An audit of performance in the analysis of biological samples in 1998 Environment Agency: Primary Audit

Institute of Freshwater Ecology

IFE Report Ref: RL/T04071R7/17

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Environment Agency: Primary Audit

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Statement of Use
Information in this document is to help biologists in the Agency to identify where analytical errors occur so that they can be reduced or eliminated. Data in the tables provide measures of the accuracy of primary data produced in accordance with the standard methods for the River Invertebrate Prediction and Classification System (RIVPACS) and analysed to the level required for the Biological Monitoring Working Party (BMWP)-score system, including General Quality Assessment. Information in this report may be used to determine statistical confidence limits and the stastical significances of differences between biological samples. This includes comparisons of Observed/Expected (O/E) values and quality bands made by the compare module of RIVPACS III+ and the statistical routine CONCLASS used for GQA surveys.

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1. INTRODUCTION

In 1998 the sampling of aquatic macro-invertebrates for the biological assessment of river quality was carried out throughout the United Kingdom. This task was undertaken by the Environment Agency (The Agency) in England and Wales, the Scottish Environment Protection Agency (SEPA) in Scotland and the Industrial Research and Technology Unit (IRTU) undertook the work in Northern Ireland.

Each organisation employed standard collection procedures as used in the 1995 General Quality Assessment (GQA) Survey. The sampling strategy was therefore compatible with RIVPACS (River InVertebrate Prediction And Classification System), a computer model developed by the Institute of Freshwater Ecology (IFE). Samples were sorted for the families of macro-invertebrates included in the Biological Monitoring Working Party (BMWP) system. For each site the taxa present were recorded on a standard data sheet. Although attempts had been made to standardise sample processing and recording techniques, these did vary somewhat from Region to Region.

In view of the number of staff involved and the variability of sample processing techniques, it was recognised that a quality assurance exercise was necessary to minimise and quantify errors. Each laboratory appointed at least one experienced analyst to act as an internal analytical quality control (AQC) inspector. These inspectors re-sorted 10% of the laboratory's samples, those samples chosen for re-sorting being selected randomly. In addition, IFE was contracted to undertake an independent, external audit of the quality of the laboratory analysis of biological samples for each Agency and SEPA region and for IRTU.. This commission was consistent with the audit performed by IFE for the National River Quality Surveys in 1990 and 1995 and for the routine biological monitoring of river sites each year between 1991 and 1994 and again in 1996 and 1997. The audit for the Agency comprised two elements. The AQC Audit provided a measure of the quality of performance of the AQC inspectors. The Primary Audit provided an independent assessment of the quality of the data, since this was not adjusted for errors identified by either of the other quality assurance procedures.

This report presents the results of the audit of 489 samples that were sorted and identified by the Agency's primary analysts. Ten samples from Southern Region were analysed using non-standard methodology and are not included in the statistical analyses for those laboratories. The results of the AQC Audit, detailing the quality of the Agency's internal AQC inspections of 416 samples, are reported separately (Gunn *et al.*, 1999).

2. SAMPLE SELECTION

Samples for audit were selected internally by each of the organisations being monitored. The method of selection used by the Agency is described in Environment Agency (1996). The number of samples selected for audit varied between laboratories and the biologists processing these samples had no prior knowledge of which samples were to be audited. Laboratories were instructed to send to IFE samples that had been processed twice (once for primary analysis and once for internal AQC inspection). Those which analysed an insufficient number of samples throughout the year to provide the requisite number of AQC-inspected samples for the audit sent as many AQC-inspected samples as they could and made up the number with samples which had been analysed just once. The manner of sample selection, which biologists would be monitored and the number of audit samples from each season, were left to the discretion of the organisation, within the limits of the total number of samples that IFE was contracted to audit.

3. SAMPLE PROCESSING

The normal protocol for Agency, SEPA and IRTU biologists was to sort their samples within the laboratory and to select examples of each scoring taxon within the BMWP system. The invertebrates were placed in a vial of preservative (4% formaldehyde solution or 70% industrial alcohol) and the BMWP taxa were listed on a data sheet. The vial of animals and the sorted material were then returned to the sample container and preservative added. Samples for internal AQC analysis should have been sorted in the same manner as the primary analysis. The AQC inspector's task included confirming the identification of the contents of the vial and the correctness of the data sheet. Any additional taxa found at AQC were to be placed in a separate vial without altering the contents of the primary analyst's vial, although this instruction was not always followed.

Each sample available to IFE for audit should have included:

i) a data sheet containing a list of the BMWP families found in the sample.
ii) a vial or vials containing representatives from each family.
iii) the preserved sample.

When these three elements were present, the sequence of operations at IFE was as follows:

a) The remainder of the sample was sorted, without reference to the data sheet or to the vials of animals, and the BMWP families identified.
b) The families contained within the vials were identified.
c) A comparison was made between the listing of families and those found in the sample by IFE.
d) A comparison was made between the listing of families and those identified from the vials by IFE.
e) "Losses" or "gains" from the original listing of families were noted. In the case of "gains", each additional family was identified, where possible, to species level, in order to clarify any specific repetitive errors. Single representatives of a "gained" taxon were noted as such.
f) An error code, selected from a list on the result sheet, was assigned by the IFE auditor for each "loss" or "gain".

Occasionally a sample did not include a vial containing representative examples of the families listed on the data sheet, while some arrived with the vial damaged in transit such that the representative specimens were no longer separated. For these samples, only operations a), c), e) and f) above were appropriate.

Several directives were issued to IFE relating to the treatment of BMWP taxa. Every taxon recorded on the data sheet must be supported by a voucher specimen of that family in the vial (or, for very large specimens, left in the sample). The only exceptions to this rule were the native crayfish, *Austropotamobius pallipes*, the medicinal leech, *Hirudo medicinalis* and the pearl mussel, *Margaritifera margaritifera* (which does not belong to a BMWP family), all of which are protected species. Where possible, IFE gave the benefit of doubt to the analyst in cases of the "loss" of Planariidae, specimens of which have been known to disintegrate in preservative. Animals deemed to have been dead at the time of sampling, cast insect skins, pupal exuviae and empty mollusc shells were to be excluded from the listing of families present. Isolated posterior ends of "living"

specimens were not acceptable as records of a taxon. In these cases, thorax plus abdomen was deemed acceptable but abdomen only was deemed unacceptable. Terrestrial representatives of BMWP scoring families were also to be excluded from the audit. For this reason, Clambidae, Chrysomelidae and Curculionidae, which appear in the BMWP list, were excluded for the purposes of the audit since most representatives of these families are, at best, only semi-aquatic. Trichopteran pupae, although not routinely identified by many biologists, were to be included in the listing of families.

4. REPORTING

The results of each sample audit were recorded on a standard report form and sent to the appropriate Regional Biologist. Examples for Primary and AQC Audits of the same site are shown in Figures 1 & 2. IFE were instructed not to include copies of these forms in the report but that each region would keep their own forms as an appendix to this report. For audit samples where a vial of animals was included, the comparison between the listing of families and the taxa found in the vial by IFE was shown in the section of the report form headed "VIAL". Discrepancies could be due to carelessness, misidentifications or errors in completing the data sheet listing the families present. Families not on the listing but found by IFE in the remainder of the sample were entered in the section of the report form headed "SAMPLE" under "Additional BMWP taxa found by IFE". This section also included taxa added by the internal AQC analyst. Taxa recorded here represent families missed by the analyst(s) on sorting the sample. When the families listed as "losses" in the first section of the report form were compared with the full list of families recorded in the sample by IFE, some apparent losses from the vial were offset by the presence of those families in the remainder of the sample. These taxa were therefore listed both as "losses" from the vial and as "gains" from the sample and were neither a net loss nor a net gain. In these cases, the families were marked with an asterisk in both boxes. Such errors are noted as "omissions".

Species identifications, state of development (eg adult or larval coleopterans) and the presence of a single representative of a family within the remainder of the sample were recorded in the centre section of the report form under "species name".

IFE was asked to interpret each error to provide a possible cause. An error code, selected from a list of options at the foot of each result sheet, was entered against each taxon in the column headed "Presumed cause of error".

For those samples in which the vial of animals was damaged or missing, the "VIAL" sections of the report form were not applicable (N/a). Families not on the list but present in the sample were entered in the section under "SAMPLE" : "Additional taxa" as before. Families recorded on the list but not found by IFE were indicated in the section above this. If the vial of animals was retained by the sorter, entries in this box could include the sole representative of a family which was removed, a family seen at the site which escaped or was released (without mention being made on the data sheet), inaccurate identification or the wrong family box being ticked on the data sheet.

The final section of the result sheet summarises the audit, giving details of the numbers of "losses", "gains" and "omissions", together with the net effects on BMWP score and the number of scoring taxa.

Figure 1. An example of a Primary Audit result sheet

EXTERNAL AUDIT OF BIOLOGICAL SAMPLES

REGION: Example | **LABORATORY:** Example | **DATE:** 01/04/98

WATER-COURSE: Beautiful River | **PRIMARY ANALYST:** XX | **AQC ANALYST:** YY

SITE: Utopia | **CODE:** 0001/AQC01 | **SORT/AQC METHOD:** Preserved/Preserved

RESULTS OF PRIMARY AUDIT

Family name	Presumed cause of error (see footnotes)
VIAL	
BMWP taxa not found in vial	
Planorbidae	12
Terrestrial snail in vial	
Baetidae *	1
Limnephilidae	7
Additional BMWP taxa found in vial	
Lepidostomatidae	7
Lepidostoma hirtum (Fabricius)	
SAMPLE	
BMWP taxa not found in sample (for samples where vial is broken or absent)	
N/a	
Additional BMWP taxa found in sample	
Baetidae *	1
Baetis rhodani (Pictet)	
Hydrophilidae (incl. Hydraenidae)	9
Hydraena gracilis Germar (a) 1 only	
Hydroptilidae	11
Hydroptila sp. (p)	
Psychomyiidae (incl. Ecnomidae)	11
Psychomyia pusilla (Fabricius) 1 only	

SUMMARY OF AUDIT

LOSSES: 2 **GAINS:** 4 **OMISSIONS:** 1

NET EFFECTS:
ON BMWP SCORE 19
ON NO. OF TAXA 2

1 No representative of family in vial
2 Alternative terrestrial specimen in vial
3 Posterior end only in vial
4 Empty shell or case or cast skin in vial
5 Specimen dead at time of sampling
6 Taxon in vial but not recorded
7 Mis-identification
8 Typographical error - wrong box ticked
9 Taxon missed in sorting
10 Unexplained error
11 Taxon added in internal AQC
12 Recorded taxon that was rejected by AQC analyst

Omission (*) = Recorded, not in vial but found by IFE in sample (no net loss or gain)

Figure 2. An example of an AQC Audit result sheet

EXTERNAL AUDIT OF BIOLOGICAL SAMPLES

REGION: Example | **LABORATORY:** Example | **DATE:** 01/04/97

WATER-COURSE: Beautiful River | **PRIMARY ANALYST:** XX | **AQC ANALYST:** YY

SITE: Utopia | **CODE:** 0001/AQC01 | **SORT/AQC METHOD:** Preserved/Preserved

RESULTS OF AQC AUDIT

Family name	Presumed cause of error (see footnotes)
VIAL	
BMWP taxa not found in vial	
Baetidae *	1
Limnephilidae	7
Additional BMWP taxa found in vial	
Lepidostomatidae	7
Lepidostoma hirtum (Fabricius)	
SAMPLE	
BMWP taxa not found in sample (for samples where vial is broken or absent)	
N/a	
Additional BMWP taxa found in sample	
Baetidae *	1
Baetis rhodani (Pictet)	
Hydrophilidae (incl. Hydraenidae)	9
Hydraena gracilis Germar (a) 1 only	

SUMMARY OF AUDIT

LOSSES: 1 GAINS: 2 OMISSIONS: 1

NET EFFECTS:
ON BMWP SCORE 8
ON NO. OF TAXA 1

1 No representative of family in vial
2 Alternative terrestrial specimen in vial
3 Posterior end only in vial
4 Empty shell or case or cast skin in vial
5 Specimen dead at time of sampling
6 Taxon in vial but not recorded
7 Mis-identification
8 Typographical error - wrong box ticked
9 Taxon missed in sorting
10 Unexplained error
11 Taxon added in internal AQC
12 Recorded taxon that was rejected by AQC analyst

Omission (*) = Recorded, not in vial but found by IFE in sample (no net loss or gain)

5. RESULTS

The results of the Primary Audit for 1998 for all Agency Regions are presented, Region by Region, in Tables 1 to 58. A summary of the basic audit results in terms of losses, gains and omissions is followed by the statistics of these regional audit results centered around the target of acceptability of no more than two missed taxa per sample. These data are presented for each analyst, for their Area Laboratories and for the Region as a whole. Then follows information on the net effects of the Primary Audit on the BMWP score and number of taxa for the Region's data. These results are again based on the target of no more than two missed taxa per sample. The figure of 13 for an acceptable underestimate of BMWP score is based on twice the average score of all taxa in the BMWP listing (excluding Clambidae, Chrysomelidae and Curculionidae, which are excluded from the audit). This average score is 6.57. Following this are listings for the Region of the taxa missed at family and species levels in the 1998 audit. Tables 59 and 60 summarise the statistics and effects of the 1998 Primary Audit for the whole of the Agency. Tables 61 and 62 give listings of all taxa, at family and species levels respectively, missed in sorting by the Agency's primary analysts and Tables 63 and 64 give similar listings for all samples audited in 1998 for the whole of the United Kingdom (Primary and AQC Audits for Agency Regions plus single Audit for other organisations). Data for the AQC Audit is presented in a separate report (Gunn *et al*, 1999).

Estimating sample biases for the compare module of RIVPACS III+

The underestimation of the number of BMWP-scoring taxa is termed bias for the purpose of the compare module of RIVPACS III+. An estimate of bias is provided by the net gains (number of gains minus number of losses). The average net gains for each laboratory, Region and the Agency as a whole are listed in Table 60 in the column "mean net effect on no. of taxa". These values may be used directly for RIVPACS. To estimate the bias over a different period to that covered by this audit, it is necessary to refer to the Primary Audit result sheets for individual samples. Note that estimates of bias should be based on the results of at least 20 audited samples. Further instructions are given in Clarke *et al.* (1997).

6. ACKNOWLEDGEMENTS

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AUDIT OF ANGLIAN REGION'S PRIMARY ANALYSTS

Table 1 The 20 samples audited for Central Area of Anglian Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Rhee	Tadlow Bridge Farm	EIS	2	0	0
Nar	Castle Acre Road Bridge	EIS	0	1	1
Grand Union Canal	Ivinghoe Bridge	EIS	0	1	0
Wissey	Ickbury Bridge	EIS	1	2	0
Fenton Lode	Sewards Farm Bridge	EIS	1	4	0
Wissey	Hilgay Bridge	EIS	0	3	0
Marley Gap Brook	Stocks Bridge	LJS	0	0	0
Hexton Brook	Shillington Road Bridge	LJS	1	0	2
Running Water	Ruxox Bridge	LJS	0	0	0
Ouse	Sam Jones Mill	LJS	0	1	0
Tove	Cappenham Bridge	LJS	0	2	0
Hiz	Cadwell Arch	LJS	0	1	1
Middleton Stop Drain	Middleton Town Bridge	LJS	0	2	1
Sixteen Foot Drain	Horseways Corner	SEH	0	0	0
Wissey	Hilgay Bridge	SEH	3	1	2
Highlode	d/s Ramsey STW	SEH	0	3	0
Bourn Brook	Foxes Bridge	SEH	0	2	0
Ten Mile	Brandon Creek	SEH	0	0	0
Culford Stream	West Stowe Road Bridge	SEH	0	1	0
Ingol	Snettisham	WTC	0	8	0

Table 2 The 20 samples audited for Eastern Area of Anglian Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Butley Creek	Low Corner	CSA	0	1	1
Chelmer	d/s Sandford Mill	CSA	0	3	0
Blackwater	Wickham Mill	CSA	0	5	0
Alde	Bruisyard Arch Bridge	CSA	0	2	0
Deben	Barley Farm	CFW	0	1	0
Intwood Stream	Intwood Church Ford	CFW	0	2	0
Gipping	d/s ICI Weir	CFW	1	2	0
Toppesfield Brook	A604 Bridge	CFW	0	3	0
Chad Brook	Long Melford	EB	0	0	0
Blackwater	China Bridge	EB	0	0	0
Yare	Bawburgh	EB	0	3	0
Chelmer	Springfield Mill	EB	0	1	0
Colne	Nunnery Bridge	JHS	0	4	0
Roach	Rochford Reservoir	JHS	1	4	0
Chelmer	Fleck Bridge	JMG	0	0	0
Stour	Brundon Mill	JMG	0	2	0
Mermaid	Brampton Bridge	LSM	1	2	0
Belstead Brook	Brook Corner	LSM	1	1	0
Pant	Petches Bridge	LSM	0	0	0
Chelmer-Blackwater Canal	Heybridge	MJ	0	2	0

Table 3 The 20 samples audited for Northern Area of Anglian Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Glen	Kates Bridge	CLP	0	3	0
S. Forty Foot Drain	Swineshead Bridge	CLP	0	1	0
Lower Witham	Five Mile House	CLP	0	1	0
Willow Brook	Pen Green Lane	CLP	0	1	0
Nene	Wollaston Mill	CLP	0	0	0
North Kelsey Beck	u/s R. Ancholme	IMC	1	1	0
Swanspool Brook	Wellingborough	IMC	0	2	0
Nene	White Mills	IMC	0	2	0
Welland	Sibbertoft	IMC	1	0	0
Rase	Bishopbridge	IMC	0	1	1
Hog Dyke	Raunds	IMC	0	0	0
South Forty Foot Drain	Donington Bridge	IMC	0	0	0
North Gwash	Upper Hambleton R/B	IMC	0	3	0
Gwash	u/s Belmesthorpe	IMC	1	4	0
Willoughby High Drain	Hogsthorpe	RPC	2	2	0
Whaplode	Whaplode Marsh	RPC	0	1	0
South Drove Drain	Horseshoe Bridge	RPC	0	0	0
Nene	Warmington	RPC	1	6	0
Ise	Burton Latimer	RPC	0	2	0
Slea	Annick	RPC	1	5	0

Table 4 Statistics of the 1998 Primary Audit for Anglian Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Central	**20**	**1.60**	**0.43**	**4**	**20.00**	**8**	**2.35**	**0.47**
EIS	6	1.83	0.60	2	33.33	4	2.67	0.56
LJS	7	0.86	0.34	0	0	2	1.57	0.48
SEH	6	1.17	0.48	1	16.67	3	2.00	0.93
WTC	1	8.00	n/a	1	100.00	8	8.00	n/a
Eastern	**20**	**1.90**	**0.32**	**6**	**30.00**	**5**	**2.15**	**0.34**
CFW	4	2.00	0.41	1	25.00	3	2.25	0.48
CSA	4	2.75	0.85	2	50.00	5	3.00	0.71
EB	4	1.00	0.71	1	25.00	3	1.00	0.71
JHS	2	4.00	0.00	2	100.00	4	4.50	0.50
JMG	2	1.00	1.00	0	0	2	1.00	1.00
LSM	3	1.00	0.58	0	0	2	1.67	0.88
MJ	1	2.00	n/a	0	0	2	2.00	n/a
Northern	**20**	**1.75**	**0.38**	**5**	**25.00**	**6**	**2.15**	**0.45**
CLP	5	1.20	0.49	1	20.00	3	1.20	0.49
IMC	9	1.44	0.47	2	22.22	4	1.89	0.51
RPC	6	2.67	0.95	2	33.33	6	3.33	1.15
Anglian Region	**60**	**1.75**	**0.22**	**15**	**25.00**	**8**	**2.22**	**0.24**

Table 5 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Anglian Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Central	**20**	**7.45**	**25.00**	**46**	**1.20**	**20.00**	**8**
EIS	6	8.83	33.33	25	1.17	33.33	3
LJS	7	4.14	14.29	15	0.71	0	2
SEH	6	3.50	16.67	15	0.67	16.67	3
WTC	1	46.00	100.00	46	8.00	100.00	8
Eastern	**20**	**9.40**	**25.00**	**25**	**1.70**	**30.00**	**5**
CFW	4	11.75	50.00	23	1.75	25.00	3
CSA	4	12.25	25.00	21	2.75	50.00	5
EB	4	4.75	25.00	16	1.00	25.00	3
JHS	2	18.00	50.00	25	3.50	100.00	4
JMG	2	5.00	0	10	1.00	0	2
LSM	3	6.00	0	13	0.33	0	1
MJ	1	9.00	0	9	2.00	0	2
Northern	**20**	**8.55**	**30.00**	**28**	**1.40**	**25.00**	**5**
CLP	5	6.80	20.00	18	1.20	20.00	3
IMC	9	7.78	33.33	28	1.11	22.22	3
RPC	6	11.17	33.33	27	2.00	33.33	5
Anglian Region	**60**	**8.47**	**26.67**	**46**	**1.43**	**25.00**	**8**

Table 6 The families missed by Anglian Region's primary analysts

Family	n	% of Anglian Region's missed families in Primary Audit
Hydroptilidae	10	10.53
Caenidae	7	7.37
Planariidae (incl. Dugesiidae)	6	6.32
Leptoceridae	5	5.26
Psychomyiidae (incl. Ecnomidae)	4	4.21
Planorbidae	4	4.21
Lymnaeidae	4	4.21
Elmidae	4	4.21
Hydrobiidae (incl. Bithyniidae)	3	3.16
Ancylidae (incl. Acroloxidae)	3	3.16
Scirtidae	3	3.16
Polycentropodidae	2	2.11
Dytiscidae (incl. Noteridae)	2	2.11
Libellulidae	2	2.11
Leptophlebiidae	2	2.11
Coenagrionidae	2	2.11
Corixidae	2	2.11
Baetidae	2	2.11
Simuliidae	2	2.11
Haliplidae	2	2.11
Tipulidae	2	2.11
Goeridae	2	2.11
Glossiphoniidae	2	2.11
Erpobdellidae	2	2.11
Valvatidae	2	2.11
Asellidae	1	1.05
Unionidae	1	1.05
Piscicolidae	1	1.05
Gammaridae (incl. Crangonyctidae)	1	1.05
Sericostomatidae	1	1.05
Ephemeridae	1	1.05
Gyrinidae	1	1.05
Hydrophilidae (incl. Hydraenidae)	1	1.05
Hydropsychidae	1	1.05
Leuctridae	1	1.05
Limnephilidae	1	1.05
Chironomidae	1	1.05
Neritidae	1	1.05
Ephemerellidae	1	1.05
Total	**95**	**100**

Table 7 The species missed by Anglian Region's primary analysts

Species	n	% of Anglian Region's missed species in Primary Audit
Caenis luctuosa group	5	4.95
Ancylus fluviatilis Muller	3	2.97
Lype sp.	3	2.97
Polycelis nigra group	3	2.97
Hydroptila sp.	3	2.97
Oulimnius tuberculatus (Muller)	3	2.97
Athripsodes aterrimus (Stephens)	3	2.97
Elodes sp.	3	2.97
Potamopyrgus jenkinsi (Smith)	3	2.97
Habrophlebia fusca (Curtis)	2	1.98
Oxyethira sp.	2	1.98
Lymnaea stagnalis (L.)	2	1.98
Erpobdella octoculata (L.)	2	1.98
Glossiphonia complanata (L.)	2	1.98
Gyraulus albus (Muller)	2	1.98
Haliplus sp.	2	1.98
Micronecta sp.	2	1.98
Libellulidae indet	2	1.98
Lymnaea peregra (Muller)	2	1.98
Goera pilosa (Fabricius)	2	1.98
Agraylea multipunctata Curtis	2	1.98
Valvata cristata Muller	2	1.98
Caenis horaria (L.)	2	1.98
Simulium (Simulium) ornatum group	2	1.98
Orthotrichia sp.	1	0.99
Triaenodes bicolor (Curtis)	1	0.99
Tipula (Yamatotipula) montium group	1	0.99
Mystacides azurea (L.)	1	0.99
Mystacides nigra (L.)	1	0.99
Orectochilus villosus (Muller)	1	0.99
Piscicola geometra (L.)	1	0.99
Orthocladiinae	1	0.99
Planaria torva (Muller)	1	0.99
Theodoxus fluviatilis (L.)	1	0.99
Tanytarsini	1	0.99
Sericostoma personatum (Spence)	1	0.99
Potamonectes depressus (Fabricius)	1	0.99
Polycentropus flavomaculatus (Pictet)	1	0.99
Polycelis sp.	1	0.99
Tinodes waeneri (L.)	1	0.99

Table 7 continued

Species	n	% of Anglian Region's missed species in Primary Audit
Baetis rhodani (Pictet)	1	0.99
Potamonectes sp.	1	0.99
Lymnaea sp.	1	0.99
Agraylea sp.	1	0.99
Anisus vortex (L.)	1	0.99
Anodonta sp.	1	0.99
Antocha vitripennis (Meigen)	1	0.99
Armiger crista (L.)	1	0.99
Athripsodes cinereus (Curtis)	1	0.99
Bithynia tentaculata (L.)	1	0.99
Cloeon dipterum (L.)	1	0.99
Crangonyx pseudogracilis Bousfield	1	0.99
Cyrnus flavidus Mclachlan	1	0.99
Ithytrichia sp.	1	0.99
Limnephilidae indet	1	0.99
Leuctra geniculata (Stephens)	1	0.99
Asellus aquaticus (L.)	1	0.99
Laccobius (Macrolaccobius) bipunctatus (Fabricius)	1	0.99
Dugesia polychroa group	1	0.99
Ischnura elegans (Van der Linden)	1	0.99
Hydropsyche sp.	1	0.99
Hippeutis complanatus (L.)	1	0.99
Ephemerella ignita (Poda)	1	0.99
Ephemera sp.	1	0.99
Elmis aenea (Muller)	1	0.99
Enallagma cyathigerum (Charpentier)	1	0.99
Total	**101**	**100**

AUDIT OF MIDLANDS REGION'S PRIMARY ANALYSTS

Table 8 The 20 samples audited for Upper Severn Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Severn	Caersws	7	0	2	0
Moelfre Tributary	u/s Moelfre Hall	7	0	1	0
Teme	Leintwardine	7	1	1	0
MW Brook	Rockhouse Inn	7	0	0	0
Trannon	u/s Cilhaul	7	0	1	0
Stourbridge	Roman Road	8	0	0	0
Mantllymsyryn	d/s Farm	41	0	2	0
Mor Brook	Crosshouses	41	0	2	0
Perry	Wykey	45	0	2	1
Newnes Brook	A 495	45	0	1	0
Morda	A483	45	0	2	0
Lake Tributary	u/s Glog	45	0	0	0
Tern	Longdon	45	0	3	0
Salwarpe	Stoke Prior	45	0	1	0
Perry	Platt Bridge	45	0	5	0
Sundorne	Upper Astley	45	2	4	0
Caebitra Brook	Brompton	48	0	2	0
Hartlebury Brook	Titton Bridge	48	0	4	0
Shrawley Brook	B4196 Bridge	48	0	5	0
Blakedown Brook	Viaduct	48	0	2	1

Table 9 The 20 samples audited for Lower Severn Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Sherbourne	Charterhouse	11	0	0	0
Withy Brook	High Bridge	11	0	0	0
Painswick Stream	Stratford Park	11	0	1	3
Noleham Brook	Welford Pastures	11	0	2	0
Wymans Brook	d/s Pittville Lakes	11	0	3	0
Stockton Brook	u/s R.Stowe	12	0	1	0
Stowe	Browns Bridge	12	1	1	0
Alne	Wootton Wawen	12	1	2	0
Clifton Brook	Post House Hotel	12	0	1	0
Cinderford Brook	u/s Culvert	39	0	2	0
Pool Brook	Hanley Swan	39	0	0	0
Canley Brook	Kenilworth	39	0	0	0
Ban Brook	Salford Priors	39	0	0	0
Avon	Hampton Lucy	39	0	5	1
Cannop Brook	Newerne	39	0	3	0
Dene	d/s Kineton WRW	44	0	2	0
Bow Brook	Defford Bridge	44	1	2	1
Badsey Brook	Offenham	44	0	3	0
Dimore Brook	Elmore	44	0	0	1
Bushley Longdon Brook	Queenhill	45	0	0	0

Table 10 The 20 samples audited for Upper Trent Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Causeley Brook	Bucknall	3	0	0	0
Tame	Kingsbury	3	0	1	0
Sence	Ratcliffe Culey	3	2	2	0
Tame	Tipton	3	0	0	0
Bourne	u/s Shustoke Res	3	0	2	1
Fowlea Brook	Longbridge Hayes	3	0	0	0
Blythe	Cheswick Green	3	0	1	0
Moreton Brook	Confluence	8	0	2	0
Churnet	Middle Hulme	8	0	3	1
Anker	Atherstone	8	0	3	0
Saredon Brook	Great Wryley	8	0	2	0
Griffins Brook	Bourneville	8	0	0	0
Dove	Glutton Bridge	8	0	0	0
Fowlea Brook	Longbridge Hayes	42	0	2	0
Crane Brook	Ashcroft Farm	42	1	3	0
Cole	Houndsfield Lane	42	0	2	1
Blythe	Hampden in Arden	42	0	1	0
Temple Balsall Brook	B4101 Bridge	43	1	3	0
Didgerley Brook	Fillongley Lodge	43	0	2	0
Swarbourne	Yoxall	47	1	4	1

Table 11 The 20 samples audited for Lower Trent Area of Midlands Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Oakerthorpe Brook	Unspecified site	4	0	0	0
Alfreton Brook	Alfreton	4	0	4	0
Normanton Brook	d/s Newbold Verdon	4	0	2	0
Rainworth Water	Robin Dam Bridge	5	0	1	0
Wye	Wye Dale	5	0	2	0
Marton Drain	Torksey	5	0	2	0
Bailey Brook	Milnhay Road	5	0	1	0
Peakshole Water	d/s Peak Cavern	40	0	0	0
Lea Brook	Unspecified site	40	0	3	0
Bottle Brook	u/s Kilburn STW	40	0	2	0
Repton Brook	u/s Woodville	40	1	0	0
Whitwell Brook	A60	40	0	4	0
Papermill Dyke	Tickhill	40	0	4	0
Enderby (Huncote) Brook	u/s R. Soar	40	0	3	0
Carr Brook	Bottle Brook confluence	43	2	2	0
Gotham Brook	Glebe Farm	43	0	2	0
Eau	Scotter	44	1	4	1
Waterton Drain	Trent confluence	44	0	1	0
Burton Brook	Burton Lazars	44	0	5	1
Gallow Hole Dyke	Rufford Park	46	0	1	0

Table 12 Statistics of the 1998 Primary Audit for Midlands Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Upper Severn	**20**	**2.00**	**0.34**	**5**	**25.00**	**5**	**2.25**	**0.38**
7	5	1.00	0.32	0	0	2	1.20	0.37
8	1	0	n/a	0	0	0	0	n/a
41	2	2.00	0	0	0	2	2.00	0
45	8	2.25	0.59	3	37.50	5	2.63	0.73
48	4	3.25	0.75	2	50.00	5	3.50	0.65
Lower Severn	**20**	**1.40**	**0.31**	**4**	**20.00**	**5**	**1.85**	**0.38**
11	5	1.20	0.58	1	20.00	3	1.80	0.80
12	4	1.25	0.25			2	1.75	0.48
39	6	1.67	0.84	2	33.33	5	1.83	0.98
44	4	1.75	0.63	1	25.00	3	2.50	0.65
45	1	0	n/a	0	0	0	0	n/a
Upper Trent	**20**	**1.65**	**0.27**	**5**	**25.00**	**4**	**2.10**	**0.39**
3	7	0.86	0.34	0	0	2	1.29	0.61
8	6	1.67	0.56	2	33.33	3	1.83	0.65
42	4	2.00	0.41	1	25.00	3	2.50	0.65
43	2	2.50	0.50	1	50.00	3	3.00	1.00
47	1	4.00	n/a	1	100.00	4	6.00	n/a
Lower Trent	**20**	**2.15**	**0.33**	**7**	**35.00**	**5**	**2.45**	**0.39**
4	3	2.00	1.15	1	33.33	4	2.00	1.15
5	4	1.50	0.29	0	0	2	1.50	0.29
40	7	2.29	0.64	4	57.14	4	2.43	0.57
43	2	2.00	0	0	0	2	3.00	1.00
44	3	3.33	1.20	2	66.67	5	4.33	1.67
46	1	1.00	n/a	0	0	1	1.00	n/a
Midlands Region	**80**	**1.80**	**0.16**	**21**	**26.25**	**5**	**2.16**	**0.19**

Table 13 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Midlands Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Upper Severn	**20**	**10.65**	**25.00**	**35**	**1.85**	**20.00**	**5**
7	5	5.40	0	12	0.80	0	2
8	1	0	0	0	0	0	0
41	2	10.50	0	11	2.00	0	2
45	8	11.00	37.50	23	2.00	25.00	5
48	4	19.25	50.00	35	3.25	50.00	5
Lower Severn	**20**	**6.55**	**15.00**	**19**	**1.25**	**20.00**	**5**
11	5	8.00	20.00	17	1.20	20.00	3
12	4	4.00	0	9	0.75	0	1
39	6	8.17	33.33	19	1.67	33.33	5
44	4	6.50	0	12	1.50	25.00	3
45	1	0	0	0	0	0	0
Upper Trent	**20**	**6.95**	**15.00**	**23**	**1.40**	**15.00**	**3**
3	7	2.29	0	10	0.57	0	2
8	6	9.50	33.33	21	1.67	33.33	3
42	4	6.75	0	12	1.75	0	2
43	2	8.00	0	10	2.00	0	2
47	1	23.00	100.00	23	3.00	100.00	3
Lower Trent	**20**	**9.65**	**30.00**	**25**	**1.95**	**35.00**	**5**
4	3	9.00	33.33	21	2.00	33.33	4
5	4	8.25	25.00	17	1.50	0	2
40	7	12.00	42.86	25	2.14	57.14	4
43	2	4.00	0	13	1.00	0	2
44	3	12.67	33.33	21	3.00	66.67	5
46	1	3.00	0	3	1.00	0	1
Midlands Region	**80**	**8.45**	**21.25**	**35**	**1.61**	**22.50**	**5**

Table 14 The families missed by Midland Region's primary analysts

Family	n	% of Midlands Region's missed families in Primary Audit
Planariidae (incl. Dugesiidae)	12	8.76
Caenidae	9	6.57
Hydrobiidae (incl. Bithyniidae)	8	5.84
Planorbidae	7	5.11
Glossiphoniidae	7	5.11
Elmidae	7	5.11
Haliplidae	6	4.38
Baetidae	6	4.38
Nemouridae	5	3.65
Sphaeriidae	5	3.65
Gammaridae (incl. Crangonyctidae)	4	2.92
Dytiscidae (incl. Noteridae)	4	2.92
Lymnaeidae	4	2.92
Tipulidae	4	2.92
Hydroptilidae	4	2.92
Limnephilidae	4	2.92
Hydropsychidae	4	2.92
Psychomyiidae (incl. Ecnomidae)	3	2.19
Simuliidae	3	2.19
Leptoceridae	3	2.19
Ancylidae (incl. Acroloxidae)	3	2.19
Goeridae	3	2.19
Asellidae	3	2.19
Sericostomatidae	2	1.46
Hydrophilidae (incl. Hydraenidae)	2	1.46
Oligochaeta	2	1.46
Chloroperlidae	2	1.46
Polycentropodidae	2	1.46
Taeniopterygidae	1	0.73
Coenagrionidae	1	0.73
Gyrinidae	1	0.73
Erpobdellidae	1	0.73
Gerridae	1	0.73
Physidae	1	0.73
Notonectidae	1	0.73
Leptophlebiidae	1	0.73
Rhyacophilidae (incl. Glossosomatidae)	1	0.73
Total	**137**	**100**

Table 15 The species missed by Midlands Region's primary analysts

Species	n	% of Midlands Region's missed species in Primary Audit
Potamopyrgus jenkinsi (Smith)	8	5.63
Polycelis nigra group	7	4.93
Caenis luctuosa group	6	4.23
Pisidium sp.	5	3.52
Baetis rhodani (Pictet)	5	3.52
Elmis aenea (Muller)	4	2.82
Lymnaea peregra (Muller)	4	2.82
Glossiphonia complanata (L.)	4	2.82
Haliplus sp.	4	2.82
Hydroptila sp.	4	2.82
Gammarus pulex (L.)	3	2.11
Helobdella stagnalis (L.)	3	2.11
Polycelis felina (Dalyell)	3	2.11
Armiger crista (L.)	3	2.11
Asellus aquaticus (L.)	3	2.11
Caenis horaria (L.)	3	2.11
Hydropsyche sp.	2	1.41
Plectrocnemia conspersa (Curtis)	2	1.41
Nemurella picteti Klapalek	2	1.41
Hydraena gracilis Germar	2	1.41
Nemoura avicularis Morton	2	1.41
Ancylus fluviatilis Muller	2	1.41
Gyraulus albus (Muller)	2	1.41
Polycelis sp.	2	1.41
Potamonectes depressus (Fabricius)	2	1.41
Sericostoma personatum (Spence)	2	1.41
Oulimnius tuberculatus (Muller)	2	1.41
Silo pallipes (Fabricius)	2	1.41
Brychius elevatus (Panzer)	2	1.41
Chloroperla torrentium (Pictet)	2	1.41
Platambus maculatus (L.)	1	0.70
Oreodytes sanmarkii (Sahlberg)	1	0.70
Oulimnius sp.	1	0.70
Orectochilus villosus (Muller)	1	0.70
Physa acuta group	1	0.70
Paraleptophlebia submarginata (Stephens)	1	0.70
Tinodes waeneri (L.)	1	0.70
Rhyacophila dorsalis (Curtis)	1	0.70
Simulium (Eusimulium) aureum group	1	0.70
Simulium (Simulium) noelleri Friederichs	1	0.70

Table 15 continued

Species	n	% of Midlands Region's missed species in Primary Audit
Simulium (Simulium) ornatum group	1	0.70
Tinodes rostocki Mclachlan	1	0.70
Tipula (Yamatotipula) montium group	1	0.70
Tipula sp.	1	0.70
Triaenodes bicolor (Curtis)	1	0.70
Tubificidae	1	0.70
Theromyzon tessulatum (Muller)	1	0.70
Baetis vernus Curtis	1	0.70
Notonecta sp.	1	0.70
Lype sp.	1	0.70
Adicella reducta (Mclachlan)	1	0.70
Anabolia nervosa (Curtis)	1	0.70
Athripsodes cinereus (Curtis)	1	0.70
Bathyomphalus contortus (L.)	1	0.70
Brachyptera risi (Morton)	1	0.70
Caenis rivulorum Eaton	1	0.70
Cloeon dipterum (L.)	1	0.70
Dicranota sp.	1	0.70
Dugesia polychroa group	1	0.70
Erpobdella octoculata (L.)	1	0.70
Gammarus sp.	1	0.70
Limnius volckmari (Panzer)	1	0.70
Anisus vortex (L.)	1	0.70
Gerris sp.	1	0.70
Acroloxus lacustris (L.)	1	0.70
Nemoura cinerea (Retzius)	1	0.70
Lumbriculidae	1	0.70
Limnephilus sp.	1	0.70
Limnephilidae indet	1	0.70
Ischnura elegans (Van der Linden)	1	0.70
Hydropsyche siltalai Dohler	1	0.70
Hydropsyche pellucidula (Curtis)	1	0.70
Helius sp.	1	0.70
Goera pilosa (Fabricius)	1	0.70
Glyphotaelius pellucidus (Retzius)	1	0.70
Total	**142**	**100**

AUDIT OF NORTH EAST REGION'S PRIMARY ANALYSTS

Table 16 The 20 samples audited for Dales Area of North East Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Ouse	d/s A64 Bridge (Airlift)	CJ	0	1	0
Wharfe	Grassington	CJ	0	3	0
Wharfe	Kettlewell	CJ	0	0	0
Ure	West Tanfield	CJ	0	0	0
Ouse	d/s Nidd Mouth (Airlift)	CJ	0	1	0
Ouse	d/s Nidd Mouth (Sweep)	CJ	0	1	0
Wharfe	Otley (28.7.98)	JMG	0	0	0
Ure	Aldwark Toll Bridge (12.8.98)	JMG	0	0	0
Wharfe	Otley (30.9.98)	JMG	0	0	0
Wharfe	Boston Spa	JR	0	4	0
Ure	Aldwark Toll Bridge (5.5.98)	JR	1	3	0
Ouse	d/s Moor Monkton (Sweep)	JR	0	7	0
Ouse	Beningborough Hall (Sweep)	JR	0	4	0
Ouse	d/s Moor Monkton (Airlift)	JR	0	4	0
Ouse	Nether Poppleton (Airlift)	JR	0	5	0
Ure	Boroughbridge (12.8.98)	SJL	0	1	0
Ure	d/s Kilgram Bridge	SJL	0	0	0
Ure	Boroughbridge (30.11.98)	SJL	0	1	0
Ure	Hawes	SW	0	1	0
Ouse	Acaster Malbis	SW	0	1	0

Table 17 The 20 samples audited for Northumbria Area of North East Region

River	Site	Primary Analyst	Losses	Gains	Omissions
East Howle Beck	u/s Poachers Pocket CSO	FC	0	1	0
Browney	A167 Bridge	FC	0	0	0
Wear	Witton-Le-Wear	FC	0	1	1
Smallhope Burn	d/s Lanchester STW	FC	0	1	0
Valley Burn	d/s Tudhoe Mill STW	FC	0	0	0
Swinhope Burn	Swinhope	FC	1	0	0
Moors Burn	u/s Sedgeletch STW	FC	0	0	0
Wear	u/s Vinovium	FC	1	4	0
Gaunless	South Church	FC	0	1	0
Brierdene Burn	Whitley Bay	JL	0	1	0
Till	Doddington Bridge	JL	0	1	0
Blyth	Bellasis Bridge	JL	1	2	0
Aln	Bridge of Aln	JL	0	3	0
Wansbeck	Bothal Steps	JL	0	0	0
Lewis Burn	u/s Visitor Centre	VW	0	2	0
South Tyne	Warden	VW	0	1	0
Don	Jarrow Cemetery	VW	0	1	0
Derwent	Clockburn	VW	0	3	0
South Tyne	Alston	VW	0	2	0
East Allen	The Haining	VW	0	2	0

Table 18 The 20 samples audited for Ridings Area of North East Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Hebble Brook	d/s Jumples	BM	0	1	2
Winestead Drain	Patrington Haven	EWS	1	3	0
West Beck	Wansford Bridge	EWS	0	1	0
Rons Cliff Dike	d/s Gunthwaite Bridge	JB	1	6	1
County Dike	d/s Woodall Beck	JB	0	2	0
Hebden Water	u/s Calder	LA	0	2	0
Hebden Water	u/s Crimsworth Dean Beck	LA	0	1	0
Dearne	u/s Clayton West	LBS	0	1	0
Colne	Colne Bridge	LBS	0	0	0
Hipper	Bobbin Mill Lane	LBS	1	1	0
Aire	Beal (Airlift)	LBS	0	0	0
Don	Oxspring Bridge	MR	0	0	0
Don	d/s Blackburn Meadows	RM	0	0	0
Alcomden Water	d/s Walshaw Dean Reservoirs	RM	0	2	0
Meanwood Beck	d/s CSO	RM	0	0	0
Don	u/s Morehall	RM	0	2	0
Hebden Water	Hebden Stream Gauge	RM	0	1	0
Ramsden Clough	d/s Brownhill Reservoir	RT	0	0	0
Ryeburn	Ripponden	RT	0	0	0
Hull	Sutton Road Bridge	RT	0	0	0

Table 19 Statistics of the 1998 Primary Audit for North East Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Dales	**20**	**1.85**	**0.45**	**7**	**35.00**	**7**	**1.90**	**0.46**
CJ	6	1.00	0.45	1	16.67	3	1.00	0.45
JMG	3	0	0	0	0	0	0	0
JR	6	4.50	0.56	6	100.00	7	4.67	0.49
SJL	2	0.50	0.50	0	0	1	0.50	0.50
SL	1	1.00	n/a	0	0	1	1.00	n/a
SW	2	1.00	0	0	0	1	1.00	0
Northumbria	**20**	**1.30**	**0.25**	**3**	**15.00**	**4**	**1.50**	**0.29**
FC	9	0.89	0.42	1	11.11	4	1.22	0.52
JL	5	1.40	0.51	1	20.00	3	1.60	0.60
VW	6	1.83	0.31	1	16.67	3	1.83	0.31
Ridings	**20**	**1.15**	**0.33**	**2**	**10.00**	**6**	**1.45**	**0.43**
BM	1	1.00	n/a	0	0	1	3.00	n/a
EWS	2	2.00	1.00	1	50.00	3	2.50	1.50
JB	2	4.00	2.00	1	50.00	6	5.00	3.00
LA	2	1.50	0.50	0	0	2	1.50	0.50
LBS	4	0.50	0.29	0	0	1	0.75	0.48
MR	1	0	n/a	0	0	0	0	n/a
RM	5	1.00	0.45	0	0	2	1.00	0.45
RT	3	0	0	0	0	0	0	0
North East Region	**60**	**1.43**	**0.20**	**12**	**20.00**	**7**	**1.62**	**0.23**

Table 20 Net effects of the Primary Audit on BMWP score and number of scoring taxa for North East Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Dales	**20**	**11.15**	**30.00**	**39**	**1.80**	**30.00**	**7**
CJ	6	8.67	16.67	26	1.00	16.67	3
JMG	3	0	0	0	0	0	0
JR	6	25.17	83.33	39	4.33	83.33	7
SJL	2	3.00	0	6	0.50	0	1
SL	1	3.00	0	3	1.00	0	1
SW	2	5.50	0	6	1.00	0	1
Northumbria	**20**	**7.45**	**25.00**	**27**	**1.15**	**15.00**	**3**
FC	9	4.67	11.11	27	0.67	11.11	3
JL	5	8.20	20.00	23	1.20	20.00	3
VW	6	11.00	50.00	18	1.83	16.67	3
Ridings	**20**	**6.40**	**10.00**	**42**	**1.00**	**5.00**	**5**
BM	1	4.00	0	4	1.00	0	1
EWS	2	7.00	0	9	1.50	0	2
JB	2	26.50	50.00	42	3.50	50.00	5
LA	2	10.50	0	11	1.50	0	2
LBS	4	2.75	0	7	0.25	0	1
MR	1	0	0	0	0	0	0
RM	5	5.00	20.00	15	1.00	0	2
RT	3	0	0	0	0	0	0
North East Region	**60**	**8.33**	**21.67**	**42**	**1.32**	**16.67**	**7**

Table 21 The families missed by North East Region's primary analysts

Family	n	% of North East Region's missed families in Primary Audit
Limnephilidae	6	7.89
Hydroptilidae	6	7.89
Leptoceridae	4	5.26
Lepidostomatidae	4	5.26
Elmidae	4	5.26
Caenidae	3	3.95
Sphaeriidae	3	3.95
Calopterygidae	3	3.95
Nemouridae	2	2.63
Planariidae (incl. Dugesiidae)	2	2.63
Planorbidae	2	2.63
Valvatidae	2	2.63
Chironomidae	2	2.63
Polycentropodidae	2	2.63
Chloroperlidae	2	2.63
Psychomyiidae (incl. Ecnomidae)	2	2.63
Gyrinidae	2	2.63
Gammaridae (incl. Crangonyctidae)	2	2.63
Ephemerellidae	2	2.63
Dytiscidae (incl. Noteridae)	2	2.63
Simuliidae	2	2.63
Hydropsychidae	2	2.63
Sericostomatidae	1	1.32
Asellidae	1	1.32
Perlidae	1	1.32
Piscicolidae	1	1.32
Goeridae	1	1.32
Oligochaeta	1	1.32
Beraeidae	1	1.32
Baetidae	1	1.32
Dendrocoelidae	1	1.32
Hydrobiidae (incl. Bithyniidae)	1	1.32
Hydrophilidae (incl. Hydraenidae)	1	1.32
Leptophlebiidae	1	1.32
Leuctridae	1	1.32
Lymnaeidae	1	1.32
Neritidae	1	1.32
Total	**76**	**100**

Table 22 The species missed by North East Region's primary analysts

Species	n	% of North East Region's missed species in Primary Audit
Hydroptila sp.	4	4.94
Caenis rivulorum Eaton	3	3.70
Calopteryx splendens (Harris)	3	3.70
Lepidostoma hirtum (Fabricius)	3	3.70
Chloroperla tripunctata (Scopoli)	2	2.47
Hydropsyche siltalai Dohler	2	2.47
Oulimnius sp.	2	2.47
Ithytrichia sp.	2	2.47
Limnephilus lunatus Curtis	2	2.47
Gyraulus albus (Muller)	2	2.47
Elmis aenea (Muller)	2	2.47
Ephemerella ignita (Poda)	2	2.47
Athripsodes sp.	2	2.47
Pisidium sp.	2	2.47
Piscicola geometra (L.)	1	1.23
Oreodytes sanmarkii (Sahlberg)	1	1.23
Orectochilus villosus (Muller)	1	1.23
Nemoura avicularis Morton	1	1.23
Naididae	1	1.23
Mystacides azurea (L.)	1	1.23
Nemoura cambrica group	1	1.23
Sericostoma personatum (Spence)	1	1.23
Valvata piscinalis (Muller)	1	1.23
Valvata cristata Muller	1	1.23
Theodoxus fluviatilis (L.)	1	1.23
Sphaeriidae indet	1	1.23
Simulium sp.	1	1.23
Simulium (Simulium) ornatum group	1	1.23
Silo sp.	1	1.23
Polycelis felina (Dalyell)	1	1.23
Psychomyia pusilla (Fabricius)	1	1.23
Prodiamesinae	1	1.23
Potamopyrgus jenkinsi (Smith)	1	1.23
Potamophylax cingulatus/latipennis	1	1.23
Potamonectes depressus (Fabricius)	1	1.23
Polycentropus flavomaculatus (Pictet)	1	1.23
Lype sp.	1	1.23
Caenis luctuosa (Burmeister)	1	1.23
Agabus sp.	1	1.23
Asellus meridianus Racovitza	1	1.23

Table 22 continued

Species	n	% of North East Region's missed species in Primary Audit
Athripsodes albifrons (L.)	1	1.23
Habrophlebia fusca (Curtis)	1	1.23
Beraea maurus (Curtis)	1	1.23
Lymnaea peregra (Muller)	1	1.23
Ceraclea nigronervosa (Retzius)	1	1.23
Chironomidae indet	1	1.23
Crangonyx pseudogracilis Bousfield	1	1.23
Crenobia alpina (Dana)	1	1.23
Cyrnus flavidus Mclachlan	1	1.23
Leuctra fusca (L.)	1	1.23
Baetis vernus Curtis	1	1.23
Dendrocoelum lacteum (Muller)	1	1.23
Limnephilidae indet	1	1.23
Lepidostomatidae indet	1	1.23
Hydraena gracilis Germar	1	1.23
Halesus radiatus (Curtis)	1	1.23
Gyrinidae indet	1	1.23
Gammarus pulex (L.)	1	1.23
Dugesia polychroa group	1	1.23
Drusus annulatus (Stephens)	1	1.23
Dinocras cephalotes (Curtis)	1	1.23
Lumbriculidae	1	1.23
Total	**81**	**100**

AUDIT OF NORTH WEST REGION'S PRIMARY ANALYSTS

Table 23 The 20 samples audited for Central Area of North West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Barden Clough	ptc R.Calder	AM	0	2	0
Wyre	Cam Brook	AM	0	2	0
Crossens	Tarleton Runner (11.5.98)	AM	0	2	0
Blundel Brook	Broughton	AM	1	0	0
Conder	Old Galgate Bridge	AM	0	0	0
Eller Brook	Burscough Bridge	BL	0	0	0
Hyndburn	Tinker Brook	EIG	1	4	0
Pendle Water	u/s Barden Lane	EIG	0	2	0
Duddle Brook	ptc R.Ribble	EIG	1	3	0
Pendle	R.Laneshaw	EIG	0	5	0
Crossens	Tarleton Runner (11.11.98)	EIG	0	1	0
Hillylaid Pool	d/s Royles Brook	FD	1	1	0
Downholland Brook	Downholland Brook	HFH	1	1	0
Ribble	Brockholes Bridge	HFH	0	2	0
Liggard Brook	u/s Liggard Road Bridge	HFH	1	0	0
Lune	Clapham Beck	HFH	0	0	1
Darwen	Hole Brook	HFH	0	1	0
Tun Brook	ptc R.Ribble	HFH	0	0	0
Wycoller Beck	ptc R.Laneshaw	HFH	0	2	0
Calder	Townley Park	KCH	0	3	0

Table 24 The 12 samples audited for Northern Area of North West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Dubwath Beck	NX 198 312	AJ	2	0	0
Mosedale Beck	Wallthwaite	AJ	0	1	0
Briggle Beck	u/s TBM outfall pipe	AJ	0	1	0
Sepulchre Beck	d/s Janet Bridge	DS	4	3	0
Lund Beck	d/s Ulverston SSO	KMF	0	2	0
Levy Beck	u/s Ulverston SSO	KMF	0	2	0
Kent	u/s Barley Bridge	KMF	0	2	0
Winster	Lindeth Road	KMF	0	1	0
Newland Beck	A590 Bridge	KMF	0	1	0
Tarn Beck	Tongue House	NTC	0	0	0
Poaka Beck	u/s WTP discharge	NTC	0	2	0
Irt	Forest Bridge	NTC	0	1	0

Table 25 The 20 samples audited for Southern Area of North West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Cotterill Clough	ptc Bollin	AG	1	0	0
Birket	ptc The Fender	AG	1	1	0
Bollin	ptc R. Dean	AT	1	2	1
Irwell	Limelight	DGH	1	1	0
The Fender	ptc Birket	FD	0	1	3
Black Brook	ptc R. Goyt	GD	0	3	0
Irwell	u/s Bury ETW	GM	0	2	0
Mersey	ptc Padgate Brook	JEB	0	0	0
Sinderland Brook	u/s Altringham ETW	KA	1	0	0
Stewards Brook	Ditton Road	KA	0	0	0
Ditton Brook	Ditton	KA	0	2	0
Bollin	u/s Railway Bridge	KA	0	3	0
Gowy	Stanney	LCB	0	0	0
Wilson Brook	ptc Randal Brook	MW	0	1	0
Goyt	ptc R. Etherow	MW	0	4	1
Un-Named Watercourse	d/d Biddulph Park ETW	MW	0	6	0
Salters Brook	u/s Ashton Brook	RM	0	2	2
Harrop Brook	ptc Dean	RM	1	0	0
Borsdane Brook	u/s A58 Bridge	RM	1	2	0
Weaver	Old Hoolgrave Farm	RM	0	1	0

Table 26 Statistics of the 1998 Primary Audit for North West Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Central	**20**	**1.55**	**0.32**	**4**	**20.00**	**5**	**1.90**	**0.32**
AM	5	1.20	0.49	0	0	2	1.40	0.40
BL	1	0	n/a	0	0	0	0	n/a
EIG	5	3.00	0.71	3	60.00	5	3.40	0.81
FD	1	1.00	n/a	0	0	1	2.00	n/a
HFH	7	0.86	0.34	0	0	2	1.29	0.29
KCH	1	3.00	n/a	1	100.00	3	3.00	n/a
Northern	**12**	**1.33**	**0.26**	**1**	**8.33**	**3**	**1.83**	**0.51**
AJ	3	0.67	0.33	0	0	1	1.33	0.33
DS	1	3.00	n/a	1	100.00	3	7.00	n/a
KMF	5	1.60	0.24	0	0	2	1.60	0.24
NTC	3	1.00	0.58	0	0	2	1.00	0.58
Southern	**20**	**1.55**	**0.35**	**4**	**20.00**	**6**	**2.25**	**0.38**
AG	2	0.50	0.50	0	0	1	1.50	0.50
AT	1	2.00	n/a	0	0	2	4.00	n/a
DGH	1	1.00	n/a	0	0	1	2.00	n/a
FD	1	1.00	n/a	0	0	1	4.00	n/a
GD	1	3.00	n/a	1	100.00	3	3.00	n/a
GM	1	2.00	n/a	0	0	2	2.00	n/a
JEB	1	0	n/a	0	0	0	0	n/a
KA	4	1.25	0.75	1	25.00	3	1.50	0.65
LCB	1	0	n/a	0	0	0	0	n/a
MW	3	3.67	1.45	2	66.67	6	4.00	1.53
RM	4	1.25	0.48	0	0	2	2.25	0.75
North West Region	**52**	**1.50**	**0.19**	**9**	**17.31**	**6**	**2.02**	**0.22**

Table 27 Net effects of the Primary Audit on BMWP score and number of scoring taxa for North West Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Central	**20**	**6.95**	**20.00**	**35**	**1.25**	**15.00**	**5**
AM	5	3.40	0	8	1.00	0	2
BL	1	0	0	0	0	0	0
EIG	5	15.60	40.00	35	2.60	40.00	5
FD	1	0	0	0	0	0	0
HFH	7	3.29	14.29	16	0.57	0	2
KCH	1	21.00	100.00	21	3.00	100.00	3
Northern	**12**	**5.25**	**16.67**	**20**	**0.83**	0	**2**
AJ	3	1.00	0	10	0.00	0	1
DS	1	-12.00	0	-12	-1.00	0	-1
KMF	5	9.80	20.00	20	1.60	0	2
NTC	3	7.67	33.33	16	1.00	0	2
Southern	**20**	**5.75**	**15.00**	**31**	**1.20**	**20.00**	**6**
AG	2	-2.50	0	-2	-0.50	0	0
AT	1	1.00	0	1	1.00	0	1
DGH	1	0	0	0	0	0	0
FD	1	3.00	0	3	1.00	0	1
GD	1	11.00	0	11	3.00	100.00	3
GM	1	12.00	0	12	2.00	0	2
JEB	1	0	0	0	0	0	0
KA	4	6.00	25.00	17	1.00	25.00	3
LCB	1	0	0	0	0	0	0
MW	3	20.67	66.67	31	3.67	66.67	6
RM	4	1.75	0	7	0.75	0	2
North West Region	**52**	**6.10**	**17.31**	**35**	**1.13**	**13.46**	**6**

Table 28 The families missed by North West Region's primary analysts

Family	n	% of North West Region's missed families in Primary Audit
Sphaeriidae	9	13.04
Lymnaeidae	5	7.25
Hydrobiidae (incl. Bithyniidae)	5	7.25
Limnephilidae	4	5.80
Baetidae	4	5.80
Psychomyiidae (incl. Ecnomidae)	3	4.35
Nemouridae	3	4.35
Planariidae (incl. Dugesiidae)	3	4.35
Tipulidae	2	2.90
Leptoceridae	2	2.90
Hydrophilidae (incl. Hydraenidae)	2	2.90
Physidae	2	2.90
Planorbidae	2	2.90
Hydroptilidae	2	2.90
Simuliidae	2	2.90
Taeniopterygidae	2	2.90
Asellidae	2	2.90
Ancylidae (incl. Acroloxidae)	2	2.90
Caenidae	2	2.90
Leptophlebiidae	1	1.45
Polycentropodidae	1	1.45
Hydropsychidae	1	1.45
Gammaridae (incl. Crangonyctidae)	1	1.45
Erpobdellidae	1	1.45
Dendrocoelidae	1	1.45
Glossiphoniidae	1	1.45
Chloroperlidae	1	1.45
Beraeidae	1	1.45
Sericostomatidae	1	1.45
Elmidae	1	1.45
Total	**69**	**100**

Table 29 The species missed by North West Region's primary analysts

Species	n	% of North West Region's missed species in Primary Audit
Pisidium sp.	8	10.67
Potamopyrgus jenkinsi (Smith)	5	6.67
Baetis rhodani (Pictet)	3	4.00
Lymnaea sp.	2	2.67
Lymnaea truncatula (Muller)	2	2.67
Limnephilidae indet	2	2.67
Hydroptila sp.	2	2.67
Hydraena gracilis Germar	2	2.67
Caenis rivulorum Eaton	2	2.67
Brachyptera risi (Morton)	2	2.67
Baetis vernus Curtis	2	2.67
Ancylus fluviatilis Muller	2	2.67
Asellus aquaticus (L.)	2	2.67
Simulium (Simulium) ornatum group	2	2.67
Tinodes waeneri (L.)	2	2.67
Gammarus pulex (L.)	1	1.33
Erpobdella octoculata (L.)	1	1.33
Elmis aenea (Muller)	1	1.33
Dicranota sp.	1	1.33
Dendrocoelum lacteum (Muller)	1	1.33
Crangonyx pseudogracilis Bousfield	1	1.33
Glossiphonia heteroclita (L.)	1	1.33
Simulium (Nevermannia) cryophilum group	1	1.33
Beraea maurus (Curtis)	1	1.33
Sphaeriidae indet	1	1.33
Athripsodes cinereus (Curtis)	1	1.33
Armiger crista (L.)	1	1.33
Tipula sp.	1	1.33
Amphinemura sulcicollis (Stephens)	1	1.33
Planaria torva (Muller)	1	1.33
Chloroperla torrentium (Pictet)	1	1.33
Nephrotoma sp.	1	1.33
Tinodes unicolor (Pictet)	1	1.33
Gyraulus albus (Muller)	1	1.33
Planariidae indet	1	1.33
Physa sp.	1	1.33
Paraleptophlebia submarginata (Stephens)	1	1.33
Nemurella picteti Klapalek	1	1.33
Nemoura cambrica group	1	1.33
Mystacides azurea (L.)	1	1.33

Table 29 continued

Species	n	% of North West Region's missed species in Primary Audit
Sericostoma personatum (Spence)	1	1.33
Physa acuta group	1	1.33
Helobdella stagnalis (L.)	1	1.33
Micropterna sp.	1	1.33
Hydropsyche siltalai Dohler	1	1.33
Potamophylax cingulatus/latipennis	1	1.33
Polycelis nigra group	1	1.33
Polycelis felina (Dalyell)	1	1.33
Lymnaea peregra (Muller)	1	1.33
Plectrocnemia conspersa (Curtis)	1	1.33
Total	**75**	**100**

AUDIT OF SOUTHERN REGION'S PRIMARY ANALYSTS

Table 30 The 23 samples audited for the Hants & Isle of Wight Area of Southern Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Shirley Pond	West Margin	W13	1	1	0
Test	Lynch	W13	3	2	0
Crofton Stream	Crofton Dairy Farm	W13	0	0	0
Mopley Pond Stream	Stanswood	W23	0	0	0
Caulbourne	Shalfleet	W23	0	0	0
Dever Drainage Ditch	d/s Confluence Ditch 1 & 2	W29	0	0	0
Lymington	Boldre Bridge	W30	0	1	0
Warblington Stream No 2	Church Path	W32	0	2	0
Hatchet Stream	St Leonards	W32	1	2	0
Avonwater	Wooton	W32	0	0	0
Meon	u/s Routine	W32	1	1	1
Bourne Rivulet	d/s SMB CF	W32	0	1	0
Effluent Channel	d/s The Nythe CF	W34	1	4	0
Titchfield Stream	Road Bridge	W34	0	2	0
Hoeford Lake	B3385 Bridge	W34	0	0	0
Itchen	Gaters Mill	W34	1	3	2
Walhampton Stream	Lisle Court Road	W34	0	0	1
Royal Military Canal	Hythe	W34	1	1	3

The following samples were live-sorted (non-standard methodology for the laboratory) and are not included in the statistical analyses in Tables 33 and 34.

Casbrook Stream	Control u/s Landfill	W9	0	1	0
Hamble Tributary	Site 3 d/s discharge	W13	0	1	0
Danes Stream Trib	u/s Downton Manor Farm Ditch	W29	1	4	5
Itchen Tributary	Roddington Forge	W32	0	1	0
Casbrook Common Stream	d/s Bunny Lane Bridge	W32	0	1	0

Table 31 The 20 samples audited for the Kent Area of Southern Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Great Stour	Longport Bridge	E1	0	2	0
Great Stour	Bucksford	E1	0	1	0
Great Stour	Horton	E1	0	0	0
Wateringbury Stream	Wateringbury	E2	2	0	0
Hammer Stream	Iborden Park	E2	1	1	0
Medway	Bramble Tye Bridge	E6	1	2	0
Great Stour	Shalmsford Street	E6	0	3	0
Rother	Witherenden Bridge	E19	0	2	0
Bartley Mill Stream	Win Bridge	E19	1	3	0
Wateringbury Stream	Pizien Well Road	E28	0	0	0
Grom	Burrswood	E28	0	0	0
Gibbs Brook	Brook Farm	E31	0	1	0
Rother	Udiam	E33	0	3	0
Bartley Mill Stream	Win Bridge	E33	0	1	0
Dour	Russell Gardens	E33	2	1	0
Dour	d/s Lorne Road	E33	1	2	0
Darent	Bridge Cottage	E36	0	0	0
Darent	Shoreham	E36	0	0	0
Medway	Teston Bridge	E36	0	0	0
Tide Brook	d/s Washwell Lane	E38	1	1	0

Table 32 The 16 samples audited for the Sussex Area of Southern Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Bevern Stream	u/s Roadbridge	W15	0	3	0
Rother	S.Ambersham Investigation	W26	0	0	0
Bull	Bull Bridge	W26	0	0	0
Ouse	u/s Storm Outfall	W31	0	3	0
Bull Tributary	Site 5 d/s Vineyard	W31	0	0	0
Broad Rife	u/s Sidlesham STW	W33	1	0	0
Arun	Newbridge	W33	1	0	0
Lidsey Rife	u/s STW	W33	0	2	1
Adur East	Hookers Farm	W33	0	1	1
Blakes Gill	Scolliers Bridge	W34	1	3	0
Black Sewer	Staplefields Bridge	W34	1	2	0

The following samples were live-sorted (non-standard methodology for the laboratory) and are not included in the statistical analyses in Tables 33 and 34.

Boldings Brook	u/s Road Bridge	W15	1	8	0
Bevern Tributary	u/s Plumpton P/S	W15	0	0	0
Ditch adj Ridgewood Stream	u/s Discharge	W19	0	0	0
Barnham Rife	u/s Lisdey Rife confluence	W26	2	3	0
Uck	d/s Ridgewood Stream confluence	W26	0	2	1

Table 33 Statistics of the 1998 Primary Audit for Southern Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Hants & I.O.W.	**18**	**1.11**	**0.28**	**2**	**11.11**	**4**	**2.00**	**0.49**
W13	3	1.00	0.58	0	0	2	2.33	1.45
W23	2	0	0	0	0	0	0	0
W29	1	0	n/a	0	0	0	0	n/a
W30	1	1.00	n/a	0	0	1	1.00	n/a
W32	5	1.20	0.37	0	0	2	1.80	0.58
W34	6	1.67	0.67	2	33.33	4	3.17	1.01
Kent	**20**	**1.15**	**0.24**	**3**	**15.00**	**3**	**1.60**	**0.29**
E1	3	1.00	0.58	0	0	2	1.00	0.58
E2	2	0.50	0.50	0	0	1	2.00	0
E6	2	2.50	0.50	1	50.00	3	3.00	0
E19	2	2.50	0.50	1	50.00	3	3.00	1.00
E28	2	0	0	0	0	0	0	0
E31	1	1.00	n/a	0	0	1	1.00	n/a
E33	4	1.75	0.48	1	25.00	3	2.50	0.50
E36	3	0	0	0	0	0	0	0
E38	1	1.00	n/a	0	0	1	2.00	n/a
Sussex	**11**	**1.27**	**0.41**	**3**	**27.27**	**3**	**1.82**	**0.44**
W15	1	3.00	n/a	1	100.00	3	3.00	n/a
W26	2	0	0	0	0	0	0	0
W31	2	1.50	1.50	1	50.00	3	1.50	1.50
W33	4	0.75	0.48	0	0	2	1.75	0.48
W34	2	2.50	0.50	1	50.00	3	3.50	0.50
Southern Region	**49**	**1.16**	**0.17**	**8**	**16.33**	**4**	**1.80**	**0.23**

Table 34 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Southern Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Hants & IOW	**18**	**4.56**	**11.11**	**22**	**0.61**	**5.56**	**3**
W13	3	-3.33	0	4	-0.33	0	0
W23	2	0	0	0	0	0	0
W29	1	0	0	0	0	0	0
W30	1	7.00	0	7	1.00	0	1
W32	5	5.60	0	10	0.80	0	2
W34	6	9.50	33.33	22	1.17	16.67	3
Kent	**20**	**4.40**	**15.00**	**19**	**0.70**	**10.00**	**3**
E1	3	5.00	0	12	1.00	0	2
E19	2	14.00	50.00	17	2.00	0	2
E2	2	-5.50	0	0	-1.00	0	0
E28	2	0	0	0	0	0	0
E31	1	3.00	0	3	1.00	0	1
E33	4	6.75	25.00	14	1.00	25.00	3
E36	3	0	0	0	0	0	0
E38	1	2.00	0	2	0	0	0
E6	2	12.00	50.00	19	2.00	50.00	3
Sussex	**11**	**4.18**	**9.09**	**19**	**0.91**	**18.18**	**3**
W15	1	19.00	100.00	19	3.00	100.00	3
W26	2	0	0	0	0	0	0
W31	2	4.50	0	9	1.50	50.00	3
W33	4	-0.50	0	8	0.25	0	2
W34	2	10.00	0	11	1.50	0	2
Southern Region	**49**	**4.41**	**12.24**	**22**	**0.71**	**10.20**	**3**

Table 35 The families missed by Southern Region's primary analysts

Family	n	% of Southern Region's missed families in Primary Audit
Hydrophilidae (incl. Hydraenidae)	5	10.00
Valvatidae	4	8.00
Haliplidae	3	6.00
Tipulidae	3	6.00
Baetidae	2	4.00
Leuctridae	2	4.00
Lepidostomatidae	2	4.00
Ephemerellidae	2	4.00
Planorbidae	2	4.00
Hydroptilidae	2	4.00
Lymnaeidae	2	4.00
Nemouridae	1	2.00
Odontoceridae	1	2.00
Sphaeriidae	1	2.00
Piscicolidae	1	2.00
Planariidae (incl. Dugesiidae)	1	2.00
Rhyacophilidae (incl. Glossosomatidae)	1	2.00
Sericostomatidae	1	2.00
Physidae	1	2.00
Dendrocoelidae	1	2.00
Libellulidae	1	2.00
Ancylidae (incl. Acroloxidae)	1	2.00
Limnephilidae	1	2.00
Caenidae	1	2.00
Dytiscidae (incl. Noteridae)	1	2.00
Elmidae	1	2.00
Gyrinidae	1	2.00
Heptageniidae	1	2.00
Hydrometridae	1	2.00
Hydropsychidae	1	2.00
Ephemeridae	1	2.00
Beraeidae	1	2.00
Total	**50**	**100**

Table 36 The species missed by Southern Region's primary analysts

Species	n	% of Southern Region's missed species in Primary Audit
Valvata cristata Muller	4	7.69
Haliplus sp.	3	5.77
Ephemerella ignita (Poda)	2	3.85
Hydroptila sp.	2	3.85
Hydraena gracilis Germar	2	3.85
Lymnaea peregra (Muller)	2	3.85
Libellulidae indet	1	1.92
Leuctra sp.	1	1.92
Leuctra fusca (L.)	1	1.92
Lepidostoma hirtum (Fabricius)	1	1.92
Lepidostomatidae indet	1	1.92
Nemoura avicularis Morton	1	1.92
Nephrotoma sp.	1	1.92
Odontocerum albicorne (Scopoli)	1	1.92
Physa fontinalis (L.)	1	1.92
Pilaria (Pilaria) sp.	1	1.92
Piscicola geometra (L.)	1	1.92
Pisidium sp.	1	1.92
Planaria torva (Muller)	1	1.92
Rhyacophila sp.	1	1.92
Sericostoma personatum (Spence)	1	1.92
Ithytrichia sp.	1	1.92
Potamophylax cingulatus (Stephens)	1	1.92
Baetis rhodani (Pictet)	1	1.92
Tipula sp.	1	1.92
Ilybius sp.	1	1.92
Anacaena bipustulata (Marsham)	1	1.92
Anisus vortex (L.)	1	1.92
Baetis sp.	1	1.92
Bathyomphalus contortus (L.)	1	1.92
Beraeodes minutus (L.)	1	1.92
Caenis luctuosa group	1	1.92
Dendrocoelum lacteum (Muller)	1	1.92
Elmis aenea (Muller)	1	1.92
Ephemera danica Muller	1	1.92
Gyrinus sp.	1	1.92
Heptagenia sulphurea (Muller)	1	1.92
Hydropsyche sp.	1	1.92
Hydraena riparia Kugelann	1	1.92
Hydraena testacea Curtis	1	1.92

Table 36 continued

Species	n	% of Southern Region's missed species in Primary Audit
Hydrometra stagnorum (L.)	1	1.92
Drusus annulatus (Stephens)	1	1.92
Ancylus fluviatilis Muller	1	1.92
Total	**52**	**100**

AUDIT OF SOUTH WEST REGION'S PRIMARY ANALYSTS

Table 37 The 10 samples audited for Cornwall Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Mink Farm Tributary	u/s Mink Farm	DS	1	1	0
Pelynt Stream	u/s Pelynt STW	DS	2	1	0
Tehidy Stream	Coombe	RJW	0	0	0
Lympscott Tributary	Lympscott	RJW	1	0	0
Porthowan Stream	u/s Porthowan STW	RJW	0	2	0
Camel	Hendra Barn	RJW	1	1	0
Thorndon Plantation Trib	d/s Starling Roost	SAG	0	2	0
Tavy	Hill Bridge	SAG	0	5	0
Allen	Knightsmill	SAG	1	2	0
Tamar	Dexbeer Bridge	SJH	0	2	0

Table 38 The 20 samples audited for Devon Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Mere	Site 1	AD	0	0	0
Dean Burn	u/s B3380 Bridge	AD	0	0	0
Caen Tributary	d/s Knowle STW	AD	0	0	0
Otter	Tipton St John	AD	0	0	0
Torridge	Rothern Bridge	AD	1	0	0
Lew	Hatherleigh Bridge	AD	0	1	0
Erme	u/s Ivybridge STW	AD	0	0	0
Drimpton Stream	u/s Netherhay Ford	AD	1	0	0
Corry Brook	Old Coryton	AD	0	0	0
Otter	Hoemoor Farm	AG	0	1	0
Umbourne Brook	u/s Coly confluence	AG	1	3	0
Otter	Churchingford STW	AG	0	2	1
Lilley Brook	u/s Tedburn St Mary STW	AG	0	1	0
Marwood Stream	u/s STW	AG	0	2	0
Culm	u/s F.E. Discharge	AG	0	5	0
Mardle	Mardle Way	AG	0	1	0
Axe	Seaborough Bridge	AG	0	4	0
Liverton Brook	d/s Liverton PS	JB	1	1	0
Dart	d/s Buckfastleigh STW	LB	0	3	0
Erme	Sequers Bridge	TA	0	3	0

Table 39 The 8 samples audited for North Wessex Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Broughton Brook	Newbarn	AB	0	0	0
Fivehead	Bulford	AB	0	0	0
Wall Brook	Cudworth	AB	0	0	0
Parrett	Thorney	SH	0	1	0
Cam Tributary	d/s Lower Barton	SS	0	0	0
Melbury Stream Trib 3	u/s Lewcombe Manor	WO	0	0	0
Cam	Brookhampton House	WO	0	0	0
Parrett	Haselbury Bridge	WO	0	2	0

Table 40 The 20 samples audited for South Wessex Area of South West Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Western Avon Tributary	u/s Stanton St Bernard STW	AJK	0	0	0
Cards Mill Tributary	Cards Mill Farm	CMH	0	1	0
Tarrant	Tarrant Rawston	CMH	0	1	0
Sharcott Stream	d/s Malmesbury Potatoes	CMH	1	1	0
Charing Cross Tributary	Cards Mill Farm	CMH	0	0	0
Wylye	Kingston Deverill	CMH	0	1	0
Tarrant	Tarrant Monkton	CMH	0	0	0
Hampshire Avon	Stratford-sub-Castle	CMH	1	0	0
Moors	d/s Industrial Estate	CMH	0	2	0
South Winterbourne	Winterbourne Herringstone	JMB	0	0	0
North Winterbourne	Winterbourne Kingston	JMB	0	0	0
North Winterbourne	Marsh Bridge	JMB	0	1	0
Jordan	d/s Waterside Holiday Park	PRH	0	0	0
Winspit Stream	u/s Worth Matravers STW	PRH	0	0	0
Winspit Stream	d/s Worth Matravers STW	PRH	0	0	0
Sharcott Stream	u/s Malmesbury Potatoes	PRH	0	0	0
Champernhayes Stream	Charmouth	PRH	0	0	0
Tarrant	d/s Manor Farm	PRH	0	2	0
South Winterbourne	West Stafford	PRH	1	0	0
Bere Stream	Weatherby Castle	PRH	0	0	0

Table 41 Statistics of the1998 Primary Audit for South West Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Cornwall	**10**	**1.60**	**0.45**	**1**	**10.00**	**5**	**2.20**	**0.42**
DS	2	1.00	0	0	0	1	2.50	0.50
RJW	4	0.75	0.48	0	0	2	1.25	0.48
SAG	3	3.00	1.00	1	33.33	5	3.33	0.88
SJH	1	2.00	n/a	0	0	2	2.00	n/a
Devon	**20**	**1.35**	**0.34**	**5**	**25.00**	**5**	**1.60**	**0.35**
AD	9	0.11	0.11	0	0	1	0.33	0.17
AG	8	2.38	0.53	3	37.50	5	2.63	0.56
JB	1	1.00	n/a	0	0	1	2.00	n/a
LB	1	3.00	n/a	1	100.00	3	3.00	n/a
TA	1	3.00	n/a	1	100.00	3	3.00	n/a
North Wessex	**8**	**0.38**	**0.26**	**0**	**0**	**2**	**0.38**	**0.26**
AB	3	0	0.00	0	0	0	0	0
SH	1	1.00	n/a	0	0	1	1.00	n/a
SS	1	0.00	n/a	0	0	0	0	n/a
WO	3	0.67	0.67	0	0	2	0.67	0.67
South Wessex	**20**	**0.45**	**0.15**	**0**	**0**	**2**	**0.60**	**0.17**
AJK	1	0	n/a	0	0	0	0	n/a
CMH	8	0.75	0.25	0	0	2	1.00	0.27
JMB	3	0.33	0.33	0	0	1	0.33	0.33
PRH	8	0.25	0.25	0	0	2	0.38	0.26
South West Region	**58**	**0.95**	**0.17**	**6**	**10.34**	**5**	**1.19**	**0.18**

Table 42 Net effects of the Primary Audit on BMWP score and number of scoring taxa for South West Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Cornwall	**10**	**8.00**	**20.00**	**29**	**1.00**	**10.00**	**5**
DS	2	-1.50	0	5	-0.50	0	0
RJW	4	5.50	25.00	20	0.25	0	2
SAG	3	17.00	33.33	29	2.67	33.33	5
SJH	1	10.00	0	10	2.00	0	2
Devon	**20**	**7.80**	**30.00**	**33**	**1.15**	**20.00**	**5**
AD	9	-0.22	0	8	-0.11	0	1
AG	8	14.88	50.00	33	2.25	25.00	5
JB	1	0	0	0	0	0	0
LB	1	23.00	100.00	23	3.00	100.00	3
TA	1	16.00	100.00	16	3.00	100.00	3
North Wessex	**8**	**1.88**	**0**	**12**	**0.38**	**0**	**2**
AB	3	0	0	0	0	0	0
SH	1	3.00	0	3	1.00	0	1
SS	1	0	0	0	0	0	0
WO	3	4.00	0	12	0.67	0	2
South Wessex	**20**	**1.70**	**0**	**11**	**0.30**	**0**	**2**
AJK	1	0	0	0	0	0	0
CMH	8	3.00	0	11	0.50	0	2
JMB	3	1.67	0	5	0.33	0	1
PRH	8	0.63	0	10	0.13	0	2
South West Region	**58**	**4.91**	**13.79**	**33**	**0.72**	**8.62**	**5**

Table 43 The families missed by South West Region's primary analysts

Family	n	% of South West Region's missed families in Primary Audit
Goeridae	4	7.41
Nemouridae	4	7.41
Hydrophilidae (incl. Hydraenidae)	3	5.56
Baetidae	3	5.56
Planariidae (incl. Dugesiidae)	3	5.56
Elmidae	2	3.70
Gyrinidae	2	3.70
Ancylidae (incl. Acroloxidae)	2	3.70
Psychomyiidae (incl. Ecnomidae)	2	3.70
Rhyacophilidae (incl. Glossosomatidae)	2	3.70
Simuliidae	2	3.70
Limnephilidae	2	3.70
Sericostomatidae	1	1.85
Asellidae	1	1.85
Sphaeriidae	1	1.85
Scirtidae	1	1.85
Polycentropodidae	1	1.85
Planorbidae	1	1.85
Piscicolidae	1	1.85
Philopotamidae	1	1.85
Odontoceridae	1	1.85
Leptophlebiidae	1	1.85
Leptoceridae	1	1.85
Hydroptilidae	1	1.85
Hydropsychidae	1	1.85
Heptageniidae	1	1.85
Haliplidae	1	1.85
Glossiphoniidae	1	1.85
Gammaridae (incl. Crangonyctidae)	1	1.85
Dendrocoelidae	1	1.85
Corixidae	1	1.85
Caenidae	1	1.85
Chloroperlidae	1	1.85
Tipulidae	1	1.85
Lepidostomatidae	1	1.85
Total	**54**	**100**

Table 44 The species missed by South West Region's primary analysts

Species	n	% of South West Region's missed species in Primary Audit
Baetis rhodani (Pictet)	3	5.56
Silo pallipes (Fabricius)	3	5.56
Hydraena gracilis Germar	3	5.56
Ancylus fluviatilis Muller	2	3.70
Limnephilidae indet	2	3.70
Orectochilus villosus (Muller)	2	3.70
Polycelis nigra group	2	3.70
Psychomyia pusilla (Fabricius)	2	3.70
Protonemura sp.	2	3.70
Micronecta sp.	1	1.85
Nemurella picteti Klapalek	1	1.85
Piscicola geometra (L.)	1	1.85
Plectrocnemia conspersa (Curtis)	1	1.85
Odontocerum albicorne (Scopoli)	1	1.85
Polycelis felina (Dalyell)	1	1.85
Rhyacophila sp.	1	1.85
Sericostoma personatum (Spence)	1	1.85
Simulium (Simulium) ornatum group	1	1.85
Simulium (Wilhelmia) sp.	1	1.85
Sphaeriidae indet	1	1.85
Wormaldia sp.	1	1.85
Glossiphonia complanata (L.)	1	1.85
Tipula (Yamatotipula) montium group	1	1.85
Caenis rivulorum Eaton	1	1.85
Habrophlebia fusca (Curtis)	1	1.85
Limnius volckmari (Panzer)	1	1.85
Amphinemura sp.	1	1.85
Asellus aquaticus (L.)	1	1.85
Brychius elevatus (Panzer)	1	1.85
Agapetus sp.	1	1.85
Chloroperla torrentium (Pictet)	1	1.85
Dendrocoelum lacteum (Muller)	1	1.85
Elmis aenea (Muller)	1	1.85
Hippeutis complanatus (L.)	1	1.85
Lepidostomatidae indet	1	1.85
Athripsodes sp.	1	1.85
Hydropsyche siltalai Dohler	1	1.85
Ithytrichia sp.	1	1.85
Heptagenia sulphurea (Muller)	1	1.85
Goera pilosa (Fabricius)	1	1.85

Table 44 continued

Species	n	% of South West Region's missed species in Primary Audit
Gammarus pulex (L.)	1	1.85
Elodes sp.	1	1.85
Total	**54**	**100**

AUDIT OF THAMES REGION'S PRIMARY ANALYSTS

Table 45 The 20 samples audited for the South East Area of Thames Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Hogsmill	Surbiton Hill Park	307	0	1	1
Mole	Leatherhead	307	1	1	0
Bourne	u/s Thames (21.5.98)	307	1	3	0
Beverley Brook	Richmond Park (14.7.98)	307	1	2	1
Beverley Brook	Richmond Park (7.9.98)	307	0	3	0
Bull Brook	Warfield Park Farm	307	0	0	0
Blackwater	GS Swallowfield	307	2	3	1
Bourne	u/s Thames (18.11.98)	307	0	4	2
Hinley Brook	Fleet	317	0	1	0
Stanford Brook	Smarts Heath Lane	317	0	7	1
Oakhanger Stream	u/s Priory Farm	317	0	1	0
Hart	Hartford Bridge	317	1	1	0
Cranleigh Waters	u/s Collins Brook	317	0	1	0
Gatwick Stream	u/s Mole	317	0	2	0
Thames	d/s Skiff Club	317	1	0	0
Hascombe Stream	d/s Roadbridge	317	0	1	1
Barkham Brook	Borfield	317	2	4	0
Compton Stream	u/s Culvert	317	0	0	0
The Cut	u/s Thames	317	0	0	0
Boveney Ditch	u/s Thames	317	0	2	0

Table 46 The 20 samples audited for the North East Area of Thames Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Ver	Chequers Lane	DJL	0	4	0
Quin	Braughing Bridge	DJL	0	3	0
Haley Hill Ditch	Buntingford	DJL	0	0	0
Cuffley Brook	Cuffley Hill	DJL	0	0	0
Lee	u/s Luton STW	DJL	0	3	0
Ingrebourne	u/s Weald Brook	DJL	0	1	0
Dollis Brook	Bell Lane	JE	0	0	0
G.U.C.	Tring	JE	0	1	0
Duke of Northumberland	Worton Road	JE	1	0	0
Stanstead Brook	Gypsy Lane	JE	0	3	0
Stort	d/s Meesden Bridge	JE	0	2	0
Hunsden Brook	u/s R.Stort	JE	2	3	0
Chess	d/s Bois Mill	JE	1	0	0
Rib	Wadesmill	JE	0	2	0
G.U.C. (Denham)	u/s A40	JE	1	3	0
Chess	Chesham	JE	0	3	0
Costons Brook	u/s R.Brent	KG	0	1	0
Beane	Watton-at-Stone	KG	0	3	0
Ingrebourne	Harold Court Road	KG	0	1	1
Ash	Much Hadham	KG	0	1	0

Table 47 The 20 samples audited for the West Area of Thames Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Tackley Stream	d/s Pumping Station	DJB	0	2	0
Wye	Bassetbury Lane	DJB	1	3	0
Lambourn	East Shefford (19.5.98)	DJB	0	3	1
Worminghall Brook	Worminghall	DJB	1	2	0
Blunsden Brook	Water Eaton	JAB	0	0	0
Sars Brook	U/s Lake	JAB	1	1	0
Dun	Hungerford	JAB	0	6	1
Kennet	Stitchcombe Mill	JAB	1	1	0
Tuckmill Brook	d/s Shrivenham STW	JAB	0	2	0
Windrush	Newbridge	JAB	0	7	1
Letcombe Brook	d/s Wantage STW	JAB	0	4	
Lydebank Brook	East Hendred	JAB	0	0	1
Northfield Brook	Sandford	JAB	1	5	1
Marcham Brook	Marcham	JAB	0	4	0
Lambourn	East Shefford (8.9.98)	JTT	1	3	3
Lambourn	A4 Newbury	JTT	0	2	2
Moor Ditch	B4016 Appleford	JTT	1	4	0
Marcham Brook	Fyfield	JTT	1	3	1
Wye	u/s Wycombe Marsh Mill	JTT	2	4	0
Wheatley Ditch	Superstore Car Park	JTT	0	1	0

Table 48 Statistics of the 1998 Primary Audit for Thames Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standa erro
North East	**20**	**1.70**	**0.30**	**8**	**40.00**	**4**	**2.00**	**0.32**
DJL	6	1.83	0.70	3	50.00	4	1.83	0.70
JE	10	1.70	0.42	4	40.00	3	2.20	0.49
KG	4	1.50	0.50	1	25.00	3	1.75	0.48
South East	**20**	**1.85**	**0.39**	**6**	**30.00**	**7**	**2.65**	**0.51**
307	8	2.13	0.48	4	50.00	4	3.38	0.73
317	12	1.67	0.58	2	16.67	7	2.17	0.69
West	**20**	**2.85**	**0.42**	**11**	**55.00**	**7**	**3.90**	**0.51**
DJB	4	2.50	0.29	2	50.00	3	3.25	0.48
JAB	10	3.00	0.80	5	50.00	7	3.70	0.88
JTT	6	2.83	0.48	4	66.67	4	4.67	0.84
Thames Region	**60**	**2.13**	**0.22**	**25**	**41.67**	**7**	**2.85**	**0.28**

Table 49 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Thames Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximur underestim of no. of ta
North East	**20**	**7.65**	**35.00**	**19**	**1.45**	**30.00**	**4**
DJL	6	9.33	50.00	18	1.83	50.00	4
JE	10	6.00	30.00	16	1.20	20.00	3
KG	4	9.25	25.00	19	1.50	25.00	3
South East	**20**	**7.40**	**20.00**	**49**	**1.40**	**15.00**	**7**
307	8	7.50	37.50	18	1.50	25.00	4
317	12	7.33	8.33	49	1.33	8.33	7
West	**20**	**12.50**	**30.00**	**50**	**2.35**	**35.00**	**7**
DJB	4	9.75	0	13	2.00	25.00	3
JAB	10	15.60	50.00	50	2.70	50.00	7
JTT	6	9.17	16.67	20	2.00	16.67	3
Thames Region	**60**	**9.18**	**28.33**	**50**	**1.73**	**26.67**	**7**

Table 50 The families missed by Thames Region's primary analysts

Family	n	% of Thames Region's missed families in Primary Audit
Hydroptilidae	13	11.11
Haliplidae	6	5.13
Ancylidae (incl. Acroloxidae)	6	5.13
Hydrobiidae (incl. Bithyniidae)	5	4.27
Planorbidae	5	4.27
Planariidae (incl. Dugesiidae)	5	4.27
Sphaeriidae	5	4.27
Valvatidae	5	4.27
Caenidae	4	3.42
Elmidae	4	3.42
Simuliidae	4	3.42
Glossiphoniidae	4	3.42
Psychomyiidae (incl. Ecnomidae)	3	2.56
Oligochaeta	3	2.56
Dendrocoelidae	3	2.56
Limnephilidae	3	2.56
Lymnaeidae	3	2.56
Hydrophilidae (incl. Hydraenidae)	3	2.56
Beraeidae	3	2.56
Leptophlebiidae	2	1.71
Piscicolidae	2	1.71
Hydrometridae	2	1.71
Ephemerellidae	2	1.71
Scirtidae	2	1.71
Polycentropodidae	1	0.85
Physidae	1	0.85
Sialidae	1	0.85
Tipulidae	1	0.85
Sericostomatidae	1	0.85
Chironomidae	1	0.85
Goeridae	1	0.85
Notonectidae	1	0.85
Baetidae	1	0.85
Coenagrionidae	1	0.85
Corixidae	1	0.85
Dytiscidae (incl. Noteridae)	1	0.85
Gerridae	1	0.85
Hydropsychidae	1	0.85
Lepidostomatidae	1	0.85
Leptoceridae	1	0.85

Table 50 continued

Family	**n**	**% of Thames Region's missed families in Primary Audit**
Leuctridae	1	0.85
Gammaridae (incl. Crangonyctidae)	1	0.85
Asellidae	1	0.85
Libellulidae	1	0.85
Total	**117**	**100**

Table 51 The species missed by Thames Region's primary analysts

Species	n	% of Thames Region's missed species in Primary Audit
Hydroptila sp.	11	8.94
Potamopyrgus jenkinsi (Smith)	5	4.07
Pisidium sp.	5	4.07
Elmis aenea (Muller)	4	3.25
Caenis luctuosa group	4	3.25
Polycelis nigra group	4	3.25
Ancylus fluviatilis Muller	4	3.25
Limnephilidae indet	3	2.44
Lymnaea peregra (Muller)	3	2.44
Haliplus sp.	3	2.44
Dendrocoelum lacteum (Muller)	3	2.44
Helobdella stagnalis (L.)	3	2.44
Beraeodes minutus (L.)	3	2.44
Haliplus lineatocollis (Marsham)	3	2.44
Acroloxus lacustris (L.)	3	2.44
Valvata cristata Muller	3	2.44
Piscicola geometra (L.)	2	1.63
Simulium (Boophthora) erythrocephalum (de Geer)	2	1.63
Oxyethira sp.	2	1.63
Lype sp.	2	1.63
Simulium (Simulium) ornatum group	2	1.63
Tubificidae	2	1.63
Valvata piscinalis (Muller)	2	1.63
Gyraulus albus (Muller)	2	1.63
Ephemerella ignita (Poda)	2	1.63
Elodes sp.	2	1.63
Sericostoma personatum (Spence)	1	0.81
Physa sp.	1	0.81
Coenagrionidae indet	1	0.81
Cercyon sp.	1	0.81
Planorbis carinatus/planorbis	1	0.81
Planorbis sp.	1	0.81
Callicorixa praeusta (Fieber)	1	0.81
Oulimnius tuberculatus (Muller)	1	0.81
Bithynia tentaculata (L.)	1	0.81
Sialis sp.	1	0.81
Baetis rhodani (Pictet)	1	0.81
Asellus aquaticus (L.)	1	0.81
Tinodes waeneri (L.)	1	0.81
Armiger crista (L.)	1	0.81

Table 51 continued

Species	n	% of Thames Region's missed species in Primary Audit
Anacaena bipustulata (Marsham)	1	0.81
Habrophlebia fusca (Curtis)	1	0.81
Planariidae indet	1	0.81
Polycentropus flavomaculatus (Pictet)	1	0.81
Hydropsyche angustipennis (Curtis)	1	0.81
Hippeutis complanatus (L.)	1	0.81
Simulium (Simulium) noelleri Friederichs	1	0.81
Oulimnius sp.	1	0.81
Hydrometra stagnorum (L.)	1	0.81
Hydrometra sp.	1	0.81
Goera pilosa (Fabricius)	1	0.81
Laccobius (Macrolaccobius) bipunctatus (Fabricius)	1	0.81
Lepidostoma hirtum (Fabricius)	1	0.81
Leptophlebiidae indet	1	0.81
Leuctra geniculata (Stephens)	1	0.81
Mystacides azurea (L.)	1	0.81
Ormosia sp.	1	0.81
Libellulidae indet	1	0.81
Orthocladiinae	1	0.81
Notonecta sp.	1	0.81
Oreodytes sanmarkii (Sahlberg)	1	0.81
Gammarus pulex (L.)	1	0.81
Gerris (Gerris) lacustris (L.)	1	0.81
Lumbriculidae	1	0.81
Glossiphonia complanata (L.)	1	0.81
Total	**123**	**100**

AUDIT OF WELSH REGION'S PRIMARY ANALYSTS

Table 52 The 20 samples audited for Northern Area of Welsh Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Afon Crawcwellt North	u/s of Leat	356	0	0	0
Afon Crawcwellt North	d/s of Leat	356	0	3	0
Un-named Watercourse	d/s Lobster Pot	358	1	0	0
Un-named Stream	Church Bay	359	1	0	0
Plowley Brook	u/s Aldford Brook	360	0	0	0
Nant y Gwyryd	Site 2	360	0	0	0
Coddington Brook	Coddington	360	1	0	0
Afon Ogwen	Nant Ffrancon Site 3	376	0	2	0
Afon Morwynion	u/s WTW discharge	376	0	1	0
Aldford Brook	Lea Hall	376	0	4	0
Afon Morwynion	d/s WTW Discharge	376	1	0	0
Golborne Brook	Milton Green	376	0	1	0
Cadnant	u/s Bethel STW	377	0	3	0
Cadnant	S. of Cross Roads	377	0	5	0
Afon Llugwy	u/s Bridge	377	0	0	0
Un-named Watercourse	d/s Gardd Fawr Tipping	377	0	2	0
Afon Alyn	u/s STW Stream	377	0	1	0
Un-named Stream	u/s Garth Tipping	377	0	2	0
Afon Alyn	u/s CSO	377	0	1	0
Afon Dulas Tributary	u/s Betws yn Rhos STW	377	1	3	0

Table 53 The 20 samples audited for South Eastern Area of Welsh Region

River	Site	Primary Analyst	Losses	Gains	Omission
Nant LLwyn yr Eos	d/s Lagoons	370	1	2	0
Ebbw Fach	d/s Six Bells Minewater	370	0	0	0
Ebbw	u/s Aiwa	370	0	2	0
Taff	u/s Llwynon Reservoir	370	0	2	0
Tarell	Brecon	370	1	4	0
Nant Gledyr	Gypsy Lane	370	2	0	0
Gwyddon	Picnic Site	370	0	2	0
Rhymney	u/s Trehir Tip	370	0	0	0
Nant Myddlyn	d/s Cwm Coke Works	372	0	4	0
Glamorganshire Canal	d/s Discharges	375	2	2	0
Yazor Brook	u/s Wye at Bulmers	375	0	1	0
Nant Merdogg	d/s Silent Valley	375	0	0	0
Cwm Brook	d/s Tributary	375	0	1	0
Cwm Brook	d/s Road Bridge	375	0	0	0
Arrow	u/s Mayglothling	375	0	0	0
Elan	Newydd Bridge	375	1	1	0
Frome	u/s Bishops Frome STW	375	0	0	0
Frome	Avonbury Court	375	1	3	0
Nant Rhydhalog	u/s Nant Dyfrgi	375	1	1	0
Worm Brook	d/s Kenderchurch STW	375	0	3	0

Table 54 The 20 samples audited for South Western Area of Welsh Region

River	Site	Primary Analyst	Losses	Gains	Omissions
Gwydyll	u/s Esgair Mywn	362	0	1	0
Gwydyll	d/s Esgair Mwyn	362	0	0	0
Nant Harvest Hall	d/s Tyn y Fron	362	0	0	0
Castell	d/s Castell Metal Mine	362	0	0	0
Silo	u/s Daren Mine	362	0	1	0
Rheidol	u/s Cwm Rheidol Metal Mine	362	0	2	0
Cwmnewyddion	d/s Mine, u/s Ceunant	362	0	0	0
Daren/Peithyll	d/s Daren Farm	362	0	1	0
Llynfi	Llangynwyd	362	0	1	0
Ystwyth	u/s Cwmystwyth MM	362	0	0	0
Taf	u/s Mansel Davies	362	0	3	0
Nant Erfin	Site 2, u/s Roadbridge	362	0	1	0
Goytre	d/s Discharge 2	363	1	1	0
Un-named Watercourse	d/s Cwm Mawr Metal Mine	374	1	5	1
Blaenpelenna	Blaenpelenna 5a	NCW	0	1	0
Gwenffrwd	Site W8002	NCW	1	3	0
Pelenna	Site W8003	NCW	0	0	0
Afan	W037 Afan	NCW	0	0	0
Narberth Brook	d/s Concrete bridge	NCW	0	2	0
Narberth Brook	Narberth	NCW	0	1	0

Table 55 Statistics of the 1998 Primary Audit for Welsh Region

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Northern	**20**	**1.40**	**0.34**	**5**	**25.00**	**5**	**1.65**	**0.33**
356	2	1.50	1.50	1	50.00	3	1.50	1.50
358	1	0	n/a	0	0	0	1.00	n/a
359	1	0	n/a	0	0	0	1.00	n/a
360	3	0	0	0	0	0	0.33	0.33
376	5	1.60	0.68	1	20.00	4	1.80	0.58
377	8	2.13	0.55	3	37.50	5	2.25	0.59
South Eastern	**20**	**1.40**	**0.30**	**4**	**20.00**	**4**	**1.85**	**0.36**
370	8	1.50	0.50	1	12.50	4	2.00	0.57
372	1	4.00	n/a	1	100.00	4	4.00	n/a
375	11	1.09	0.34	2	18.18	3	1.55	0.47
South Western	**20**	**1.15**	**0.29**	**3**	**15.00**	**5**	**1.35**	**0.39**
362	12	0.83	0.27	1	8.33	3	0.83	0.27
363	1	1.00	n/a	0	0	1	2.00	n/a
374	1	5.00	n/a	1	100.00	5	7.00	n/a
NCW	6	1.17	0.48	1	16.67	3	1.33	0.61
Welsh Region	**60**	**1.32**	**0.18**	**12**	**20.00**	**5**	**1.62**	**0.20**

Table 56 Net effects of the Primary Audit on BMWP score and number of scoring taxa for Welsh Region

Analyst/ Group	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestimate of no. of taxa
Northern	**20**	**6.40**	**30.00**	**25**	**1.15**	**20.00**	**5**
356	2	8.50	50.00	17	1.50	50.00	3
358	1	-5.00	0	-5	-1.00	0	-1
359	1	-7.00	0	-7	-1.00	0	-1
360	3	-1.00	0	0	-0.33	0	0
376	5	6.60	20.00	15	1.40	20.00	4
377	8	11.63	50.00	25	2.00	25.00	5
S. Eastern	**20**	**6.45**	**25.00**	**23**	**0.95**	**15.00**	**4**
370	8	7.00	25.00	17	1.00	12.50	3
372	1	23.00	100.00	23	4.00	100.00	4
375	11	4.55	18.18	22	0.64	9.09	3
S. Western	**20**	**5.75**	**15.00**	**21**	**1.00**	**10.00**	**4**
362	12	5.00	16.67	18	0.83	8.33	3
363	1	7.00	0	7	0	0	0
374	1	21.00	100.00	21	4.00	100.00	4
NCW	6	4.50	0	13	1.00	0	2
Welsh Region	**60**	**6.20**	**23.33**	**25**	**1.03**	**15.00**	**5**

Table 57 The families missed by Welsh Region's primary analysts

Family	n	% of Welsh Region's missed families in Primary Audit
Sphaeriidae	5	7.35
Oligochaeta	5	7.35
Ancylidae (incl. Acroloxidae)	4	5.88
Nemouridae	4	5.88
Dytiscidae (incl. Noteridae)	3	4.41
Psychomyiidae (incl. Ecnomidae)	3	4.41
Limnephilidae	2	2.94
Leuctridae	2	2.94
Hydropsychidae	2	2.94
Piscicolidae	2	2.94
Lymnaeidae	2	2.94
Elmidae	2	2.94
Erpobdellidae	2	2.94
Hydroptilidae	2	2.94
Beraeidae	2	2.94
Taeniopterygidae	2	2.94
Simuliidae	2	2.94
Sialidae	1	1.47
Perlodidae	1	1.47
Philopotamidae	1	1.47
Physidae	1	1.47
Planorbidae	1	1.47
Polycentropodidae	1	1.47
Sericostomatidae	1	1.47
Scirtidae	1	1.47
Leptoceridae	1	1.47
Hydrophilidae (incl. Hydraenidae)	1	1.47
Hydrometridae	1	1.47
Hydrobiidae (incl. Bithyniidae)	1	1.47
Glossiphoniidae	1	1.47
Ephemerellidae	1	1.47
Dendrocoelidae	1	1.47
Coenagrionidae	1	1.47
Chloroperlidae	1	1.47
Chironomidae	1	1.47
Caenidae	1	1.47
Baetidae	1	1.47
Tipulidae	1	1.47
Goeridae	1	1.47
Total	**68**	**100**

Table 58 The species missed by Welsh Region's primary analysts

Species	n	% of Welsh Region's missed species in Primary Audit
Ancylus fluviatilis Muller	4	5.80
Pisidium sp.	4	5.80
Lumbriculidae	3	4.35
Protonemura sp.	2	2.90
Erpobdellidae indet	2	2.90
Oreodytes sanmarkii (Sahlberg)	2	2.90
Brachyptera risi (Morton)	2	2.90
Naididae	2	2.90
Lype sp.	2	2.90
Piscicola geometra (L.)	2	2.90
Hydroptila sp.	2	2.90
Lymnaea sp.	1	1.45
Nemoura cinerea (Retzius)	1	1.45
Nemouridae indet	1	1.45
Oulimnius tuberculatus (Muller)	1	1.45
Perlodes microcephala (Pictet)	1	1.45
Lymnaea peregra (Muller)	1	1.45
Physa sp.	1	1.45
Plectrocnemia conspersa (Curtis)	1	1.45
Potamopyrgus jenkinsi (Smith)	1	1.45
Pyrrhosoma nymphula (Sulzer)	1	1.45
Sericostoma personatum (Spence)	1	1.45
Sialis fuliginosa Pictet	1	1.45
Simulium (Eusimulium) aureum group	1	1.45
Simulium (Simulium) ornatum group	1	1.45
Sphaeriidae indet	1	1.45
Tinodes waeneri (L.)	1	1.45
Bathyomphalus contortus (L.)	1	1.45
Silo nigricornis (Pictet)	1	1.45
Ephemerella ignita (Poda)	1	1.45
Wormaldia sp.	1	1.45
Agabus guttatus (Paykull)	1	1.45
Athripsodes bilineatus (L.)	1	1.45
Baetis scambus group	1	1.45
Beraea maurus (Curtis)	1	1.45
Caenis rivulorum Eaton	1	1.45
Chaetopteryx villosa (Fabricius)	1	1.45
Chloroperla torrentium (Pictet)	1	1.45
Dendrocoelum lacteum (Muller)	1	1.45
Beraea pullata (Curtis)	1	1.45

Table 58 continued

Species	n	% of Welsh Region's missed species in Primary Audit
Dicranota sp.	1	1.45
Limnius volckmari (Panzer)	1	1.45
Glossiphonia complanata (L.)	1	1.45
Gyraulus albus (Muller)	1	1.45
Hydrocyphon deflexicollis (Muller)	1	1.45
Hydrometra sp.	1	1.45
Hydrophilidae indet	1	1.45
Hydropsyche siltalai Dohler	1	1.45
Hydropsyche sp.	1	1.45
Leuctra fusca (L.)	1	1.45
Leuctra sp.	1	1.45
Limnephilidae indet	1	1.45
Diamesinae	1	1.45
Total	**69**	**100**

SUMMARY OF PRIMARY AUDIT FOR ENVIRONMENT AGENCY

Table 59 Statistics of the 1998 Primary Audit for each Agency laboratory

Analyst/Group	n	Mean gains	Standard error	No.samples >2 gains	% samples >2 gains	Highest no. gains	Mean errors (l+g+o)	Standard error
Anglian Region	**60**	**1.75**	**0.22**	**15**	**25.00**	**8**	**2.22**	**0.24**
Central	20	1.60	0.43	4	20.00	8	2.35	0.47
Eastern	20	1.90	0.32	6	30.00	5	2.15	0.34
Northern	20	1.75	0.38	5	25.00	6	2.15	0.45
Midlands Region	**80**	**1.80**	**0.16**	**21**	**26.25**	**5**	**2.16**	**0.19**
Upper Severn	20	2.00	0.34	5	25.00	5	2.25	0.38
Lower Severn	20	1.40	0.31	4	20.00	5	1.85	0.38
Upper Trent	20	1.65	0.27	5	25.00	4	2.10	0.39
Lower Trent	20	2.15	0.33	7	35.00	5	2.45	0.39
North East Region	**60**	**1.43**	**0.20**	**12**	**20.00**	**7**	**1.62**	**0.23**
Dales	20	1.85	0.45	7	35.00	7	1.90	0.46
Northumbria	20	1.30	0.25	3	15.00	4	1.50	0.29
Ridings	20	1.15	0.33	2	10.00	6	1.45	0.43
North West Region	**52**	**1.50**	**0.19**	**9**	**17.31**	**6**	**2.02**	**0.22**
Central	20	1.55	0.32	4	20.00	5	1.90	0.32
Northern	12	1.33	0.26	1	8.33	3	1.83	0.51
Southern	20	1.55	0.35	4	20.00	6	2.25	0.38
Southern Region	**49**	**1.16**	**0.17**	**8**	**16.33**	**4**	**1.80**	**0.23**
Sussex	11	1.27	0.41	3	27.27	3	1.82	0.44
Hants & I.O.W.	18	1.11	0.28	2	11.11	4	2.00	0.49
Kent	20	1.15	0.24	3	15.00	3	1.60	0.29
South West Region	**58**	**0.95**	**0.17**	**6**	**10.34**	**5**	**1.19**	**0.18**
Cornwall	10	1.60	0.45	1	10.00	5	2.20	0.42
Devon	20	1.35	0.34	5	25.00	5	1.60	0.35
North Wessex	8	0.38	0.26	0	0	2	0.38	0.26
South Wessex	20	0.45	0.15	0	0	2	0.60	0.17
Thames Region	**60**	**2.13**	**0.22**	**25**	**41.67**	**7**	**2.85**	**0.28**
North East	20	1.70	0.30	8	40.00	4	2.00	0.32
South East	20	1.85	0.39	6	30.00	7	2.65	0.51
West	20	2.85	0.42	11	55.00	7	3.90	0.51
Welsh Region	**60**	**1.32**	**0.18**	**12**	**20.00**	**5**	**1.62**	**0.20**
Northern	20	1.40	0.34	5	25.00	5	1.65	0.33
South Eastern	20	1.40	0.30	4	20.00	4	1.85	0.36
South Western	20	1.15	0.29	3	15.00	5	1.35	0.39
Whole of Agency	**479**	**1.53**	**0.07**	**112**	**23.38**	**8**	**1.95**	**0.08**

Table 60 Net effects of the 1998 Primary Audit on BMWP score and number of scoring taxa for each Agency laboratory

Region/Area	n	Mean net effect on BMWP score	% of samples underestimated by score >13	Maximum underestimate of BMWP score	Mean net effect on no. of taxa	% of samples underestimated by >2 taxa	Maximum underestima of no. of ta
Anglian	**60**	**8.47**	**26.67**	**46**	**1.43**	**25.00**	**8**
Central	20	7.45	25.00	46	1.20	20.00	8
Eastern	20	9.40	25.00	25	1.70	30.00	5
Northern	20	8.55	30.00	28	1.40	25.00	5
Midlands	**80**	**8.45**	**21.25**	**35**	**1.61**	**22.50**	**5**
Upper Severn	20	10.65	25.00	35	1.85	20.00	5
Lower Severn	20	6.55	15.00	19	1.25	20.00	5
Upper Trent	20	6.95	15.00	23	1.40	15.00	3
Lower Trent	20	9.65	30.00	25	1.95	35.00	5
North East	**60**	**8.33**	**21.67**	**42**	**1.32**	**16.67**	**7**
Dales	20	11.15	30.00	39	1.80	30.00	7
Northumbria	20	7.45	25.00	27	1.15	15.00	3
Ridings	20	6.40	10.00	42	1.00	5.00	5
North West	**52**	**6.10**	**17.31**	**35**	**1.13**	**13.46**	**6**
Central	20	6.95	20.00	35	1.25	15.00	5
Northern	12	5.25	16.67	20	0.83	0	2
Southern	20	5.75	15.00	31	1.20	20.00	6
Southern	**49**	**4.41**	**12.24**	**22**	**0.71**	**10.20**	**3**
Hants & I.O.W.	18	4.56	11.11	22	0.61	5.56	3
Kent	20	4.40	15.00	19	0.70	10.00	3
Sussex	11	4.18	9.09	19	0.91	18.18	3
South West	**58**	**4.91**	**13.79**	**33**	**0.72**	**8.62**	**5**
Cornwall	10	8.00	20.00	29	1.00	10.00	5
Devon	20	7.80	30.00	33	1.15	20.00	5
North Wessex	8	1.88	0	12	0.38	0	2
South Wessex	20	1.70	0	11	0.30	0	2
Thames	**60**	**9.18**	**28.33**	**50**	**1.73**	**26.67**	**7**
North East	20	7.65	35.00	19	1.45	30.00	4
South East	20	7.40	20.00	49	1.40	15.00	7
West	20	12.50	30.00	50	2.35	35.00	7
Welsh	**60**	**6.20**	**23.33**	**25**	**1.03**	**15.00**	**5**
Northern	20	6.40	30.00	25	1.15	20.00	5
South Eastern	20	6.45	25.00	23	0.95	15.00	4
South Western	20	5.75	15.00	21	1.00	10.00	4
Whole of Agency	**479**	**7.15**	**20.88**	**50**	**1.24**	**17.75**	**8**

Table 61 The families missed by the Agency's Primary Analysts in the 1998 Audit

Family	n	% of Agency's missed families in Primary Audit
Hydroptilidae	40	6.01
Planariidae (incl. Dugesiidae)	32	4.80
Sphaeriidae	29	4.35
Caenidae	28	4.20
Elmidae	25	3.75
Planorbidae	24	3.60
Limnephilidae	23	3.45
Hydrobiidae (incl. Bithyniidae)	23	3.45
Ancylidae (incl. Acroloxidae)	21	3.15
Lymnaeidae	21	3.15
Psychomyiidae (incl. Ecnomidae)	20	3.00
Baetidae	20	3.00
Nemouridae	19	2.85
Haliplidae	18	2.70
Hydrophilidae (incl. Hydraenidae)	18	2.70
Leptoceridae	17	2.55
Simuliidae	17	2.55
Glossiphoniidae	16	2.40
Tipulidae	14	2.10
Hydropsychidae	13	1.95
Valvatidae	13	1.95
Dytiscidae (incl. Noteridae)	13	1.95
Goeridae	12	1.80
Oligochaeta	11	1.65
Gammaridae (incl. Crangonyctidae)	10	1.50
Polycentropodidae	10	1.50
Sericostomatidae	9	1.35
Asellidae	9	1.35
Dendrocoelidae	8	1.20
Beraeidae	8	1.20
Ephemerellidae	8	1.20
Piscicolidae	8	1.20
Lepidostomatidae	8	1.20
Leptophlebiidae	8	1.20
Chloroperlidae	7	1.05
Leuctridae	7	1.05
Scirtidae	7	1.05
Gyrinidae	7	1.05
Erpobdellidae	6	0.90
Physidae	6	0.90

Table 61 continued

Family	**n**	**% of Agency's missed families in Primary Audit**
Coenagrionidae	5	0.75
Chironomidae	5	0.75
Taeniopterygidae	5	0.75
Rhyacophilidae (incl. Glossosomatidae)	4	0.60
Corixidae	4	0.60
Hydrometridae	4	0.60
Libellulidae	4	0.60
Calopterygidae	3	0.45
Sialidae	2	0.30
Ephemeridae	2	0.30
Gerridae	2	0.30
Odontoceridae	2	0.30
Notonectidae	2	0.30
Heptageniidae	2	0.30
Neritidae	2	0.30
Philopotamidae	2	0.30
Perlodidae	1	0.15
Perlidae	1	0.15
Unionidae	1	0.15
Total	**666**	**100**

Table 62 The species missed by the Agency's Primary Analysts in the 1998 Audit

Species	n	% of Agency's missed species in Primary Audit
Hydroptila sp.	28	4.02
Pisidium sp.	25	3.59
Potamopyrgus jenkinsi (Smith)	23	3.30
Ancylus fluviatilis Muller	18	2.58
Polycelis nigra group	17	2.44
Caenis luctuosa group	16	2.30
Lymnaea peregra (Muller)	14	2.01
Elmis aenea (Muller)	14	2.01
Baetis rhodani (Pictet)	14	2.01
Haliplus sp.	12	1.72
Limnephilidae indet	11	1.58
Gyraulus albus (Muller)	10	1.43
Hydraena gracilis Germar	10	1.43
Valvata cristata Muller	10	1.43
Simulium (Simulium) ornatum group	10	1.43
Lype sp.	9	1.29
Sericostoma personatum (Spence)	9	1.29
Glossiphonia complanata (L.)	9	1.29
Caenis rivulorum Eaton	8	1.15
Dendrocoelum lacteum (Muller)	8	1.15
Ephemerella ignita (Poda)	8	1.15
Piscicola geometra (L.)	8	1.15
Asellus aquaticus (L.)	8	1.15
Oulimnius tuberculatus (Muller)	7	1.00
Gammarus pulex (L.)	7	1.00
Helobdella stagnalis (L.)	7	1.00
Tinodes waeneri (L.)	6	0.86
Elodes sp.	6	0.86
Hydropsyche siltalai Dohler	6	0.86
Lumbriculidae	6	0.86
Polycelis felina (Dalyell)	6	0.86
Armiger crista (L.)	6	0.86
Silo pallipes (Fabricius)	5	0.72
Oreodytes sanmarkii (Sahlberg)	5	0.72
Orectochilus villosus (Muller)	5	0.72
Plectrocnemia conspersa (Curtis)	5	0.72
Goera pilosa (Fabricius)	5	0.72
Caenis horaria (L.)	5	0.72
Ithytrichia sp.	5	0.72
Brachyptera risi (Morton)	5	0.72

Table 62 continued

Species	n	% of Agency's missed species in Primary Audit
Lepidostoma hirtum (Fabricius)	5	0.72
Hydropsyche sp.	5	0.72
Habrophlebia fusca (Curtis)	5	0.72
Chloroperla torrentium (Pictet)	5	0.72
Libellulidae indet	4	0.57
Lymnaea sp.	4	0.57
Mystacides azurea (L.)	4	0.57
Nemoura avicularis Morton	4	0.57
Nemurella picteti Klapalek	4	0.57
Acroloxus lacustris (L.)	4	0.57
Oxyethira sp.	4	0.57
Oulimnius sp.	4	0.57
Erpobdella octoculata (L.)	4	0.57
Beraeodes minutus (L.)	4	0.57
Potamonectes depressus (Fabricius)	4	0.57
Sphaeriidae indet	4	0.57
Baetis vernus Curtis	4	0.57
Protonemura sp.	4	0.57
Valvata piscinalis (Muller)	3	0.43
Athripsodes sp.	3	0.43
Anisus vortex (L.)	3	0.43
Tipula sp.	3	0.43
Hippeutis complanatus (L.)	3	0.43
Dugesia polychroa group	3	0.43
Tubificidae	3	0.43
Calopteryx splendens (Harris)	3	0.43
Psychomyia pusilla (Fabricius)	3	0.43
Bathyomphalus contortus (L.)	3	0.43
Leuctra fusca (L.)	3	0.43
Brychius elevatus (Panzer)	3	0.43
Lepidostomatidae indet	3	0.43
Beraea maurus (Curtis)	3	0.43
Limnius volckmari (Panzer)	3	0.43
Crangonyx pseudogracilis Bousfield	3	0.43
Naididae	3	0.43
Haliplus lineatocollis (Marsham)	3	0.43
Polycentropus flavomaculatus (Pictet)	3	0.43
Polycelis sp.	3	0.43
Athripsodes cinereus (Curtis)	3	0.43
Physa sp.	3	0.43

Table 62 continued

Species	n	% of Agency's missed species in Primary Audit
Dicranota sp.	3	0.43
Tipula (Yamatotipula) montium group	3	0.43
Athripsodes aterrimus (Stephens)	3	0.43
Micronecta sp.	3	0.43
Planaria torva (Muller)	3	0.43
Drusus annulatus (Stephens)	2	0.29
Bithynia tentaculata (L.)	2	0.29
Ischnura elegans (Van der Linden)	2	0.29
Hydrometra stagnorum (L.)	2	0.29
Erpobdellidae indet	2	0.29
Hydrometra sp.	2	0.29
Cloeon dipterum (L.)	2	0.29
Anacaena bipustulata (Marsham)	2	0.29
Agraylea multipunctata Curtis	2	0.29
Heptagenia sulphurea (Muller)	2	0.29
Chloroperla tripunctata (Scopoli)	2	0.29
Cyrnus flavidus Mclachlan	2	0.29
Planariidae indet	2	0.29
Orthocladiinae	2	0.29
Odontocerum albicorne (Scopoli)	2	0.29
Potamophylax cingulatus/latipennis	2	0.29
Paraleptophlebia submarginata (Stephens)	2	0.29
Simulium (Eusimulium) aureum group	2	0.29
Physa acuta group	2	0.29
Simulium (Boophthora) erythrocephalum (de Geer)	2	0.29
Nephrotoma sp.	2	0.29
Theodoxus fluviatilis (L.)	2	0.29
Nemoura cinerea (Retzius)	2	0.29
Simulium (Simulium) noelleri Friederichs	2	0.29
Nemoura cambrica group	2	0.29
Notonecta sp.	2	0.29
Wormaldia sp.	2	0.29
Limnephilus lunatus Curtis	2	0.29
Laccobius (Macrolaccobius) bipunctatus (Fabricius)	2	0.29
Leuctra geniculata (Stephens)	2	0.29
Leuctra sp.	2	0.29
Lymnaea truncatula (Muller)	2	0.29
Triaenodes bicolor (Curtis)	2	0.29
Rhyacophila sp.	2	0.29
Lymnaea stagnalis (L.)	2	0.29

Table 62 continued

Species	n	% of Agency's missed species in Primary Audit
Beraea pullata (Curtis)	1	0.14
Silo sp.	1	0.14
Rhyacophila dorsalis (Curtis)	1	0.14
Silo nigricornis (Pictet)	1	0.14
Sialis sp.	1	0.14
Pyrrhosoma nymphula (Sulzer)	1	0.14
Prodiamesinae	1	0.14
Sialis fuliginosa Pictet	1	0.14
Baetis sp.	1	0.14
Callicorixa praeusta (Fieber)	1	0.14
Baetis scambus group	1	0.14
Caenis luctuosa (Burmeister)	1	0.14
Theromyzon tessulatum (Muller)	1	0.14
Adicella reducta (Mclachlan)	1	0.14
Agabus guttatus (Paykull)	1	0.14
Agabus sp.	1	0.14
Agapetus sp.	1	0.14
Agraylea sp.	1	0.14
Amphinemura sp.	1	0.14
Amphinemura sulcicollis (Stephens)	1	0.14
Anabolia nervosa (Curtis)	1	0.14
Simulium sp.	1	0.14
Tinodes rostocki Mclachlan	1	0.14
Simulium (Nevermannia) cryophilum group	1	0.14
Anodonta sp.	1	0.14
Antocha vitripennis (Meigen)	1	0.14
Tanytarsini	1	0.14
Asellus meridianus Racovitza	1	0.14
Crenobia alpina (Dana)	1	0.14
Athripsodes albifrons (L.)	1	0.14
Athripsodes bilineatus (L.)	1	0.14
Simulium (Wilhelmia) sp.	1	0.14
Tinodes unicolor (Pictet)	1	0.14
Micropterna sp.	1	0.14
Gerris sp.	1	0.14
Glossiphonia heteroclita (L.)	1	0.14
Glyphotaelius pellucidus (Retzius)	1	0.14
Nemouridae indet	1	0.14
Gyrinidae indet	1	0.14
Gyrinus sp.	1	0.14

Table 62 continued

Species	n	% of Agency's missed species in Primary Audit
Halesus radiatus (Curtis)	1	0.14
Coenagrionidae indet	1	0.14
Helius sp.	1	0.14
Ormosia sp.	1	0.14
Limnephilus sp.	1	0.14
Hydraena riparia Kugelann	1	0.14
Hydraena testacea Curtis	1	0.14
Hydrocyphon deflexicollis (Muller)	1	0.14
Hydrophilidae indet	1	0.14
Hydropsyche angustipennis (Curtis)	1	0.14
Hydropsyche pellucidula (Curtis)	1	0.14
Leptophlebiidae indet	1	0.14
Mystacides nigra (L.)	1	0.14
Pilaria (Pilaria) sp.	1	0.14
Cercyon sp.	1	0.14
Chaetopteryx villosa (Fabricius)	1	0.14
Chironomidae indet	1	0.14
Potamophylax cingulatus (Stephens)	1	0.14
Potamonectes sp.	1	0.14
Platambus maculatus (L.)	1	0.14
Ilybius sp.	1	0.14
Planorbis sp.	1	0.14
Gerris (Gerris) lacustris (L.)	1	0.14
Diamesinae	1	0.14
Gammarus sp.	1	0.14
Dinocras cephalotes (Curtis)	1	0.14
Physa fontinalis (L.)	1	0.14
Perlodes microcephala (Pictet)	1	0.14
Enallagma cyathigerum (Charpentier)	1	0.14
Ephemera danica Muller	1	0.14
Ephemera sp.	1	0.14
Orthotrichia sp.	1	0.14
Ceraclea nigronervosa (Retzius)	1	0.14
Planorbis carinatus/planorbis	1	0.14
Total	**697**	**100**

MISSED TAXA FOR ALL SAMPLES IN THE 1998 AUDIT

Table 63 Missed families for all samples in the 1998 Audit

Family	n	% of missed families in 1998 Audit
Hydroptilidae	61	5.91
Planariidae (incl. Dugesiidae)	45	4.36
Caenidae	44	4.26
Sphaeriidae	42	4.07
Elmidae	39	3.78
Planorbidae	38	3.68
Limnephilidae	35	3.39
Psychomyiidae (incl. Ecnomidae)	35	3.39
Hydrophilidae (incl. Hydraenidae)	34	3.29
Simuliidae	32	3.10
Lymnaeidae	31	3.00
Ancylidae (incl. Acroloxidae)	31	3.00
Hydrobiidae (incl. Bithyniidae)	30	2.90
Baetidae	28	2.71
Nemouridae	27	2.61
Leptoceridae	27	2.61
Glossiphoniidae	27	2.61
Haliplidae	24	2.32
Tipulidae	22	2.13
Hydropsychidae	22	2.13
Dytiscidae (incl. Noteridae)	18	1.74
Gammaridae (incl. Crangonyctidae)	18	1.74
Goeridae	17	1.65
Lepidostomatidae	17	1.65
Polycentropodidae	17	1.65
Chloroperlidae	16	1.55
Ephemerellidae	16	1.55
Valvatidae	15	1.45
Asellidae	14	1.36
Oligochaeta	14	1.36
Leptophlebiidae	14	1.36
Sericostomatidae	13	1.26
Beraeidae	12	1.16
Taeniopterygidae	12	1.16
Rhyacophilidae (incl. Glossosomatidae)	12	1.16
Dendrocoelidae	11	1.06
Gyrinidae	10	0.97
Piscicolidae	10	0.97
Physidae	10	0.97
Leuctridae	10	0.97
Erpobdellidae	8	0.77

Table 63 continued

Family	n	% of missed families in 1998 Audit
Chironomidae	7	0.68
Coenagrionidae	7	0.68
Scirtidae	7	0.68
Libellulidae	6	0.58
Hydrometridae	5	0.48
Notonectidae	4	0.39
Odontoceridae	4	0.39
Corixidae	4	0.39
Philopotamidae	3	0.29
Unionidae	3	0.29
Brachycentridae	3	0.29
Calopterygidae	3	0.29
Gerridae	3	0.29
Perlidae	3	0.29
Sialidae	3	0.29
Heptageniidae	3	0.29
Ephemeridae	3	0.29
Neritidae	2	0.19
Siphlonuridae	1	0.10
Perlodidae	1	0.10
Total	**1033**	**100**

Table 64 Missed species for all samples in the 1998 Audit

Species	n	% of missed species in 1998 Audit
Hydroptila sp.	39	3.60
Pisidium sp.	36	3.32
Potamopyrgus jenkinsi (Smith)	30	2.77
Ancylus fluviatilis Muller	27	2.49
Elmis aenea (Muller)	25	2.31
Caenis luctuosa group	23	2.12
Polycelis nigra group	21	1.94
Hydraena gracilis Germar	21	1.94
Baetis rhodani (Pictet)	21	1.94
Lymnaea peregra (Muller)	21	1.94
Limnephilidae indet	19	1.75
Simulium (Simulium) ornatum group	17	1.57
Ephemerella ignita (Poda)	16	1.48
Caenis rivulorum Eaton	15	1.39
Lype sp.	15	1.39
Haliplus sp.	15	1.39
Gyraulus albus (Muller)	14	1.29
Sericostoma personatum (Spence)	13	1.20
Glossiphonia complanata (L.)	13	1.20
Gammarus pulex (L.)	13	1.20
Helobdella stagnalis (L.)	12	1.11
Asellus aquaticus (L.)	12	1.11
Lepidostoma hirtum (Fabricius)	12	1.11
Chloroperla torrentium (Pictet)	12	1.11
Dendrocoelum lacteum (Muller)	11	1.02
Valvata cristata Muller	11	1.02
Brachyptera risi (Morton)	10	0.92
Piscicola geometra (L.)	10	0.92
Hydropsyche siltalai Dohler	10	0.92
Armiger crista (L.)	9	0.83
Polycelis felina (Dalyell)	9	0.83
Ithytrichia sp.	9	0.83
Habrophlebia fusca (Curtis)	9	0.83
Oxyethira sp.	8	0.74
Hydropsyche sp.	8	0.74
Oulimnius tuberculatus (Muller)	8	0.74
Plectrocnemia conspersa (Curtis)	8	0.74
Orectochilus villosus (Muller)	8	0.74
Tinodes waeneri (L.)	8	0.74
Psychomyia pusilla (Fabricius)	8	0.74
Silo pallipes (Fabricius)	7	0.65

Table 64 continued

Species	n	% of missed species in 1998 Audit
Caenis horaria (L.)	7	0.65
Elodes sp.	6	0.55
Athripsodes aterrimus (Stephens)	6	0.55
Oreodytes sanmarkii (Sahlberg)	6	0.55
Athripsodes cinereus (Curtis)	6	0.55
Lumbriculidae	6	0.55
Libellulidae indet	6	0.55
Dicranota sp.	6	0.55
Sphaeriidae indet	6	0.55
Acroloxus lacustris (L.)	6	0.55
Erpobdella octoculata (L.)	6	0.55
Polycentropus flavomaculatus (Pictet)	6	0.55
Potamonectes depressus (Fabricius)	6	0.55
Agapetus sp.	6	0.55
Beraeodes minutus (L.)	6	0.55
Goera pilosa (Fabricius)	6	0.55
Bathyomphalus contortus (L.)	6	0.55
Hippeutis complanatus (L.)	5	0.46
Chloroperla tripunctata (Scopoli)	5	0.46
Crangonyx pseudogracilis Bousfield	5	0.46
Crenobia alpina (Dana)	5	0.46
Limnius volckmari (Panzer)	5	0.46
Mystacides azurea (L.)	5	0.46
Anisus vortex (L.)	5	0.46
Lymnaea sp.	5	0.46
Oulimnius sp.	5	0.46
Nemoura avicularis Morton	5	0.46
Physa sp.	5	0.46
Haliplus lineatocollis (Marsham)	5	0.46
Baetis vernus Curtis	5	0.46
Protonemura sp.	5	0.46
Beraea maurus (Curtis)	5	0.46
Leuctra fusca (L.)	4	0.37
Rhyacophila sp.	4	0.37
Lepidostomatidae indet	4	0.37
Simulium (Wilhelmia) sp.	4	0.37
Athripsodes sp.	4	0.37
Laccobius (Macrolaccobius) bipunctatus (Fabricius)	4	0.37
Lymnaea truncatula (Muller)	4	0.37
Simulium (Simulium) noelleri Friederichs	4	0.37

Table 64 continued

Species	n	% of missed species in 1998 Audit
Naididae	4	0.37
Polycelis sp.	4	0.37
Nemurella picteti Klapalek	4	0.37
Valvata piscinalis (Muller)	4	0.37
Tubificidae	4	0.37
Tipula sp.	4	0.37
Notonecta sp.	4	0.37
Brychius elevatus (Panzer)	4	0.37
Tipula (Yamatotipula) montium group	4	0.37
Odontocerum albicorne (Scopoli)	4	0.37
Agraylea multipunctata Curtis	3	0.28
Rhyacophila dorsalis (Curtis)	3	0.28
Hydropsyche pellucidula (Curtis)	3	0.28
Brachycentrus subnubilus Curtis	3	0.28
Pyrrhosoma nymphula (Sulzer)	3	0.28
Amphinemura sulcicollis (Stephens)	3	0.28
Hydrometra stagnorum (L.)	3	0.28
Anodonta sp.	3	0.28
Orthocladiinae	3	0.28
Physa acuta group	3	0.28
Nemoura cambrica group	3	0.28
Dugesia polychroa group	3	0.28
Leuctra sp.	3	0.28
Calopteryx splendens (Harris)	3	0.28
Silo sp.	3	0.28
Dinocras cephalotes (Curtis)	3	0.28
Athripsodes bilineatus (L.)	3	0.28
Micronecta sp.	3	0.28
Lymnaea stagnalis (L.)	3	0.28
Planaria torva (Muller)	3	0.28
Planariidae indet	3	0.28
Drusus annulatus (Stephens)	3	0.28
Limnephilus lunatus Curtis	3	0.28
Antocha vitripennis (Meigen)	3	0.28
Simulium (Eusimulium) aureum group	3	0.28
Glossiphonia heteroclita (L.)	2	0.18
Athripsodes albifrons (L.)	2	0.18
Cyrnus flavidus Mclachlan	2	0.18
Cloeon dipterum (L.)	2	0.18
Bithynia tentaculata (L.)	2	0.18

Table 64 continued

Species	n	% of missed species in 1998 Audit
Gerris sp.	2	0.18
Gammarus sp.	2	0.18
Asellus meridianus Racovitza	2	0.18
Baetis scambus group	2	0.18
Agraylea sp.	2	0.18
Chironomidae indet	2	0.18
Anacaena bipustulata (Marsham)	2	0.18
Ephemera sp.	2	0.18
Erpobdellidae indet	2	0.18
Ormosia sp.	2	0.18
Wormaldia sp.	2	0.18
Leptophlebiidae indet	2	0.18
Leuctra geniculata (Stephens)	2	0.18
Micropterna sp.	2	0.18
Mystacides nigra (L.)	2	0.18
Nemoura cinerea (Retzius)	2	0.18
Ischnura elegans (Van der Linden)	2	0.18
Simulium (Boophthora) erythrocephalum (de Geer)	2	0.18
Limnephilus sp.	2	0.18
Sialis sp.	2	0.18
Paraleptophlebia submarginata (Stephens)	2	0.18
Protonemura meyeri (Pictet)	2	0.18
Ilybius sp.	2	0.18
Potamophylax cingulatus/latipennis	2	0.18
Planorbis carinatus/planorbis	2	0.18
Planorbis sp.	2	0.18
Nephrotoma sp.	2	0.18
Triaenodes bicolor (Curtis)	2	0.18
Tinodes unicolor (Pictet)	2	0.18
Hydropsyche angustipennis (Curtis)	2	0.18
Hydraena testacea Curtis	2	0.18
Heptagenia sulphurea (Muller)	2	0.18
Tinodes rostocki Mclachlan	2	0.18
Theromyzon tessulatum (Muller)	2	0.18
Hydraena riparia Kugelann	2	0.18
Hydrometra sp.	2	0.18
Theodoxus fluviatilis (L.)	2	0.18
Agabus sp.	1	0.09
Potamophylax cingulatus (Stephens)	1	0.09
Baetis sp.	1	0.09

Table 64 continued

Species	n	% of missed species in 1998 Audit
Prosimulium hirtipes/latimucro	1	0.09
Beraea pullata (Curtis)	1	0.09
Sialis fuliginosa Pictet	1	0.09
Agabus guttatus (Paykull)	1	0.09
Potamonectes sp.	1	0.09
Adicella reducta (Mclachlan)	1	0.09
Prodiamesinae	1	0.09
Polycentropus sp.	1	0.09
Anacaena globulus (Paykull)	1	0.09
Tanytarsini	1	0.09
Taeniopteryx nebulosa (L.)	1	0.09
Siphlonurus lacustris Eaton	1	0.09
Simulium sp.	1	0.09
Amphinemura sp.	1	0.09
Anabolia nervosa (Curtis)	1	0.09
Silo nigricornis (Pictet)	1	0.09
Simulium (Simulium) reptans (L.)	1	0.09
Amphinemura standfussi Ris	1	0.09
Simulium (Simulium) argyreatum group	1	0.09
Simulium (Nevermannia) lundstromi (Enderlein)	1	0.09
Simulium (Nevermannia) cryophilum group	1	0.09
Aplexa hypnorum (L.)	1	0.09
Ceraclea nigronervosa (Retzius)	1	0.09
Glossiphoniidae indet	1	0.09
Enallagma cyathigerum (Charpentier)	1	0.09
Enchytraeidae	1	0.09
Ephemera danica Muller	1	0.09
Hydrophilidae indet	1	0.09
Esolus parallelepipedus (Muller)	1	0.09
Hydrocyphon deflexicollis (Muller)	1	0.09
Callicorixa praeusta (Fieber)	1	0.09
Hydrobius fuscipes (L.)	1	0.09
Diamesinae	1	0.09
Glossosoma sp.	1	0.09
Glyphotaelius pellucidus (Retzius)	1	0.09
Helophorus (Atracthelophorus) brevipalpis Bedel	1	0.09
Gyrinidae indet	1	0.09
Gyrinus sp.	1	0.09
Helius sp.	1	0.09
Gerris (Gerris) lacustris (L.)	1	0.09

Table 64 continued

Species	n	% of missed species in 1998 Audit
Chaetopteryx villosa (Fabricius)	1	0.09
Brachyptera sp.	1	0.09
Pilaria (Pilaria) sp.	1	0.09
Caenis luctuosa (Burmeister)	1	0.09
Physa fontinalis (L.)	1	0.09
Philopotamus montanus (Donovan)	1	0.09
Perlodes microcephala (Pictet)	1	0.09
Ecdyonurus sp.	1	0.09
Cercyon sp.	1	0.09
Leuctra inermis Kempny	1	0.09
Paraleptophlebia sp.	1	0.09
Orthotrichia sp.	1	0.09
Coenagrionidae indet	1	0.09
Oreodytes sp.	1	0.09
Crunoecia irrorata (Curtis)	1	0.09
Nemouridae indet	1	0.09
Platambus maculatus (L.)	1	0.09
Halesus radiatus (Curtis)	1	0.09
Total	**1083**	**100**