Anabaena
Thames	12	Oscillatoria/Microcystis
Welsh	23	Anabaena/Microcystis
Wessex	31	Anabaena/Microcystis
Yorkshire	22	Anabaena/Oscillatoria
	Total = 422	

3.4 High, Medium and Low Risk Waters

3.4.1 Although a total of 1501 waters were categorised (table 13.), some regions experienced difficulties with this exercise. Thames state that it was not feasible to categorise waters due to the large number of lakes in their region. However, as an estimate over 1000 waters could be considered as high risk. Yorkshire were also unable to assess all their waters due to the lack of resources. Similarily, Severn Trent could not categorise all their waters, but categorised those visited during the monitoring programme. The total figure as given above is therefore likely to be an under-estimation.

Table 13. Number of waters categorised according to the level of risk.

Region	High Risk	Medium Risk	Low Risk
Anglian	111	17	13
Northumbrian	53	Not identified	
North West	90	350	200
Severn Trent	71	118	150
Southern	21	11	0
South West	50	27	29
Thames	Waters were not categorised		
Welsh	25	10	28
Wessex	27	18	10
Yorkshire	16	30	26
Totals	464	581	456

3.5 Waters Closed for Recreational Activities

3.5.1 Of those waters categorised, 47 in eight regions (table 14, page 11), were closed for water-based recreational activities due to large populations of blue-green algae. Again, this is likely to be an under-estimate since many regions were not always informed of those waters subject to closure. Some waters were closed down by Councils on the basis of their own information. For example, in the South West Region, the Exeter Ship Canal was closed by Exeter City Council.

3.5.2 In some situations warning notices were erected rather than closing the actual water, thus putting the emphasis on water users to avoid algal scums.

3.5.3 There were 24 cases where some water-based recreational activities were stopped, but others were allowed to continue (see right hand column of table 14.). Typically, wind surfing and canoeing were stopped, but fishing was allowed to continue.

3.5.4 It is interesting to note that the Royal Yachting Association (RYA) produced a Code of Good Practice specifically aimed at sailing clubs who wanted to allow water recreational activities to continue, when only isolated areas of a water body were effected. Essentially, the Code was aimed at minimising the risk to adults, children and dogs that accompany club members and may come close to the waters edge. The Code also gives advice to participants in water sports who are likely to be at risk, and to clubs who may suffer economic damage due to closure, or by curtailing various water sport activities.

3.6 Determination of Total Phosphorus

3.6.1 The Northumbrian and North West Regions did not carry out any analysis for Phosphorus. The other eight regions used a combination of either Total Phosphorus (TP) and/or Orthophosphate, the latter being determined on a more regular basis.

3.6.2 TP was not carried out as part of the routine monitoring programme. In some cases, it was determined during the initial stages of the programme to identify those waters that were unlikely to develop excessive growths of algae during the summer months.

3.6.3 Very few regions were able to achieve a limit of detection of $10\mu gl^{-1}$ and those that were, did so with great effort. Generally a range varying between 30 to $200\mu gl^{-1}$ was detected, below this range the validity of the results is questionable.

3.7 Standard Letters

3.7.1 The number of standard letters sent out by each region is given in Table 15. The ten regions sent out 1872 letters to owners of affected waters, Chief Environmental Health Officers, Medical Officers of Environmental Health and MAFF regional offices.

Table 15. Number of standars letters sent out by each region.

Standard Letter Destination	A	N	NW	ST	S	SW	T	WEL	WES	Y
Owners	141	15	63	115	12	13	44	23	25	45
CEHO's	123	15	63	115	12	25	152	23	21	33
MOEH	94	0	63	114	12	14	53	23	2	33
MAFF	94	15	57	86	12	9	46	23	13	31
TOTAL	452	45	246	430	48	61	295	92	61	142

A=Anglian; N=Northumbrian; NW=North West; ST=Severn Trent; S=Southern SW=South West; T=Thames; WEL=Welsh; WES=Wessex; Y=Yorkshire.

Table 14. Waters closed due to 'abundant' algae.

Waters closed for all activities	Water closed for some activities but not others
Anglian	North West
Baylam	Stanley Park Lake
Bencacre Pump	Tarleton Leisure Park
Haylings Pond Leiston	Severn Trent
Shepherds Port Lake	Babbs Mill Lake
Station Field Lake	Blithfield Resevoir
Northumbria	Colwick Park, West Lake
Leazes Park Lake	Earlswood Lake East
Raby Castle Park	Earlswood Lake West
Sweethorpe Lough	Hemlingford, Kingsbury
Silkworth Boating	Kings Mill Reservoir
Silkworth Fishing	Nat Water Sports Centre 2000m Lake
North West	Olton Mere
Bigland Tarn	Sandhills Lake
Severn Trent	Shustoke Reservoir
Blackroot Pool, Sutton Park	Staunton Harold Resevoir
Bodymoor Heath	Thornton Reservoir
Canon Hill Park Fish pool	Watermead Country Lake
Canon Hill Park Boating Lake	Watermead Education Lake
Lake at Coddington	Thames
Lakeside, Balderton	Broxbourne 1 Lake
Lifford Reservoir	Fairlands Valley Boating Lake
Mitchells Pool	Fairlands Valley Sailing Lake
National Water Sports Waterski Lake	Welsh
Plantsbrook Nature Reserve Lakes	Penrnyn
Pype Hayes Hall Lake	Syberi
Rudyard Lake	Llandegfedd
Stowe Pool	Llys Fran
Swan Hurst Park	
Upton Warren	
Southern	
Snodland Lake	
Barcombe Mills	
Chilfe Sailing Lake (Brackish)	
South West	
Darracott Reservoir	
Exwick Flood Relief Channel	
Gammaton 1 (Lower) Reservoir	
Kennick Reservoir	
Lower Tamar Reservoir	
Old Mill Reservoir	
Upper Tamar	
Welsh	
Bosherston Lakes	
Clumbran Boating	
Llandrindod	
Yorkshire	
Allerton Park Top Lake	
Brickyard Farm Lake	
Burton Constable Lower Lake	
Newby Wiske Hall Lake	
Queen Mary's Dudd Lake	
Scout Dyke Reservoir	
Smithies Dam	
Thrybergh Reservoir	

3.8 Problems Experienced With Owners, MAFF, EHO's and MOEH

3.8.1 When a water was found to contain 'abundant' blue-green algae, standard letters were sent to the owners and each of the above mentioned organisations. The regions were asked if they experienced any communication problems.

3.8.2 General problems experienced include:

a) Identifying and contacting the relevant owners, particulary in cases of multi-ownership and where an impoundment crosses district boundaries.

b) Many regions were unable to locate or establish contact with MOEH.

c) Due to the increased publicity during 1990, Biologists in some regions were inundated by telephone calls from concerned owners, members of the public and EHO's. In many cases it would appear that EHO's had a poor understanding of their own responsibilities and were unsure as to when, and how, they should take action. Despite this, communication with EHO's was greatly enhanced by giving presentations prior to the commencement of the monitoring programme.

d) The Thames Region indicate that the response received fom EHOs and owners would indicate that there were many questions not covered in the information they received from the NRA, particulary in relation to removal of general alerts.

3.9 Publicity

3.9.1 Most regions issued press releases, conducted radio and television interviews and gave presentations to EHO's. Judging by the great number of enquiries received from the public and owners in response to this, it can be postulated that the publicity campaign had a considerable impact.

3.9.2 In general, the warning leaflet was well received and was requested by a number of councils and owners of recreational waters.

3.9.3 The Southern Region emphasised the point that publicity and education should be the key issues during the 1991 monitoring programme, if risks to water users are to be minimised. Extensive monitoring is not only costly and labour intensive, but also unproductive in solving the problem.

3.10.1 **Comments and Amendments to Standard Letters, Media Briefing Note and Press Releases**

3.10.2 Each region was asked to give their comments and amendments to the above mentioned documents. Most of the comments were related to the standard letters of which by far the most prolific answer was that they were too repetitive. The Yorkshire Region suggest that a general initial standard letter could be sent which would include details of the NRAs monitoring programme, e.g. the warning levels and the action needed. Thereafter, shorter letters could be sent out notifying the sites affected, thus reducing the repetitiveness of the standard letters. The Yorkshire Region have provided the Task Group with a series of comments on the 1990 monitoring programme. These comments are quite extensive and have, therefore, been incorporated as an appendix (Appendix 4.).

3.10.3 The Wessex Region felt that the press releases were too technical in terms of public/media relations.

3.11 **Problems Experienced With General Alerts**

3.11.1 The Welsh Region were the only region not to issue a general alert. Severn Trent had received overwhelming media and public interest prior to the general alert and were inundated with phone calls (up to 100 calls/day over the region). Consequently, any further interest due to the alert was absorbed and passed unnoticed.

3.11.2 There was confusion as to whether alerts should be issued on a regional or area basis. In most cases area alerts were put out.

3.12 **Problems Experienced With the Blue-Green Algae Monitoring Procedures**

3.12.1 The regions were asked if they had any problems with the procedures as recommended in the 1990 monitoring programme for sampling algae; for example, was the criteria for the assessment of abundance (6 units/2 min scan) sufficient? Were there any problems with choice of sampling site?

3.12.2 The most common occurring problems are detailed below:

a) The routine monitoring programme for 1990 required a great deal of effort and demand on resources.

b) The counting procedure was poorly defined and the current threshold i.e. >6 units per 2min scan was considered to be too low. Some regions suggested that chlorophyll a determination would have been useful to confirm some borderline cases.

c) The use of the term "unit" was insufficient. For example, a bundle of Aphanizomenon, which could contain several hundred filaments and several thousand cells, is considered equal to a smaller bundle with just a few filaments and cells. A number of regions felt that real counts (i.e. cells ml^{-1}) would be a more accurate assessment of algal abundance.

d) In many cases, problems were experienced in obtaining access to the leeward shore to collect a sample, particulary in large impoundments such as Windermere which has a 20 mile shoreline. It was commonly found that access to the leeward shore required a great deal of effort and was therefore awkward and time consuming. In some situations the leeward shore was bordered by private land thus restricting access to NRA biologist.

e) Sampling algae at the leeward shore is not necessarily representative of the water body, as the sampling methodology would indicate.

f) Identification of blue-green algal taxa using a low powered microscope, as stated in the monitoring recommendations, proved difficult for some genera, particulary the smaller blue-greens such as Merismopedia which are easily over looked. It has been suggested that an initial scan at X100 magnification should be carried out.

g) Analytical Quality Control is needed for both algal identification and enumeration. Thames recommend identification to genus level only, identification to species level will require further training of Biologist and ultimately more expense.

h) It has been recommended that either the Sedgwick Rafter Cell or the sedimentation inverted microscope method should be used as a standard counting procedure.

i) Some sites had scums localised in a small area when the open water remained clear. Since the sampling procedure adopted represented the worst case scenario, owners were confused as to whether they should restrict activities in the whole of the water body. The information from the NRA appeared to conflict with their own experience, therefore owners were not sure of how that affected their legal responsibilities.

j) A criteria should be given for assessing blue-green algal abundance in rivers, taking flow rates into consideration.

k) Different species present different problems particulary in relation to scum formation. The Recommendations do not take this into account.

l) In May, the Welsh Region sampled Llys y Fran Reservoir for TP which was found to be $<10\mu gl^{-1}$. Despite this a massive bloom occurred in October. The threshold of $10\mu gl^{-1}$ is not wholly reliable.

m) The owners of commercial enterprises that involved high risk contact were most concerned when they received reports of 'abundant' algae. Biologists were, in many cases, unable to inform the owners of the persistence and severity of the problems.

n) The Welsh Region found that owners of waterbodies and members of the public were dissatisfied when the NRA were unable to offer advice on acceptable methods of treating the algal blooms.

o) The Wessex Region remarked that although warning notices were erected there appeared to be no curtailment of recreational activities. The region implies that the level of monitoring during 1990 was more than adequate, but did not have the impact required. This aspect requires critical re-evaluation for the 1991 programme.

4 MONITORING FROM THE END OF OCTOBER TO THE END OF NOVEMBER

4.1 Waters Sampled

4.1.1 A total of 296 waters were sampled during this period, from which 453 samples were collected (table 16.). 'Abundant' or significant populations of blue-green algae were identified in 120 waters, and scums and blooms were observed on 80 of these, most of which were in the Anglian, Severn Trent and Wessex Regions (table 17.). A list of actual waters is provided in Appendix 5.

Table 16. Number of waters that were sampled for blue-green algae:

Waters Sampled		No. of Samples Taken		No. of Samples Containing 'Abundant' Algae	
Anglian	19	Anglian	32	Anglian	13
Northunbrian	11	Northumbrian	16	Northumbrian	3
North West	14	North West	35	North West	17
Severn Trent	112	Severn Trent	122	Severn Trent	47
Southern	0	Southern	0	Southern	0
South West	28	South West	28	South West	8
Thames	31	Thames	76	Thames	18
Welsh	19	Welsh	42	Welsh	17
Wessex	37	Wessex	76	Wessex	41
Yorkshire	25	Yorkshire	26	Yorkshire	4
Total =	296	Total =	453	Total =	168

Table 17. Number of waters containing 'abundant' algae, scums and/or blooms during November.

Region	No. of Waters Containing 'Abundant' Algae	No. of Waters Containing Blooms or Scums
Anglian	12	11
Northumbrian	2	1
North West	7	Not Recorded
Severn Trent	47	30
Southern	0	0
South West	8	8
Thames	13	4
Welsh	8	4
Wessex	19	19
Yorkshire	4	3
	Total =120	80

4.2 Sampling Criteria

4.2.1 The criteria for sampling only those sites that were above 8°C, and contained 'abundant' algae during October, was heavily critised by most regions. In many cases, blooms and scums were present in waters with temperatures below 8°C, some examples are given below.

a) Anglian Region: On 5th December a scum of Aphanizomenon and Anabaena was present at Covenham Reservoir in Lincolnshire which had a temperature of 6.5°C.

b) Yorkshire Region: On 1st November a Microcystis scum was present at Queen Mary's Dubb Lake which had a temperature of 8°C.

c) On 14 December a scum of Aphanizimenon flos-aquae and Anabaena had formed below the ice cover at Beaverdyke Reservoir with a water temperature of 2°C.

4.1.3 Clearly blooms and scums do occur after October and at temperatures below 8°C, and can therefore still present a problem.

4.1.4 In the Severn Trent Region some sites were found to contain 'abundant' algae during October. These continued to bloom throughout the winter, in some cases scums were found under ice. The sampling criteria did not take this into account.

4.1.5 The Yorkshire Region state that in order to give an "all clear" for a particular waterbody (i.e. two consecutive samples containing >6 units/2min scan) sampling often continued through to January of 1991. This was also experienced by a number of other regions, and in many cases all clears could not be given due to the persistance of algae.

5 GENERAL COMMENTS

5.1 Reports of Illnesses and Fatalities

5.1.1 The NRA did not receive any reports of fatalities directly related to blue-green algal toxicity during 1990. Severn Trent report that army canoeists suffered mild flu symptoms after canoeing in Rudyard lake, Staffordshire. The day after the canoeing exercise, a thick scum was observed, which according to the British Waterways Board (the owners of Rudyard Lake), was not there previously. Rudyard Lake was also the cause of concern during 1989 when two junior soldiers were hospitalised with flu like symptoms a few days after swimming in the lake. However, in both cases there was no evidence to directly link the flu symptoms with blue-green algal toxicity.

5.1.2 Severn Trent Region employees experienced burning sensations on their hands after handling scums collected from Kings Mill Reservoir and the Stratford Canal. The burning sensations were only short-lived, rarely lasting for longer than half an hour.

5.1.3 There were also a number of reports of illnesses involving people associated with recreational activities (particulary from jetskiers, canoeists, swimmers and windsurfer) but again, most of these were unsubstantiated and lack any conclusive evidence. For example, in the Severn Trent Region a life-guard experienced stomach problems after swimming in Colwick West Lake, which contained an Aphanizomenon bloom and scum. In the Anglian Region, five children suffered stomach cramps and nausia following swimming in Fritton Lake in Norfolk which contained a Microcystis bloom. In the Yorkshire Region a fisherman at Newby Wiske Hall Lake, which had a scum of Microcystis, became ill suffering from muscle cramps and swollen glands. Again these cases have not been followed up and thus cannot be positively attributed to blue-green algal toxicity.

5.1.4 A possible case of toxicity during 1990 was reported by Camberwell Health Authority in the Thames Region. In early June 1990, a forty year old diver donned a wetsuit which had previously been placed in a polythene bag and left in stagnant river water for two to three weeks. Two days after the dive he noticed some pustules on the side of his chest and abdomen. Following this he suffered from nausea, headache, diarrhoea, abdominal pains and a high temperature. Liver enzyme levels were also raised when first tested in mid-June, but had decreased, although still considered high, by the end of June.

5.1.5 Although the symptoms described are characteristic of hepatoxicity there are a number of odd features, as outlined below, that question the validity of this case:

a) The patient was not directly exposed to the water.

b) There was no evidence that he ingested any water.

c) The patient was a heavy drinker and had an alcohol intake of 68 units per week for the past four years (acute liver damage is also caused by alcohol, although the symptoms were not typical of alcohol poisoning). The patient was asked to refrain totally from alcohol after which a rapid improvement was observed.

d) There is no evidence that blue-green algae were present in the wetsuit or in the water.

5.1.6 It was concluded by Professor N.D. Noah of King's College Hospital, who investigated this incident, that this was an unproven, but possible, case of acute blue-green algae hepatotoxicity.

5.1.7 A number of other unsubstantiated reports were received of dogs becoming ill after drinking blue-green algae infested waters. For example, at Gunthorpe Gravel Pit, Nottinghamshire, in the Severn Trent Region, a dog became ill after swimming in water containing a Microcystis bloom. Similar problems were also reported by the Anglian and Yorkshire Regions. The South West Region received a report that a Heifer died after drinking from a pond with a dense bloom of Synechococcus, but unfortunately, there is a lack of evidence to confirm that any of these cases were related to blue-green algae. Many of the reports received were based on unreliable and anecdotal evidence.

5.2 Complaints of Shoreline Scums and Odours

5.2.1 Most regions received general enquiries about blue-green algae, shoreline scums and water blooms; indeed, many of those waters monitored on a reactive basis were the result of complaints from members of the public. There were only five complaints of odorous scums as outlined below:

a) In the Anglian Region odorous scums were the cause of concern at Shephards Port Lake, Snettisham, Norfolk and Lynch Lake, Peterborough. Both these waters contained blue-green algal scums.

b) In the Severn Trent Region three waters were the source of complaints from members of the public due odorous algal scums, these were at Barton Under-Needwood Pool (complaint received June), Glebe Farm (complaint received May) and Kingsmill Reservoir (complaint received June).

6 CONCLUSIONS

1) During the period January to November 1990, a total of 1724 waters were sampled for blue-green algae, of which 649 (38%) contained 'abundant' populations. This includes those samples collected during the routine monitoring programme.

2) During the routine monitoring programme, 1372 waters were sampled of which 512 (37%) contained 'abundant' populatons of blue-greens.

3) Various regions were unable to categorise waters into High, Medium and Low risk categories. This was largely due to the shear numbers of waters in their region and the lack of resources.

4) Of the waters that were categorised into High, Medium and Low risk, 47 were closed for recreational activities. Many more could have been closed, but the NRA was not aware of these.

5) Total Phosphorus was not determined routinely during the routine monitoring programme. Most regions decided to use orthosphosphate as an indicator of trophic status.

6) A Total Phosphorus limit of detection of $10\mu gl^{-1}$ could not be accurately achieved.

7) EHOs require more general information on toxic blue-green algae and of the NRAs monitoring programmes. EHOs and owners need details on what actions they should take when a water(s) has been identified as containing excessive quantities of potentially toxic blue-green algae. Primarily, EHOs need to know more details of their own responsibilities.

8) The publicity campaign was very successful. EHOs were very appreciative of the highly informative presentations given by the NRA.

9) The toxic blue-green algae leaflet was widely distributed and was of great use.

10) The standard letters sent out to owners, MAFF, EHOs and MOEH were considered to be too repetitive.

11) Various regions issued general alerts on an area basis rather than a regional basis.

12) The 1990 blue-green algal monitoring programme was critised from a number of different angles, particulary the sampling and counting methodology, the criteria for assessing the level of abundance and sampling from the leeward shore.

13) Owners were not sure of their legal responsibilities when a water was identified as containing excessive growths of potentially toxic blue-green algae.

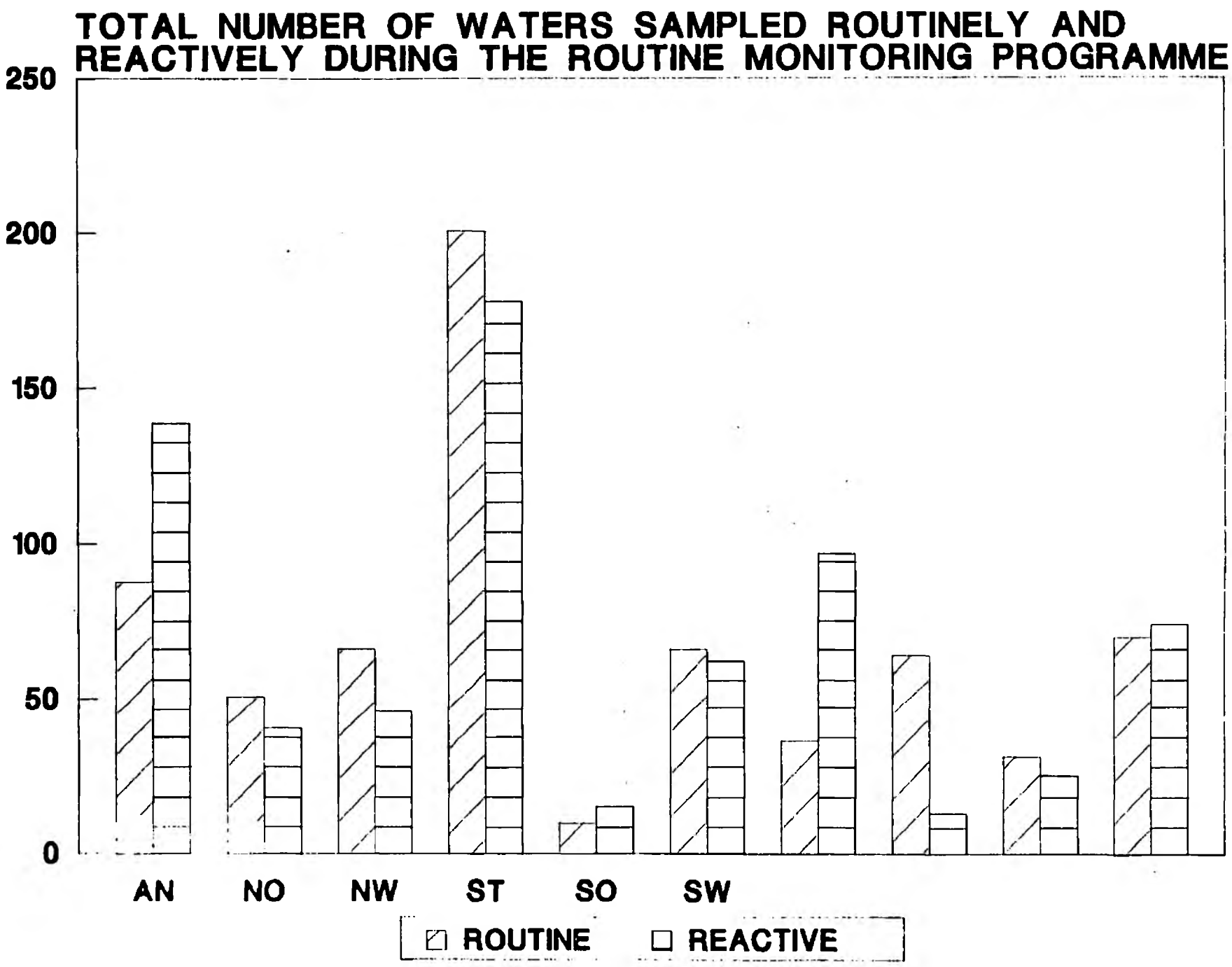
14) In some regions, scum and bloom formations were still present after October, even though water temperatures were below 8°C.

15) There were no reports of fatalities that could be directly attributed to blue-green algal toxicity during 1990. However, many reports of illnesses were received, but remain unsubstantiated accounts.

7 APPENDIX A.

Blue-Green Algal Blooms Received at Dundee University for Processing and Storage for Analysis of Toxicity and Toxin Identification.

Region and Location	Dominant Genera
Anglian	
Blickling Lake	Micro
Christchurch Park	Micro
Covenham Reservoir	Aph
Eyebrook Reservoir	Ana
Fen Drayton Windsurfing	Ana
Fritton Lake	No cells seen
Hughes and Sons	Micro, Gomph
Islip Small Gravel Pit	
Lound Run	Micro
Lynch Lake	No cells Seen
Wyboston Lakes	Aph
North West	
Bigland Tarn	Ana, Gomph, Osc
Severn Trent	
Ball Mill	Aph
Bomere Pool	Aph
Colwick Park West Lake	Aph
Coddington	Osc
Shatterford Lake	Osc
Upton Warren	Aph
Yew Tree Cottage Pond	Aph
South West	
Angal Reservoir	Gomph
Exwick Flood Relief Channel	Ana, Micro, Aph
Great Fulford Estate Lake	
Old Mill Reservoir	Gomph
Porth Reservoir	Ana
Shoebrook Park Lake	Micro
Millwall Dock	No cells Seen
Stanborough Park Lake	Osc
St James Park Lake	Osc
Welsh	
Bosherton Ponds	No cells Seen
Cefni Reservoir	Aph
Cumbria Lake	No Cells Seen
Lake Coron	No Cells Seen
Llyn Cefni	Aph
Llysyffran Dam	Ana
Orielton Decoy Pond	No Cells Found
Roath Park Lake	No Cells seen
Wessex	
Blashford Lake Reservoir	Micro
Chew Valley Lake	Aph
Durleigh Reservoir	Aph
Emborough Lake	No Cells Seen
Luxhay Reservoir	Micro
River Huntspill	Osc
Stourhead Lake	Micro, Osc
Tockenham Lake	No Cells Seen
Waterlane Fish Farm Pond 1A	Micro
Waterlane Fish Farm Pond 1B	Micro
Waterlane Fish Farm Pond 1A & 1B Effluent	
Waterlane Fish Farm Pond N5	Micro
Waterlane Fish Farm Pond N7	Micro, Aph, Gomph
Waterlane Fish Farm Pond N9	Micro
Waterlane Fish Farm Pond N10	Micro
Waterlane Fish Farm Pond N11	Micro
Waterlane Fish Farm Pond 07	Micro
Waterlane Fish Farm Pond 08	Micro
Waterlane Fish Farm Pond 4.1 Micro	
Willow Lake	Ana
Yorkshire	
Queen Mary's Dubb	Micro
Smithy Dam	Aph, Ana


TOTAL NUMBER OF WATERS SAMPLED ROUTINELY AND REACTIVELY DURING THE ROUTINE MONITORING PROGRAMME
250
200
150
100
50
0
AN
NO
NW
ST
SO
SW
ROUTINE
REACTIVE

APPENDIX B.

APPENDIX C.

Waters Containing 'Abundant' Blue-Green Algae During The Routine Monitoring Programme 1990.

Name of Water	Approximate Location
Anglian	
A Lake up river of Causeway Lake	Baylham, Suffolk
Abberton Reservoir	Nr Colchester, Essex
Alton Water	Nr Ipswich, Suffolk
Apex Lake	North Hykeham, Lincolnshire
Ardleigh Reservoir	Nr Colchester, Essex
Auberies Estate Lake	Bulmer, Suffolk
Ballast Hole	Welham, Northamptonshire
Barrow Water Ski Lake	Barrow Upon Humber
Barton Broad	Norfolk Broads, Norfolk
Beeston Lake	Beeston St Lawrence, Norfolk
Belton Lake, Tattershall Park	Tattershall, Lincolnshire
Benacre Pump	Beccles, Suffolk
Blickling Hall Lake	Blickling, Norfolk
Bridge Broad	Norfolk Broads, Norfolk
Brightwell Lake (Gravel Pit)	Kettering, Northamptonshire
Broom Pit	Nr Biggleswade, Bedfordshire
Castle Lake, Tattershall Park	Tattershall, Lincolnshire
Channels Lake	Broomfield, Chelmsfords, Essex
Coggeshall Abbey Pond	Coggeshall, Essex
Corby Boating Lake	Corby, Northamptonshire
Costessey Pit No. 2	Costessey, Norwich, Norfolk
Covenham Reservoir	Nr Covenham St Bartholomew, Linc
Cransley Reservoir	Kettering, Northamptonshire
Dairy Pond	Henham Hall, Suffolk
Daisy Broad	Norfolk Broads, Norfolk
Decoy Broad	Norfolk Broads, Norfolk
Decoy Ponds, East & South Side	Brantham, Suffolk
Decoy Pond, Purdis Heath	Ipswich, Suffolk
Delph Ditch, Marsh House Farm	Maldon, Essex
Denton Reservoir	Denton, Lincolnshire
Diss Mere	Norfolk
Elsham Country Park Lake	Elsham, Lincolnshire
Fen Drayton ARC Wind Surfing Pit	Fen Drayton, Cambridgeshire
Filby Broad	Norfolk Broads, Norfolk
Fishing Lake	Lyng, Norfolk
Foxcote Reservoir	Nr Milton Keynes,Buckinghamshire
Fraser Lake, Tattershall Park	Tattershall, Lincolnshire
Fritton Lake	Nr Great Yarmouth, Norfolk
Gosfield lake	Gosfield, Essex
Grafham Water	Nr Godmanchester, Cambridgeshire
Hall Farm Lake	Evenley, Northamptonshire
Hanningfield Reservoir	Nr Billericay, Essex
Haylings Pond	Leiston, Suffolk
Hickling Broad	Norfolk Broads, Norfolk
Hinchingbrooke Country Park Lake	Nr Huntingdon, Cambridgeshire
Hollowell Reservoir	Hollowell, Northamptonshire
Holton Hall Park Lake	Halesworth, Suffolk
Homersfield Lake	Homersfield Nr Bungay, Norfolk
Hoverton Great Broad	Norfolk Broads, Norfolk
Hoverton Little Broad	Norfolk Broads, Norfolk
Hughes Pit	Skellingthorpe, Lincolnshire
Irrigation Lake	Langworth, Lincolnshire
Island Lake, Tattershall Park	Tattershall, Lincolnshire
Kingsway Water Ski Club	Leicestershire
Lackford Pit sailing Club	Suffolk
Lake Meadows	Billericay, Essex
Lake at Sealhome Development	Grantham, Lincolnshire
Landbeach Marina (Gravel Pit)	Cambridgeshire
Lark Lake, Tattershall Park	Tattershall, Lincolnshire
Lound Run (Fritton Lake)	Nr Great Yarmouth, Norfolk
Lound-Mill Water	Suffolk
Low Level Drain	Lyng, Norfolk
Lynch Lake (Ferry Meadows)	Peterborough, Cambridgeshire
Malthouse Broad	Norfolk Broads, Norfolk
Meadow Lane Lake	St Ives, Norfolk
Mount Farm Lake	Milton Keynes, Bedfordshire
North Lake (Lake 2)	Kelsale, Suffolk
Northlands Park Lake	Basildon, Essex
Omesby Broad	Norfolk Broads, Norfolk
Ornamental Pond	Lincolnshire
Orton Trout Fishery	Peterborough, Cambridgeshire
Paxton Pit Nature Reserve	Paxton, Cambridgeshire

APPENDIX C. cont'd

Pitsford Reservoir	Pitsford, Northamptonshire
Priory Lake	Bedford, Bedfordshire
Ranworth Broad	Norfolk Broads, Norfolk
Ravensthorpe Reservoir	Ravensthorpe, Northamptonshire
River Gipping	Old Newton, Suffolk
Rollesby Broad	Norfolk Broads, Norfolk
Rollesby Sailing Club	Norfolk Broads, Norfolk
Rosary Farm Lake	Banham, Norfolk
Rowing Course, (Ferry Meadows)	Peterborough, Cambridgeshire
Rutland Water	Nr Oakham, Leicestershire
Saddington Reservoir	Saddington, Leicestershire
Salhouse Broad	Norfolk Broads, Norfolk
Shepherds Port Lake	Snettisham, Norfolk
Sibton Lake, Sibton Park	Saxmundham, Suffolk
Slade Brook Storage Reservoir	Kettering, Northamptonshire
South Walsham Broad	Norfolk Broads, Norfolk
Southwold Boating Lake	Southwold, Suffolk
Station Field Lake	Needham Market, Suffolk
Stewartby Lake	Stewartby, Bedfordshire
Suffolk Water Park	Bramford, Ipswich, Suffolk
Swanholme Lake	Lincolnshire
Thrapston Gravel Pit	Thrapston, Northamptonshire
Titchmarsh Gravel Pit	Titchmarsh, Northamptonshire
Toft Newton Reservoir	Nr Lincoln, Lincolnshire
Turnbulls pit	Ancaster, Lincolnshire
Walcot Village Pond	Walcot, Lincolnshire
West Stow Country park	Suffolk
Wickham Skeith Green Pond	Wickham Skeith, Suffolk
Willen North Lake	Bedfordshire
Wilsby Nature Reserve Lake	Lincolnshire
Witham On The Hill (Private Lae)	Witham On The Hill, Lincolnshire
Womack Water	Ludham, Norfolk
Wroxham Broad	Norfolk Broads, Norfolk
Wyboston Lake South	Wyboston, Bedfordshire
Northumbria	
Catcleugh Reservoir	Northumberland
Colt Crag Reservoir	Northumberland
Crag Lough Lake	Northumberland
Greenlea Lough	Northumberland
Hallington East Reservoir	Northumberland
Hallington West Reservoir	Northumberland
Hindshield Lake	Northumberland
Leazes Park Lake	Newcastle Upon Tyne
Little Swinburne Lake	Northumberland
Raby Castle Lake	County Durham
Silkworth Boating Lake	Tyne and Wear
Silkworth Fishing Lake	Tyne and Wear
Sweethope Lake	Northumberland
Whittle Dene Reservoir	Newcastle Upon Tyne
North West	
Ackers Pit	Stockton Heath, Warrington
Barrowford Reservoir	Nelson, Lancashire
Besom Hill Reservoir	Oldham, Manchester
Bigland Tarn	Newby Bridge, Cumbria
Blelham Tarn	Cumbria
Brick Pits	Wigton, Cumbria
Capesthorne Mere	Cheshire
Carr Mill Dam	St Helens, Mersyside

APPENDIX C. cont'd

Car Rough Pool	Mouldsworth, Nr Chester
Chorlton Water Park	Manchester
Cliffe Suction Tanks	Great Harwood, Lancashire
Clowbridge Reservoir	Rossendale
Coldwell Reservoir	Lancashire
Derwent Water	Keswick, Cumbria
Earnsdale Reservoir	Darwen, Lancashire
Esthwaite Water	Cumbria
Foulridge Reservoir	Colne, Lancashire
Glasson Dock	Lancaster, Lancashire
Grasmere	North of Windermere, Cumbria
Grimsargh No 3 Reservoir	Preston, Lancashire
Hammonds Pond	Carlisle, Cumbria
Hatchmere (Delamere Forest)	Cheshire
Jumbles Reservoir	Bolton
Killington Lake	Kendal, Cumbria
Kirkcross Quarry	Brigham, Cumbria
Lake at Willow Grove Caravan Park	Fleetwood, Lancashire
Lancaster Canal	Glasson and Preston
Leeds-Liverpool Canal	Wigan, West Lancashire
Longlands Pond	Cumbria
Lower Castleshaw Reservoir	Oldham, Manchester
Lower Strinesdale Reservoir	Oldham, Manchester
Loweswater Lake	Nr Whitehaven, Cumbria
Marton Mere	Blackpool, Lancashire
Ormsgill Reservoir	Barrow in Furness, Cumbria
Orrell Water Park	Nr Wigan, Greater Manchester
Overwater	Nr Keswick, Cumbria
Pennington Flash	Leigh, Greater Manchester
Pickmere	Cheshire
Preston Dock	Preston, Lancashire
Redesmere	Macclesfield, Cheshire
Rode Pool	Cheshire
Rumworth Lodge	Bolton,
Salford Quays, Docks 8 and 9	Greater Manchester
Scotsmans Flash	Wigan, Greater Manchester
Slipper Hill Reservoir	Foulridge, Lancashire
Stanley Park Lake	Blackpool, Lancashire
Stocks Reservoir	Slaidburn, Lancashire
Talkin Tarn	Cumbria
Tarleton Leisure Lakes	Nr Southport, Lancashire
Tatton Mere	Cheshire
Ullswater	Nr Penritff, Cumbria
Upper Castleshaw Reservoir	Oldham, Manchester
Upper Strinesdale Reservoir	Oldham, Manchester
Windermere North Basin	Nr Kendal, Cumbria
Windermere South Basin	Nr Kendal, Cumbria
Winsford Flash	Winsford, Cheshire
Winterley Pool	Crewe, Cheshire
Severn Trent	
Babbs Mill Lake	Sharp End, West Midlands
Ballmill Gravel Pool	Grimley, Worcestershire
Barton Under-Needwood Pool	Nr Burton-Upon-Trent Staff'shire
Betton Pools	Betton Abbotts, Nr Shrewsbury
Birmingham/Worcester Canal	Worcester
Black Prince Marina	Stoke-On-Trent, Staffordshire
Blackbrook Reservoir	Leicestershire

APPENDIX C. cont'd

Bleasby Gravel Pit	Bleasby, Nottinghamshire
Blithfield Reservoir	Staffordshire
Bomere	Shrewsbury, Shropshire
Borrow Pit	Sutton-on-Trent, Nottinghamshire
Bredons Hardwick Pool	Bredons Hardwick, Worcestershire
Britsh Sugar Pool	Newark-on-Trent, Lincolnshire
Burnaston Lake	Derby, Derbyshire
Butterley Reservoir	Ripley, Derbyshire
Calf Heath Reservoir	Gailey, Stafffordshire
Canon Hill Park, Boating Lake	West Midlands
Canon Hill Park, Fish Pool	West Midlands
Castle Hill Riding Centre	Branden, Coventry
Coalpit fields Pool	Bedworth, Warwickshire
Colemere	Ellesmere, Shropshire
Colwick Park, West Lake	Nottingham
Dimmingsdale Pool	Wombourne, West Midlands
Earlswood East Lake	Redditch, Worcestershire
Earlswood West Lake	Redditch, Worcestershire
Fen pools (Middle Pool)	Dudley, West Midlands
Fen Pools (Grove Pool)	Dudley, West Midlands
Festival Park (South Pool)	Stoke-On-Trent
Fishing Pools Church Claines	Worcester
Foremark Reservoir	Nr Burton Upon Trent, Derbyshire
Forest Farm Nurseries Pool	Pershore, Worcestershire
Forge Mill	Sandwell West Midlands
Foxholes Pool (Pradoe)	Nr West Felton, Oswestry
Frampton on Severn Sailing Lake	Frampton, Gloucestershire
Fulford Heath Golf Club	West Midlands
Gailey Lower Pool	Staffordshire
Gailey Upper Pool	Staffordshire
Glebe Farm	Sibson, Leicestershire
Gloucester Sharness Canal	Frampton Upon Severn, Gloucsters
Grand Union Canal	A429B Warwick
Gunthorpe Gravel Pit, Lake 1	Nr Nottingham, Nottinghamshire
Hewell Grange Lake	Redditch, Worcestershire
Home Farm Lake	Ryton on Dunsmore, Nr Coventry
Holme Pierrepoint 2000m Lake	Nottingham
Holme Pierrepoint Waterski Laggon	Nottingham
Horsehay Lake	Dawley, Telford
JCB Ornamental Pool	Rocester, Staffordshire
JCB Southern Pool	Rocester, Staffordshire
JCB Northern Pool	Rocester, Staffordshire
Kings Mill Reservoir	Kirby, Ashfield,Nottinhamshire
Kingsbury Water Park, Bodymoor Heath	Warwickshire
Kingsbury Water Park, Hemlingford Pool	Warwickshire
Kingsbury Water Park, Mitchells Pool	Warwickshire
Knighton Hall Farm	Knighton, Shropshire
Knowle Hall Pool	Knowle, Warwickshire
Knypersley Reservoir	Nr Biddulph, Staffordshire
Lake nr Wanlip Country Club	Nr Leicester, Leicestershire
Lakeside Lake	Baulderton, Newark
Lifford Reservoir	Birmingham, West Midlands
Llyn Hir	Montgomery, Powys
Lower Butts Pool	Iron Cross, Bidford-on-Avon
Lower Bittell Reservoir	Redditch/Bromsgrove Area, Warks
Lydney Boating Lake	Lydney, Gloucestershire
Marton Pool	Nr Montgomery, Shropshire
Mill Shrub	Redditch/bromsgrove Area, Warks

APPENDIX C. cont'd

Moat Pond	Morton, Warwickshire
Moor Green Resevoir	Eastwood, Nottinghamshire
Muniment Pond	Wroxall Abbey School, Warwick
Naseby Reservoir	Naseby, Northamptonshire
Newman Paddocks Lakes	Monks Kirby, Warwickshire
Ogston Reservoir	Derbyshire
Olton Mere	West Midlands
Oramental Pool	Jephson Gdns, Leamington Spa
Packington Gearys Level	Warwickshire
Packington Hall Pool	Warwickshire
Patshnull Great Pool	Nr Albrighton, Shropshire
Plantsbrook Nature Reserve, lake 1	Birmingham
Plantsbrook Nature Reserve, lake 3	Birmingham
Plantsbrook Nature Reserve, lake 4	Birmingham
Pond at Coddington	Newark, Nottinghamshire
Press Reservoir	Nr Ashover, Derbyshire
Pype Hayes Hall Lake	Erdington, West Midlands
Radford Brook	A425, Nr Leamington Spa
River Alne	Little Alne, Worcestershire
River Avon	A425, Warwick
River Avon, Stratford to Tewkesbury	Strafford, Warwickshire
River Arrow	Lower Bittel, Worcestershire
River Leam	Adelaide Road, leamington Spa
River Dene	Walton Ford, Nottinghamshire
River Maun	Sutton In Ashfield, Nottinghamsh
Rock Cottage Pools	Mamble/Hereford & Worcestershire
Rudyard Lake	Rudyard, Staffordshire
Sandshills Lake	Worksop, Nottinghamshire
Saunby Ponds	Nr Gainsborough, Lincolnshire
Shatterford Lakes (several)	Nr Worcester
Shushoke Reservoir	Coleshill, Warwickshire
Smethwick Park Pool	West Midlands
Stanford Reservoir	Rugby
Stanley Pool	Stoke-On-Trent, Staffordshire
Staunton Harold Reservoir	Nr Loughborough, Leicestershire
Stoke Floods Pool	Coventry
Stourbridge Canal	Widewater, Dudley, Nr West Brom
Stowe Pool	Lichfield, Staffordshire
Stratford Canal	Lapworth to Wootton Waven, Warks
Stubbers Green Brook	Nr Walsall, Birmingham
Stubbers Green Park Pool	Nr Walsall, Birmingham
Sulby Reservior	Welford-On-Avon,Northamptonshire
Sutton Park, Powells Pool	West Midlands
Sutton Pool, Blackroot Pool	West Midlands
Swan Hurst Park Pool	Birmingham
Swithland Reservoir	Nr Loughborough, Leicestershire
Tardebrigge Reservoir	Nr Redditch, Worcestershire
The Mere	Ellesmere, Shropshire
The Old Match Pit	Birstall, Leicestershire
Thornton Reservoir	Thornton, Leicestershire
Upper Bittell Reservoir	Redditch/Bromsgrove Area, Worcs
Upton Warren Sailing Lake	Droitwich, Worcestershire
Upton Marina	Upton on Severn, Worcester
Walcot Pool	Lydbury North, Shropshire
Water Mead Country Park, Sailing Lake	Thurmaston, Leicestershire
Water Mead Country Park, King Lear Lake	Thurmaston, Leicestershire
Water Mead Country Park, Lake 2	Thurmaston, Leicestershire
Welford Reservoir	Welford, Northamptonshire

APPENDIX C. cont'd

Weston Park Lake	Shropshire
Westport Small Lake	Stoke-On-Trent, Staffordshire
Whitcombe Reservoir East	Stroud, Gloucestershire
Whitemere	Ellesmere
Willes Meadow Reservoir	Leamington Spa
Yew Tree, Cottage Pool	Yarnfield,
Southern	
Arlington Reservoir	Arlington, East Sussex
Barcombe Mills Reservoir	Sussex
Bewl Water	Nr Royal Tunbridge Wells, Kent
Bough Beach Reservoir	Nr Sevenoaks, Kent
Cliffe Sailing Lake	Kent
Darwell Reservoir	Sussex
Ecclesbourne Lake	Hastings, East Sussex
Fordwich Lake	Canterbury, Kent
Furnace Lake	East Grinstead, West Sussex
Herons Park	Lydd, Kent
Longfield Lake	Tonbridge, Kent
Peckhams Copse Trout Fishery	Lydd, Kent
Pett Pool	Chichester, West Sussex
Powdermill Reservoir	Sedlescombe, East Sussex
Portals Lagoon	Overton, Hampshire
Railway Lake	Aylesford, Kent
Snodland Lake	Nr Maidstone, Kent
Weir Wood Reservoir	West Sussex
South West	
Argal Reservoir	Falmouth, Cornwall
Bussow Reservoir	St Ives, Cornwall
College 1 (Lower) Reservoir	Falmouth, Cornwall
College 2 (Middle) Reservoir	Falmouth, Cornwall
College 4 (Upper) Reservoir	Falmouth, Cornwall
Darracott Reservoir	Torrington, Devon
Drift Reservoir	Penzance, Cornwall
Exwick Flood Relief Channel	Exeter, Devon
Gammerton 1 (Lower) Reservoir	Bideford, Devon
Gammerton 2 (Lower) Reservoir	Bideford, Devon
Great Fulford Estate Lake	Nr Cheriton Bishop, Devon
Great Western Canal	Tiverton, Devon
Home Farm	Kenton, Devon
Jennetts Reservoir	Bideford, Devon
Kennick Reservoir	Nr Bovey Tracy, Devon
Lake House	Newton St Cyres, Devon
Loe Pool	Helston, Cornwall
Lower Slade 1 Reservoir	Ilfracombe, Devon
Lower Slade 2 (Upper) Reservoir	Ilfracombe, Devon
Lower Tamar Reservoir	Bude, Cornwall
Lynenam House	Yealmpton, Devon
Meldon pool	Okehampton, Devon
Old Mill Reservoir	Dartmouth, Devon
Porth Reservoir	Newquay, Cornwall
Rackernayes Pond	Newton Abbott, Devon
Rosewastis Farm	St Column Major, Cronwall
Shobrooke Park Lake	Crediton, Devon
Slapton Ley	Kingsbridge, Somerset
Stithians Reservoir	Redruth, Cornwall
Treveor Farm, Lower Lake	Nr Dodman point, Cornwall
Upham Farm	Farringdon, Devon
Upper Tamar Reservoir	Bude, Cornwall

APPENDIX C. cont'd

Welsh	
Aled Isaf	Clwyd
Bodenham Sailing Centre	Leominster, Hereford
Bosherton Lakes	South West Wales
Cwmbran Boating Lake	South East Wales
Decoy Pond	Orielton, Dyfed
Dolwen	North Wales
Eglwys Nunydd	Port Talbot, West Glamorgan
Hensol Castle Lake	Mid Glamorgan
Lisvane Reservoir	Cardiff, South Glamorgan
Llandegfedd	Pontypool, Gwent
Llandrindod Wells Lake	South East Wales
Llyn Syberi	Conwy Valley, Gwyned
Llyn Cefni	Anglesey
Llyn Perryhn	Anglesey
Llyn Coron	North Wales
Llys Y Fran Reservoir	South West Wales
Lower Llledi Reservoir	South West Wales
Plas Uchaf	Clwyd
Roath Park Lake	Cardiff, South Glamorgan
Royal Oak Pool	Portway
Sandy Water Lake	Llanelli, Dyfed
Talley Lake	Llandeilo, Dyfed
Tredegar Park Lake	South East Wales
Wentwood Reservoir	Gwent
Ynysfro Lower Reservoir	Llanelli, Dyfed
Wessex	
Ashford Reservoir	Nr Cannington, Bridgewater
Blagdon Reservoir	Bristol
Chard Reservoir	Chard, Somerset
Cheddar Reservoir	Cheddar, Somerset
Chew Reservoir	Bridgewater, Somerset
Chilton Trinity Lake	Nr Wiveliscombe, Somerset
Crockerton Lake	Warminster, Wiltshire
Durleigh Reservoir	Bridgewater, Somerset
Emborough Lake	Midsomer Norton
Fonthill Reservoir	Fonthill Bishop, Nr Salisbury
Gasper Lake	Wincanton, Somerset
Hawkridge Reservoir	Nr Bridgwater, Somerset
Hucklesbrook (North)	Ringwood, Hampshire
Hucklesbrook (South)	Ringwood, Hampshire
Leigh Reservoir	Taunton, Devon
Luxhay Reservoir	Taunton, Devon
Mill Farm Lake	Great Cheverell, Nr Devizes
Moors Valley Lake	Ashley Heath, Dorset
Newton Lake	Highbridge
River Huntspill	Bridgwater, Somerset
Sharp Road Pond	Parkstone, Bournemouth, Dorset
Shearwater Lake	Wincanton, Somerset
Sherborne Lake	Sherborne, Dorset
Snails/Willow Lake	Blashford, Nr Ringwood
Spinaker Lake	Blashford, Nr Ringwood
St George Park Lake	Bristol
Stourhead Lake	Wincanton, Somerset
Sutton Bingham Reservoir	Nr Yeovil, Somerset
Thorny Lake (Coarse Fishery)	Langport
Tockenham Lake	Nr Wootton Bassett, Wiltshire

APPENDIX C. cont'd

Top Lake	Wincanton, Somerset
Turners Paddock Lake	Wincanton, Somerset
Water Fish Farm	Bridport, Dorset
Willow Lake	Nr Ringwood, Hampshire
Yorkshire	
Allerton Park Middle Lake	Nr Knaresborough, North Yorksh
Allerton Park Top Lake	Nr Knaresborough, North Yorksh
Anglers Lake	Nr Wakefield, West Yorkshire
Ardsley Reservoir	Nr Wakefield, West Yorkshire
Beaverdyke Reservoir	Nr Harrogate, North Yorkshire
Blackheath Pond	Nr Ripon, North Yorkshire
Brickyard Farm Lake	Nr Malton, Yorkshire
Burton Constable Lower Lake	Holderness, North Humberside
Burton Constable Upper Lake	Holderness, North Humberside
Calder and Hebble Navigation Canal	Dewsbury, West Yorkshire
Chelker Reservoir	West Yorkshire
Damflask Reservoir	Nr Sheffield, South Yorkshire
Eavestone Lake	Nr Ripon, North Yorkshire
Eccup Reservoir	Leeds, West Yorkshire
Ellerton Park Lake	Nr Richmond, North Yorkshire
Glucose Pond	Nr Goole, North Humberside
Gouthwaite Reservoir	Nr Pately Bridge,North Yorkshire
Hay-a-Park Lake	Knaresborough, North Yorkshire
High Eske Lake	Nr Beverley, North Humberside
Hornsea Mere	Hornsea, North Humberside
Howden Marsh Pond	Howden, North Humberside
Humber Bridge Country Park Pond	Hull, North Humberside
Ingbirchworth	Nr Barnsley, South Yorkshire
John O'Gaunts Reservoir	Nr Harrogate, South Yorkshire
Lindley Wood Reservoir	Nr Harrogate, West Yorkshire
Lumley Moor Reservoir	Nr Ripon, West Yorkshire
Malham Tarn	Malham, North Yirkshire
Mill Pond Leven	Nr Beverley, North Humberside
Morehall Reservoir	Nr Sheffield, South Yorkshire
Newby Whiske Hall Lake	Nr Northallerton,North Yorkshire
Pugneys Nature Reserve Pond	Wakefield, West Yorkshire
Queen Mary's Dubb	Nr Ripon, North Yorkshire
Ramsden Reservoir	Holmebridge, Yorkshire
Scout Dyke Reservoir	Sheffield, South Yorkshire
Semerwater	Nr Bainbridge, North Yorkshire
Silsden Reservoir	Keighly, West Yorkshire
Smithies Dam	Barnsley, South Yorkshire
Thornton Reservoir	Nr Bedale, North Yorkshire
Thrybergh Reservoir	Rotherham, South Yorkshire
Tranby Croft Pond	Anlaby, Hull, Humberside
Underbank Reservoir	Stockbridge, South Yorkshire
Welbeck Lagoon	Nr Wakefield, West Yorkshire

APPENDIX D.

COMMENTS FROM THE YORKSHIRE REGION

TOXIC BLUE GREEN ALGAE REPORT AND 1990 MONITORING PROGRAMME

I understand from the above report and verbal communication with members of the task group that it will be necessary to review the method and efficacy of the monitoring programme at the end of this year. At this stage, Yorkshire Region would like to offer the following comments on both the 1990 monitoring programme and on the "Toxic Blue Green Algae" report.

1. Site Selection

There was confusion as to whether all potable water supply reservoirs, except those where there is no public or livestock access, should be sampled (as specified in report Appendix B, point 2) or whether this should only apply to those with a high risk usage (as implied in report flow chart p. 113). Yorkshire opted for the former. I would be grateful for your circulation.

We would question why so much emphasis needs to be given to potable water supply reservoirs, particularly where there are no immersion sports, to the detriment of other waters for which we also have responsibilities. The water companies normally cover the former, so would it be better to concentrate on a greater number of other high risk waters which receive no monitoring effort?

We would also take issue with the selection of a minimum of not less that 10% of all high risk waters at random. In view of the limited resources available to collect and process samples, it would be more sensible to select those waterbodies thought most likely to develop blue-green blooms.

2. Sampling Location and Method

A photographic record of the waterbody should be made, and in particular evidence of the bloom conditions.

I agree that sampling should be undertaken on the downwind shore of the waterbody, but this may prove difficult for the sampler due to time constraints and access.

3. Level of Risk Category

Surely canoeing should be moved into the high risk category?

We also suggest that fishing should be a medium level of risk and public amenity low risk. Fishing can involve direct contact with the algae in handling fish and fishing line, and of course there are also the aspects of fish consumption to consider.

4. Chemical Analysis

Yorkshire, in common with all other Regions, had difficulty in determining Total Phosphorous to the required level. This is because there were difficulties in achieving the level of blank required to be able to confidently assess phosphorous levels at 10 micro-gms/l and below.

This, however, is only part of the problem. We were asked last year, at short notice, to measure total phosphorous, but there was no definition of what was meant by this. In common with some other determinands (eg metals) the analytical procedure defines what is actually measured and not the other way round. There are two methods for total phosphorous defined in the 1980 Methods for the Examination of Waters and Associated Materials (Blue Book). These are a mild version (ammonium persulphate) and a rigorous version (sulphuric acid). unfortunately, there is no published performance data for either of these methods.

It would seem that the determination which is required is the one which is directly related to algal growth. In this respect it would seem that the required determinand is Reactive Phosphate. This is the determinand we usually refer to as orthophosphate, but under the conditions of the test, some condensed phosphate may be hydrolysed to orthophosphate, hence the term Reactive Phosphate.

The blue book describes a solvent extraction procedure for Reactive Phosphate which has a limit of detection of 0.5-0.7 micro-gms/1 p. This would be ideal against a limiting standard of 10 micro-gms/1, and perhaps it should be the method of choice. If it is so chosen, it must be borne in mind that

(a) Twelve samples require 2-3 hours, of which up to 2 hours is operator time.

(b) Specially prepared bottles are requried for taking the samples.

(c) Laboratories will need time to set up the methods in their area in order to make sure the performance is satisfactory.

On balance, this appears to be the method which will give the required data but a decision on its use needs to be made some months before the next blue-green season so that we are prepared. A decision to go ahead the week before sampling is due to begin would be useless.

This part of the monitoring programme has not been feasible in Yorkshire in 1990 and monthly algal assessment has had to be continued for all waters on the monitoring programme.

Should other chemical information be collected in association with the sampling programme to aid interpretation of results eg nitrate, nitrite, ammonia, pH?

5. Algal Assessment Method

It is important to establish a sound assessment method used by all regions in the same way. The method selected is rather crude, not a recognised method of counting algae, and difficult to operate since 0.5 ml of sample overflows a standard microscope slide (c 0.1 ml capacity). To overcome the latter, a Sedgwick Rafter counting chamber could be used, although this is designed to take 1ml.

We would like a quantitative method and in Yorkshire, we use a Sedgwick Rafter counting chamber for Microcystis and one hour sedimenttion and counting for other blue-greens. Often a rapid scan of a filtered sample is first undertaken to see whether blue greens are present.

We ask the group to reassess the method and consider adopting an optional range of methods, including those practised in Yorkshire.

If a suitable standard method of algal monitoring and chemical analysis had been undertaken, we could have gained valuable information on algal numbers/bloom scum formation, on which to base future observations and decisions.

6. Trigger Limits

Given that 0.5 ml can be scanned in two minutes under low power, just 12 units/ml currently qualifies as a potential toxic algae bloom.

It is critical to set trigger limits at an 'appropriate' level. This must be such that it minimises health risks to humans, pets, livestock and aquatic life but enables water recreational activities to continue when sensible to do so. We acknowledge that this is not easy but feel that the current response level is often too low.

It is difficult to generalise. For example:

- 12 filament/ml of Aphanizomenon or Oscillatoria constitute very low levels particularly if the filament lengths are small. Such levels would not discolour the water. In the past we have described Aphanizomenon concentrations of 3,500 filaments/ml as moderately high.

- Anabaena occurs in a very wide range of filament lengths and where they are long, filament numbers of 10-70/ml can produce cell numbers of 1,000 - 10,000/ml, at which levels slicks may be formed.

- low numbers of large Microcystis and Coelosphaerium colonies can produce scum.

It must also be remembered that because the sample is obtained downwind it should represent about the highest concentration in the waterbody.

We ask that the group review the current repsonse levels and the method of assessment. We would like different limits for different types of blue-green algae and redefinition of the 'unit'.

7. Warning System

Could the task group consider the use of a two tier warning system?

Yorkshire Water have adopted an amber and red alert system which seemed to be a much more memorable and effective way of informing the public (see attached).

8. Standard Letters

In general, insufficient thought was given to the implications of statements made in the standard letters. Regional standardisation on a generalised format would have been better.

Where a series of letters have been sent to the same EHO's, MOEH, and MAFF the content has been very repetitive. A general initial letter could be sent including information about the monitoring programme. Warning systems, details of advice which could be given and action needed. Thereafter short letters could be sent notifyng sites affected, the warning level is amber/red and the species concerned. These could be produced as preprinted coloured postcards.

Notification on Subsidence of Bloom

We now have a standard letter to be sent to owners, EHO's, MOEH and MAFF when blooms subside. Should this not also be released to the Press? It seems only fair to the owners and users that having informed the media initially we should do the same when the bloom subsides. Preprinted postcards could again be used here.

As discussed in earlier correspondence with yourselves, we were concerned about the monitoring implications given in para 4. It was subsequently changed to 'As part of its national monitoring programme, the NRA will continue to monitor the situation as necessary ....' This is better but leaves the owner wondering.

9. Continuation of Monitoring Beyond October

This is obviously necessary in waters supporting blue-greens above our limit in September/October.

Cessation of monitoring once the water temperature falls below 8°C, on the basis that the algae will no longer maintain buoyancy, implies that only the scums are hazardous. Surely this is incorrect, although we appreciate that the scums are likely to pose more of a risk because the algae are concentrated and accessible.

10. Action Plan For Individual Waterbodies

These plans will take up considerable resources but we need to liaise with owners and users about them.

We need clarification from the group as to how these action plans should be developed and implemented.

We also need to set priorities as to which waters require control measures and rank these sites in order of importance.

11. Monitoring in 1991

We suggest that the 1991 monitoring programme should centre on the sites shown to be positive in 1990.

A regional seminar for EHO's will be planned for March next year to inform them about the 1990 event and the 1991 monitoring programme. Such a seminar was undertaken by Yorkshire Region this year and proved very successful in disseminating information, pre-empting questions and gaining support.

12. Media Briefing/Internal Communication/Public Relations

When national media briefs are given the regions should be informed of the contents of these briefs and any associated documents well in advance. Insufficient time was given to study the report, prior to its release.

It is important that the task group keeps in regular touch with regional contact point to feedback the latest position etc.

A general information pack on blue-green algae including what they look like, their life cycles, hazards and health implications, should be produced to inform and educate the public. This could be a collaborative production with others such as EHO's, Royal Yachting Association, National Federation of Anglers etc.

13. Other

Although we understand that the NRA's responsibilities are the monitoring of controlled waters and informing owners, local EHO's, MOEH, and MAFF of any actual or suspected blooms and results of our analysis (Report S.10.6), we inevitably get drawn into discussions regarding advice.

I hope that you will find these comments constructive and useful to the task group when it undertakes its review.

APPENDIX E.

Number of Waters Containing 'Abundant' Algae, Scums and/or Blooms Throughout November 1991.

Waters Containing 'Abundant' Algae	Bloom Present	Scum Present
Anglian		
Blickling Lake	+	-
Covenham Reservoir	-	+
Eyebrooke Reservoir	-	+
Fen Drayton A.R.C.	-	+
Fritton Hall Lake	-	+
Lound Run	-	+
Lynch Lake	-	+
Mount Farm Lake	+	-
Islip Large Gravel Pit	-	+
Islip Small Gravel Pit	-	+
Priory Lake	+	-
Wyboston Lake	+	-
Northumbrian		
Leazes Park lake	-	-
Little Swinburn Res	+	+
North West		
Alston No.3	SCUMS AND BLOOMS WERE NOT RECORDED BY THE NORTH WEST REGION	
Blelham Tarn		
Bigland Tarn		
Esthwaite Water		
High Bullough Res		
Killington Reservoir		
Overton Water		
Severn Trent		
Barton Under-Needwood	+	-
Ballmill Gravel Pit	-	-
Blackbrook Reservoir	+	-
Bomere	+	-
Canon Hill Fish Pool	+	-
Colwick Park West Lake	+	-
Colemere	-	-
Dimmingsdale Pool	+	-
Eastwood East	+	-
Eastwood West	+	-
Fens Grove Pool	-	-
Foremark Reservoir	-	-
Foxholes Pool	+	+
Frampton-Upon-Severn	+	+
Fulford Heath	+	-
Gailey Lower Pool	-	-
Gailey Upper Pool	-	-
Gailey Lakes (Heath)	+	-
JCB Pools Ornamental	+	-
JCB Pools Northern	+	-
JCB Pools Southern	-	-
Knighton Hall Farm	-	-
Lifford Reservoir	-	-
LLyn Hir	-	-
NWSC 2000m Lake	-	-
NWSC Water Ski Lake	-	-
Packington Hall Pool	+	+
Plantsbrook Lake 3	+	-
Pond At British Sugar	+	-
Pond At Coddington	+	+
Rudyard Lake	-	-
Sandhill Lake	+	-
Shatterford Lake	-	-
Shustoke Reservoir	+	-
Stratford Canal	+	+
Swithland Reservoir	+	-
Tardebrigge Reservoir	+	-
Thornton Reservoir	-	-
Upper Bittell Res	+	-
Upton Warren	+	-
Walcot Pool	-	-
Watermead Country Pk	-	-
Welford Reservoir	+	-
Whitemere	-	-
Witcombe Resevoir	+	-

+ = Present - = Absent

APPENDIX E. cont'd

Waters Containing 'Abundant' Algae	Bloom Present	Scum Present
Yew Trees Cottage	+	+
South West		
Argal Reservior	+	-
Bussow Reservoir	+	-
Exwick Flood Relief	+	-
Exeter Ship Canal	+	-
Meldon Pool	+	-
Old Mill Reservoir	+	+
Porth Reservoir	+	-
Stithians Reervoir	+	-
Thames		
Barnet A.C. Lake	+	-
Burgess Park Lake	-	-
Farmoor 2. Reservoir	+	+
Fairlands Valley Lk	-	-
Millwall Dock	-	-
Serpentine	+	-
Stanborough Lake South	+	-
St James Park Lake	+	-
Weald Park lake	-	-
West India North Dock	-	-
West India South Dock	-	-
Welsh		
Bosherton	-	-
Cefni	+	+
Coron	-	-
Cumbran Boating Lake	+	-
Decoy Pond	-	-
LLyn Y Fran	+	+
Roath Park Lake	-	-
Syberi	-	-
Wessex		
Blagdon Reservoir	-	+
Blashford Lake	-	+
Chew Valley Lake	-	+
Clatworthy Reservoir	-	+
Durleigh Reservoir	-	+
Emborough	+	-
Hawkridge Reservoir	-	-
Hucklesbrook (North)	-	+
Hucklesbrook (South)	-	+
Leigh Resrvoir	-	-
Luxnay Reservoir	-	+
Portishead Lake	+	-
River Huntspill	+	-
Shearwater Lake	+	-
Stourhead Lake	-	+
Sutton Bingham Res	+	-
Tockenham	+	-
Water Lane Fish Farm	-	+
Willow Lake	-	+
Yorkshire		
Beaverdyke	-	-
Mill Pond	+	-
Queen Mary's Dubb Lake	-	+
Smithians Dam	-	+

+ = Present - = Absent