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Enhancement of RIVPACS for biological assessment of the quality of Scottish rivers

Final Report

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Report Date:
Report To:
IFE Report Ref. No:**

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September 1994
The Scottish Office, Environment Department
RL/T04071b1/3**

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EXECUTIVE SUMMARY

1. RIVPACS II is a software package developed by the Institute of Freshwater Ecology (IFE) for use in the assessment of the biological quality of running-water sites. The system is based on biological and environmental data from 438 good quality sites throughout Great Britain, of which 102 (23%) are in Scotland.
2. RIVPACS II was used in the 1990 River Quality Survey (RQS) of Scotland, England and Wales. Within Scotland, it was apparent that the data-base would need to be widened in order to increase the reliability of the prediction system.
3. In the present contract, there was provision for the addition of a minimum of 30 new sites. Sites were chosen in consultation with the Scottish Office Environment Department and each River Purification Board (RPB). In practice, information on 36 new sites was processed.
4. New biological samples were collected by RPB staff at 34 of the 36 sites and existing samples from the 1990 RQS were used for just two sites. All samples were made available to the IFE River Laboratory for sorting and identification of the fauna. The necessary environmental data were collated by RPB and IFE staff. Both the environmental and the biological data were logged on computer and verified prior to use in analyses.
5. This report includes full listings of the macroinvertebrate fauna recorded at each of the 36 sites in each of three seasons (spring, summer and autumn), together with the environmental data for each site, as used in the development of RIVPACS III.
6. Data for a further 17 sites in Scotland was also available to the IFE for use in the development of RIVPACS III. Prior to the analyses, information for a total of 685 sites in Great Britain was assembled for critical appraisal, including 155 sites in Scotland (23% of the total).
7. This was followed by a series of site selection procedures, which included the application of a series of stringent criteria for acceptance of sites and some early exercises in classification and prediction. As a result, the data-base for use in the development of RIVPACS III was reduced to just 614 high quality sites within Great Britain, of which 140 were in Scotland (again 23% of the total for Great Britain).
8. RIVPACS III and the supporting documentation will be supplied to the Scottish Office Environment Department and each River Purification Board as a separate package in due course.

1. INTRODUCTION

1.1 Background

RIVPACS (River Invertebrate Prediction And Classification System) is a software package developed by the Institute of Freshwater Ecology (IFE) with a number of applications for the assessment of the biological quality of running-water sites. The system offers a site-specific prediction of the macroinvertebrate fauna to be expected at a given site with known environmental characteristics in the absence of environmental stress. Comparison of this 'target' invertebrate fauna with the fauna actually present at the site provides a basis for assessing whether there has been a loss of biological quality. RIVPACS II was used in the 1990 River Quality Survey (RQS) in Scotland, England and Wales.

The research which eventually led to the development of RIVPACS started in October 1977. From the beginning, the project had the active collaboration of the Water Authorities in England and Wales and also the River Purification Boards in Scotland. From October 1977 to March 1988 major funding was provided by the Natural Environment Research Council (NERC) and the Department of the Environment (DoE), with additional funding from the Welsh Office (WO) and the Scottish Development Department (SDD) in later years.

Over this period, a biological classification of running-water sites in Great Britain was established, based on the macroinvertebrate fauna, the scope of the classification increasing periodically, as funding allowed. Information on the macroinvertebrate assemblages at sites of high biological quality over a wide range of river systems, offers the best practical baseline for setting standards of biological quality.

Early analyses provided evidence that the type of macroinvertebrate community at a site could be predicted from physical and chemical features (Wright et al 1984). Attention was then focused on refining the procedures for predicting species composition (Moss et al 1987) and examining alternative sets of predictor variables. In 1985 the DoE gave funding to allow the procedures for the prediction of species to be adapted for prediction of Biological Monitoring Working Party (BMWP) families, together with the accompanying biotic indices (BMWP score, number of scoring taxa and Average Score per Taxon (ASPT)).

In 1986/87 a classification and prediction system based on 370 sites was transferred to BBC B microcomputer and 'RIVPACS I' was then tested by the Water Authorities in England and Wales and the River Purification Boards in Scotland.

In 1988 a new classification and prediction system was produced, based on an enlarged database of 438 sites. It retained previous options for prediction of the fauna at different taxonomic levels and, in addition to the standard 3-season predictions, offered single season and paired season predictions. A single comprehensive set of easily-acquired variables, with options for substitution of missing values was recommended in order to standardize the prediction system on the best practicable set of variables.

As before, the initial version was developed on mainframe computer, but it was apparent that the full potential of the system would best be realised by transferring it to Personal Computer.

Funds were provided for the development of 'RIVPACS II' by the newly formed National Rivers Authority (NRA) and during the contract the NRA and IFE agreed to further additions and amendments which would have long-term benefits. These included a menu of six environmental options for prediction, use of a new amended version (Department of the Environment, unpublished) of the Maitland coded checklist for freshwater invertebrates (Maitland 1977) and the testing and implementation of an alternative method of site classification using DECORANA (Cox et al 1991).

RIVPACS II was then made available to the NRA, the RPBs and the DoE (NI) for use on Personal Computers (IBM PS/2 and compatibles) and mainframe computer (DEC/VAX).

A more comprehensive account of the various stages in the development of the system can be found in Wright et al (1993a).

As previously indicated, RIVPACS II has been developed from the data-base containing species identifications and environmental information for 438 running-water sites in Britain. Of these 102 (23%) are from Scotland and the remainder from England and Wales. These data are used to provide predictions by a process of comparison-by-analogy between the sites in the data-base and the sites being assessed. The reliability of a new site prediction is dependent upon there being adequate representation, in RIVPACS, of sites with comparable physical and chemical characteristics.

The use of RIVPACS II in the 1990 RQS provided a valuable test of the system. Although the overall response was generally favourable, it was apparent that RIVPACS II had some deficiencies which need to be rectified in a future version. It has been argued that such weaknesses are to be expected with a new approach (Royal Commission on Environmental Pollution, 1992) and that further developments are justified in an attempt to improve the system.

Within Scotland, the inadequacies of the RIVPACS II data-base for Scottish rivers was pinpointed by the River Purification Board biologists as a result of the 1990 RQS. There was also a recognition by the Scottish Office of the need to widen the data-base to increase the reliability of the prediction system (Scottish Office, 1992).

At the time of the 1990 RQS, the NRA funded the development of a banding system to provide a simple expression of quality in biological terms, but also asked the IFE to undertake a comprehensive testing of RIVPACS II as a separate exercise from the 1990 RQS. The results of the assessment (Wright et al 1991) helped to clarify the basis of some of the deficiencies exposed during the 1990 RQS and the work programme required to secure the improvements needed in RIVPACS III, for use in the 1995 RQS.

Since the construction of RIVPACS II, a further 103 sites have become available for inclusion in the next version as a result of surveys undertaken for what was the Nature Conservancy Council. Of these only 17 (16.5%) are from Scotland. The NRA-funded project on the Faunal Richness of Headwater Streams may add up to 50 sites in England and Wales and the NRA project entitled Testing and Further Development of RIVPACS will result in the addition of a further 55 sites in England and Wales. It is expected that the inclusion of these extra sites will overcome most of the weaknesses of the present system for England and Wales.

The current contract with the Scottish Office allows for a minimum of 30 new sites in Scotland, although in practice 36 sites are being processed. This means that the total number of RIVPACS-compatible sites for Scotland will rise to 155, thereby ensuring that the previous level of representation of sites in Scotland (23%) is maintained.

It is worth emphasizing that before any of the sites in Great Britain are included in the major analyses leading to RIVPACS III, they will be screened. This will ensure that all sites are of an acceptably high biological standard, but also that individual sites are not so unusual as to disrupt the operation of the prediction system. This comprehensive exercise will undoubtedly result in a reduction of the number of sites in Scotland, England and Wales, but we anticipate that the current level of representation of sites in Scotland will be maintained.

1.2 Objectives

The primary objective of the contract is as follows:

- to increase the number of Scottish sites in the extended version of RIVPACS and thereby improve the reliability of biological quality assessment for Scottish rivers.

In addition, there are two subsidiary objectives:

- to provide a detailed and reliable data-base of the biological condition of selected, good quality sites in Scotland as reference against which to assess ecological response to potential future environmental stress (eg climatic change, acidification, land-use change etc)
- to increase knowledge of the distribution of individual species and species assemblages of macroinvertebrates in Scotland, with particular reference to their environmental ranges, and thereby provide information of assistance in the formulation of conservation strategies.

1.3 Schedule of research

The following list of tasks are taken directly from the contract.

1. The project will be managed by the Institute of freshwater Ecology.
2. A minimum of thirty sites will be selected from streams and rivers in Scotland with the primary objective of rectifying areas where the present RIVPACS data-base is inadequate. The two main priority areas are low alkalinity streams on spatey rivers and lowland coastal burns.
3. Sites will be chosen through a process of consultation between the Institute of Freshwater Ecology, biologists within each River Purification Board and The Scottish Office.
4. In general, RPB biologists will be collecting new samples in each of spring, summer and autumn 1992 for processing at the IFE River Laboratory. In one or two instances, samples collected in 1990 as part of the River Quality Survey will be retrieved from long-term storage in Dorset and then processed.

5. All the samples will be sorted, and representative specimens of all macroinvertebrate groups will be removed for identification.
6. These macroinvertebrates, including Oligochaeta and Chironomidae, will then be identified to the best achievable level. This will normally be to species where adequate taxonomic keys are available.
7. Values of relevant environmental features for the thirty sites will be abstracted from the field pro-formas completed during 1990 or 1992 and also from maps and from any other appropriate source.
8. Biological and environmental data will be logged on computer.
9. All identifications and logged data will be subject to verification of their accuracy, prior to analysis.
10. The data for the new sites in Scotland will be incorporated into an enlarged data-set and subjected to mathematical analysis in order to provide an enhanced system for classifying river sites according to their macroinvertebrate fauna and for predicting the fauna to be expected at sites, of known environmental conditions, in the absence of pollution.
11. The results of the analyses will then be incorporated into a new version of the package for classifying and predicting the macroinvertebrate fauna of streams and rivers.
12. Full taxonomic listings for each sample at each site, to the level indicated under 6. above, will be made available to the appropriate River Purification Boards.
13. Two copies of a final project report will be provided to The Scottish Office.
14. In addition, The Scottish Office and each River Purification Board will be supplied with a copy of the software resulting from this contract, together with the supporting documentation. However copyright in the basic RIVPACS system which is being used by the Natural Environment Research Council to carry out this contract is, and will remain, vested in the Council.

1.4 Timing of the work

The formal period of the contract was from 1 April 1992 to 31 March 1994. When the details of the research proposal were discussed in November 1991, the plan was to dovetail the work on sites in Scotland with a separate contract for England and Wales being negotiated with the National Rivers Authority. The financial support from the Scottish Office was essentially to increase the data-base for Scotland, but the final output, in the form of RIVPACS III, was also dependent on the NRA contract.

The contract with the NRA allowed for new sites in England and Wales, but in addition, it included an exploration of new methodologies for classification and prediction and an evaluation of procedures for enhancing the robustness of the next version of RIVPACS. These elements were to precede the analyses leading to RIVPACS III in summer 1994, based on an increased data-base of high quality sites.

Due to changes in the NRA R&D Administration in 1992, the IFE were advised to cease work on the project in summer 1992 pending approval of the project by both the NRA and the DoE. Approval was given in late September 1992 and the studies recommenced.

By March 1994 the processing of new sites in Scotland under the Scottish Office contract was complete and sample processing for England and Wales under the NRA contract was also complete, as planned. Collation of the environmental data for all sites in Great Britain was close to completion, although a decision early in 1994 to request new discharge data for all sites resulted in a delay in completion of this data set until June 1994 (Section 2.3). Most of the elements of the NRA contract relating to robustness were completed in spring 1994 (Clarke et al 1994) and the final analyses on new methods for classification and prediction were complete by June 1994.

The process of site selection for RIVPACS III, which was coupled with the early classification exercises, commenced in June/July 1994. Site selection is now complete and this report gives an account of the basis on which some sites were rejected before the definitive analyses for RIVPACS III commenced. Now that the full list of sites has been chosen, the analyses leading to the new classification and prediction system are proceeding and will continue through the autumn. Once complete, the software for RIVPACS III will be developed, a manual will be written and both elements will be made available to the Scottish Office and each River Purification Board as a separate package.

2. THE SAMPLING PROGRAMME

2.1 Site selection

In March 1992 the IFE team based at the River Laboratory wrote to each River Purification Board to request a list of river types which were excluded from RIVPACS II, but which were considered to be worthy of inclusion in RIVPACS III, in order to make the system more comprehensive. The replies were collated by Mr David Lowson of Forth RPB and forwarded to the IFE in April 1992.

Two main priority areas emerged. First, there was a need for greater representation of low alkalinity sites on spatey rivers. This was particularly relevant in the area covered by the Highland RPB. Second, there was a feeling that lowland and coastal burns were inadequately represented in RIVPACS II.

The letter from IFE also raised the question of the need for more headwater/small stream sites in view of the fact that this was receiving further consideration in England and Wales. The letters received from the RPB regions indicated that this was not considered to be a high priority area.

The results of the Water Quality Survey of Scotland 1990 (Scottish Office, 1992) demonstrated some shortcomings of RIVPACS II in the interpretation of the biological quality of some acidified sites. For example, within Solway and Clyde RPB a small number of sites were put in biological Class A, although it was apparent to RPB biologists that their fauna had been affected by acidification. Given that the impact of acidification on the fauna is most extreme in headwater/small streams and that in badly affected areas it is difficult to find low alkalinity sites which have escaped the effects of acidification, it would seem that this particular problem should be identified using alternative techniques. In consultation with the SOEnD it was therefore agreed that no attempt would be made to select sites which could act as reference sites against which to assess the impact of acidification.

It was further agreed that the allocation of new sites to be examined within the contract should be distributed across the RPB regions according to biological need. This was determined partly using the biological results from the 1990 Water Quality Survey but also on the need to avoid large geographical gaps within the data-base.

After further consultation with RPB biologists, the IFE put forward a strategy to the SOEnD, giving the approximate distribution of new sites between the seven RPB regions. Although a minimum of 30 sites was proposed in the contract, a range of 34 to 45 sites were initially highlighted. This was to take account of the possibility that a few sites would prove to be unsuitable and also that if some sites were species poor, it might be possible to process additional samples.

In general, the RPB biologists expressed a preference for taking new samples in 1992, rather than relying on the samples already held in store by the IFE from the 1990 survey. This was because the identification of molluscs can be difficult after long-term storage, particularly at low alkalinity sites, since the shells tend to dissolve. Hence, with the exception of two sites on the R. Urr in Solway RPB, where the 1990 samples were confirmed as suitable for processing, new sampling took place in 1992.

In 1992 a total of 34 sites were given high priority status for sample collection and processing (Appendix 1 in Wright et al 1992). The following year one site within the Highland RPB was rejected on the advice of Dr J. Hunter as a result of low flows due to hydro-electric generation. On the other hand, three additional sites within Highland RPB were added to the high priority list because efficient sorting and identification of samples had generated additional time within the contract. Finally, within North-East RPB, two sites on the R. Ythan were dropped in favour of replacement sites on the R. Carron, due to problems of sample collection on the R. Ythan. Thus, by 1993 the number of sites had stabilised at 36 (Wright et al 1993).

The list of 36 sites sampled and processed within the contract, together with their National Grid References and sampling dates in spring, summer and autumn are given in Table 1.

2.2 Collection and processing of biological samples

The limits for the collection of the macroinvertebrate samples and accompanying environmental data for each site are February-May for 'spring', June-August for 'summer' and September-January for 'autumn'. Agreement was reached with each RPB region concerning the sampling sites in late April 1992 and therefore the local biologists were able to start the sampling programme in May to ensure that it conformed to the standard protocol.

The biological samples were taken using the standard RIVPACS procedure in each season as previously used in the 1990 RQS, and the preserved samples were forwarded to the IFE River Laboratory for sorting and identification.

Inevitably some problems were encountered in sample collection during 1992, predominantly as a result of high flows or because of practical difficulties in sampling within specified seasonal time limits. However, these difficulties which are documented in earlier progress reports (Wright et al 1992 and 1993b), were all successfully overcome by sampling in 1993 (see Table 1).

The samples for the two sites on the R. Urr in Solway RPB, which were collected in 1990 as part of the River Quality Survey, were retrieved from long-term storage, checked for sample condition and then processed along with the material from the remaining 34 sites.

In sorting each sample, representative specimens of all macroinvertebrate groups were removed for identification and, in addition, the abundance of each family was recorded as a log-category. That is, 1-9 individuals per sample in a family score log category 1, 10-99 score log category 2, 100-999 score log category 3 etc. The macroinvertebrates including Oligochaeta and Chironomidae, were then identified to the best achievable level in order to be wholly compatible with the existing RIVPACS data-base. Identification is normally to species, where reliable taxonomic keys are available, but generic or even family level is used where existing taxonomy is inadequate.

TABLE 1. Listing of the 36 new sites in Scotland with National Grid References and sampling dates.

RIVER	SITE	NGR	SPRING	SUMMER	AUTUMN
<u>Clyde RPB</u>					
Ayr	Nether Wellwood	NS 659262	19 May 92	7 Jul 93	13 Oct 92
Ayr	Mainholm Ford	NS 363215	19 May 92	7 Jul 93	13 Oct 92
Falloch	Keilator	NN 370238	12 May 92	18 Aug 92	17 Nov 92
Falloch	Beinglas	NN 319187	12 May 92	18 Aug 92	17 Nov 92
<u>Forth RPB</u>					
Cocklemill Burn	Kill Conquhar Mill	NO 482025	13 May 92	25 Aug 92	25 Nov 92
Craik Burn	A917 Rd. Br.	NO 611079	13 May 92	25 Aug 92	25 Nov 92
Keil Burn	Pitcruvie Castle	NO 413045	13 May 92	25 Aug 92	25 Nov 92
<u>Highland RPB</u>					
Finnan	Glen Finnan	NM 907808	5 May 92	24 Jul 92	31 Oct 92
Foyers	Dalcrag	NH 495187	5 May 92	28 Jul 92	8 Oct 92
Killin	Killin Lodge	NH 530093	5 May 92	29 Jul 92	8 Oct 92
Spean	Corrie Coille	NN 252808	12 May 92	24 Jul 92	5 Dec 92
Ailort	Craig Ghobhair	NM 853817	5 May 92	24 Jul 92	31 Oct 92
Ailort	Mon	NM 774830	5 May 92	24 Jul 92	31 Oct 92
Shiel	Shiel Bridge	NG 940188	14 May 92	30 Jul 92	26 Oct 92
Arkaig	Strathan	NM 979913	14 May 92	28 Jul 92	31 Oct 92
Meig	Bridgend	NH 323549	15 May 92	29 Jul 92	19 Oct 93
Conon	Moy Bridge	NH 477547	15 May 92	29 Jul 92	8 Oct 92
<u>North East RPB</u>					
Lossie	Cloddach	NJ 203584	14 Apr 93	4 Aug 92	7 Dec 92
Lossie	D/S Blackburn	NJ 185620	14 Apr 93	4 Aug 92	7 Dec 92
Bervie	Inverbervie G.S.	NO 824735	15 Apr 92	28 Jul 92	11 Nov 92
Carron	Tewel Ford	NO 828853	28 May 92	30 Jul 92	11 Nov 92
Canon	Stone haven	NO 874858	28 May 92	30 Jul 92	11 Nov 92
<u>Solway RPB</u>					
Urr	Corsock	NX 766757	2 May 90	20 Aug 90	20 Nov 90
Urr	Haugh of Urr	NX 806660	8 May 90	20 Aug 90	20 Nov 90
Southwick Burn	Nr Southwick House	NX 929574	14 May 92	30 Jul 92	12 Oct 93
<u>Tay RPB</u>					
Earn	Forteviot	NO 048184	19 May 92	29 Jul 92	20 Oct 92
Isla	Wester Cardean	NO 294466	20 May 92	29 Jul 92	20 Oct 92
South Esk	Stannochoy Bridge	NO 584592	28 May 92	6 Aug 92	20 Oct 92
Braan	U/S Tay confluence	NO 023423	18 May 92	5 Aug 92	20 Oct 92
Prosen Water	Prosen Bridge	NO 394586	20 May 92	6 Aug 92	20 Oct 92
Vinny Water	Pitmuies	NO 568496	20 May 92	5 Aug 92	21 Oct 92
Elliot Water	Elliot	NO 620394	20 May 92	30 Jul 92	21 Oct 92
Kenly Water	Stravithie	NO 537112	27 May 92	30 Jul 92	21 Oct 92
<u>Tweed RPB</u>					
Biggar Water	Biggar Public Park	NT 047371	18 May 92	30 Jun 93	15 Oct 92
Tarth Water	Tarth Water Foot	NT 165429	22 Apr 92	29 Jul 92	22 Oct 92
Eden Burn	A6089 Bridge	NT 627451	29 May 92	5 Aug 92	10 Nov 92

2.3 Acquisition of environmental data

The environmental data required for the 36 sites for use in RIVPACS III was acquired from a number of different sources. Standard field data-sheets for recording some environmental features were sent out to RPB biologists in April 1992 for completion at the time of sampling. Once the completed forms were returned to the IFE, the individual season values for width, depth and substratum were used to calculate the mean width, depth and substratum (4 particle size categories expressed as percentages) for each site.

A large majority of the 36 sites had been sampled during the 1990 RQS and therefore, environmental data had already been acquired. In theory, site attributes which are stable over time and which had been acquired from maps could have been abstracted from the 1990 RQS environmental files directly. In practice, and to ensure uniformity of approach with previous IFE procedures for all RIVPACS sites, we re-measured the map-derived data, including distance from source, slope and altitude.

Where available, the mean annual alkalinity values from the 1990 RQS were used, but in all other cases, specific requests for this information were made to the individual RPBs.

The final attribute required for RIVPACS III was discharge category. The IFE have had discussions with the NRA concerning the accuracy of discharge categories as derived from the 1975 River Pollution Survey maps produced by the Water Data Unit and the 1985 versions of these maps for England and Wales. Similar maps for Scotland showing discharge category are lacking and in the past, discharge categories have been derived from a simple calculation based on the width, depth and velocity measurements obtained during the three seasons sampling (Furse et al 1986). Earlier this year it was concluded that throughout Great Britain it might be possible to produce more reliable categories using either gauging station data, where available, or the Institute of Hydrology Micro Low Flow System. In turn, this might help to increase the predictive capability of RIVPACS III. The IFE therefore prepared a full list of the sites in Great Britain potentially available for inclusion in RIVPACS III. Within Scotland, hydrologists within each RPB were asked to give their professional assessment on the most appropriate discharge category, not just for the 36 new sites, but for all 155 sites potentially available for use in RIVPACS III. This has resulted in a number of changes in the discharge categories previously used in RIVPACS II.

2.4 Computer logging and verification of the biological and environmental data

On completion of the sorting and identification of the material from the 36 sites in three seasons (total of 108 samples), the information on species (presence/absence) and families (log categories) was logged on computer. Initial printouts were checked against the original data-sheets, corrected where necessary and the corrections checked. Cross checks were then carried out between the family and species level files and any anomalies corrected. Site-species matrices were constructed for all new data-sets and these were examined independently by three individuals to look for anomalies in the level of identification and for unexpected identifications. All queries were followed up by the re-examination of specimens and in those cases where changes were necessary, these were made and the corrections checked.

In addition, once the environmental data for each site had been collated, it was logged on computer in standard RIVPACS format and verified.

3. THE NEW DATA SET

3.1 Biological data

The full taxon lists for each of the 36 sites sampled within this contract can be found in Appendices 1-7, as follows:

Appendix 1	Clyde RPB	4 sites
Appendix 2	Forth RPB	3 sites
Appendix 3	Highland RPB	10 sites
Appendix 4	North-East RPB	5 sites
Appendix 5	Solway RPB	3 sites
Appendix 6	Tay RPB	8 sites
Appendix 7	Tweed RPB	3 sites

The header in each Appendix lists the River and Site names (in sequence downstream where two sites are on the same river) together with the sampling dates. Within each Appendix, each site has been allotted a number and in the taxon lists which follow, the three columns for each numbered site represent the spring, summer and autumn sampling results. A plus (+) indicates that the taxon named on the left hand side was recorded at that site in the season(s) shown, whilst negative records are coded with a zero (0).

In view of the fact that a high proportion of the studies undertaken by RPB biologists are reported at BMWP Family level, the results for each site are also presented in terms of the BMWP Scores, number of scoring taxa and Average Score Per Taxon (ASPT), based on the 3 seasons data combined (Table 2).

3.2 Environmental data

The environmental data for each site is given in Table 3. The altitude in metres, distance of the site from the source of the river (kilometres) and the slope, measured as metres per kilometre, were all derived from 1:50,000 scale maps. The information on mean annual discharge was provided by each RPB and is given as one of ten categories as follows:

Category 1	< 0.31 cubic metres per second
Category 2	> 0.31-0.62
Category 3	> 0.62-1.25
Category 4	> 1.25-2.5
Category 5	> 2.5-5.0
Category 6	> 5.0-10.0
Category 7	> 10.0-20.0
Category 8	> 20.0-40.0
Category 9	> 40.0-80.0
Category 10	> 80.0

The mean width in metres and the mean depth in centimetres were derived from measurements taken on the three sampling occasions. Note that the total alkalinity in $\text{mg l}^{-1} \text{CaCO}_3$ is the annual mean value based on the available measurements for the site. Finally, the information on the substratum is recorded as four categories, namely boulders/cobbles, pebbles/gravel, sand and silt/clay. Within the sampling area, the percentages of the superficial river bed occupied by each of the four categories were estimated in each sampling season and the mean percentages derived, as given in Table 3.

Table 2. The BMWP score, number of scoring taxa and average score per taxa (ASPT) for each of the 36 sites, based on 3 seasons data combined.

RIVER	SITE NAME	BMWP	NO.TAXA	ASPT
R. Ayr	Nether Wellwood	208	32	6.50
R. Ayr	Mainholm Ford	161	27	5.96
R. Falloch	Keilator	120	17	7.06
R. Falloch	Beinglas	107	16	6.69
Cocklemill Burn	Kill Conquhar Mill	130	24	5.42
Crail Burn	A917 Road Bridge	135	23	5.87
Keil Burn	Pitcruvie Castle	179	29	6.17
R. Finnan	Glen Finnan	136	20	6.80
R. Foyers	Dalcrag	129	18	7.17
R. Killin	Killin Lodge	114	17	6.71
R. Spean	Corrie Coille	156	22	7.09
R. Ailort	Craig Ghobhair	145	22	6.59
R. Ailort	Mon	142	22	6.45
R. Shiel	Shiel Bridge	156	23	6.78
R. Arkaig	Strathan	180	25	7.20
R. Meig	Bridgend	199	28	7.11
R. Conon	Moy Bridge	168	25	6.72
R. Lossie	Cloddach	174	25	6.96
R. Lossie	U/S Blackburn	202	30	6.73
R. Bervie	Inverbervie G.S.	148	24	6.17
R. Carron	Tewel Ford	163	25	6.52
R. Carron	Stonehaven	191	30	6.37
R. Urr	Corsock	236	37	6.38
R. Urr	Haugh of Urr	238	36	6.61
Southwick Burn	Nr. Southwick House	163	25	6.52
R. Eam	Forteviot	208	31	6.71
R. Isla	Wester Cardean	210	32	6.56
South Esk	Stannochoy Bridge	204	31	6.58
R. Braan	U/S Tay Confluence	194	30	6.47
Prosen Water	Prosen Bridge	189	26	7.27
Vinny Water	Pitmuies	167	27	6.19
Elliot Water	Elliot	171	28	6.11
Kenly Water	Stravithie	166	30	5.53
Biggar Water	Biggar Public Park	118	18	6.56
Tarth Water	Tarth Water Foot	183	28	6.54
Eden Burn	A6089 Bridge	158	26	6.08

Table 3. Environmental data for the new sites in Scotland. See text for further explanation.

RIVER	SITE NAME	ALTITUDE	SLOPE	DISCHARGE	DISTANCE	WIDTH	DEPTH	ALKALINITY	BOULDERS/	PEBBLES/	SAND	SILT/
		m	m km ⁻¹	CATEGORY	km	m	cm	mg l ⁻¹ CaCO ₃	COBBLES	GRAVEL		CLAY
R. Ayr	Nether Wellwood	191	2.9	4	14.0	9.9	24.7	95.0	70	28	2	0
R. Ayr	Mainholm Ford	5	1.3	7	59.5	45.3	66.4	83.0	50	50	0	0
R. Falloch	Keilator	176	11.1	3	6.0	8.0	26.4	7.8	78	21	1	0
R. Falloch	Beinglas	13	5.0	6	13.5	19.4	22.0	11.0	40	60	0	0
Cockle mill Burn	Kill Conquhar Mill	16	5.9	2	8.5	2.6	18.9	141.0	65	27	7	1
Crail Burn	A917 Road Bridge	35	20.0	1	4.5	2.0	15.1	224.0	75	20	5	0
Keil Burn	Pitcruvie Castle	47	10.0	1	4.5	4.3	17.8	126.0	67	28	5	0
R. Finnan	Glen Finnan	5	12.5	4	8.0	13.3	37.6	2.3	47	45	8	0
R. Foyers	Dalcrag	139	12.5	6	24.0	23.3	35.6	6.3	64	33	3	0
R. Killin	Killin Lodge	327	6.7	5	12.0	25.7	28.3	5.3	47	45	8	0
R. Spean	Corrie Coille	73	5.0	7	59.0	33.3	41.7	5.3	68	28	3	1
R. Ailort	Craig Ghobhair	45	50.0	2	2.0	2.3	21.1	1.8	55	40	3	2
R. Ailort	Mon	15	9.1	5	10.0	18.3	30.0	1.2	23	62	10	5
R. Shiel	Shiel Bridge	2	2.9	6	16.0	30.0	40.0	5.5	32	60	8	0
R. Arkaig	Strathan	50	8.3	7	10.0	40.0	31.1	4.8	30	62	6	2
R. Meig	Bridgend	100	6.7	6	29.0	25.0	19.4	3.5	13	84	3	0
R. Conon	Moy Bridge	17	1.1	9	54.0	65.0	68.3	3.3	7	83	8	2
R. Lossie	Cloddach	44	8.3	4	27.0	15.1	25.0	23.0	70	30	0	0
R. Lossie	D/S Blackburn	22	2.3	4	32.0	5.0	39.3	28.0	3	47	50	0
R. Bervie	Inverbervie G.S.	9	5.9	4	29.0	7.3	32.0	47.0	55	35	9	1

RIVER	SITE NAME	ALTITUDE	SLOPE	DISCHARGE	DISTANCE	WIDTH	DEPTH	ALKALINITY	BOULDERS/	PEBBLES/	SAND	SILT/
		m	m km ⁻¹	CATEGORY	km	m	cm	mg l ⁻¹ CaCO ₃	COBBLES	GRAVEL		CLAY
R. Carron	Tewel Ford	56	8.3	2	9.0	5.9	21.1	50.0	62	25	12	1
R. Carron	Stonehaven	4	10.0	2	14.0	8.0	15.4	57.0	42	42	10	6
R. Urr	Corsock	106	8.3	4	15.0	15.3	31.3	14.0	68	29	3	0
R. Urr	Haug of Urr	20	2.5	6	27.5	13.7	24.7	33.3	50	50	0	0
Southwick Burn	Nr. Southwick House	16	12.5	3	8.4	7.0	22.9	17.3	47	18	35	0
R. Earn	Forteviot	5	0.8	8	63.0	28.3	44.6	28.0	60	25	12	3
R. Isla	Wester Cardean	39	0.5	6	49.0	31.0	30.5	32.0	27	63	5	5
South Esk	Stannochoy Bridge	25	2.0	7	66.4	19.0	53.3	29.0	70	25	4	1
R. Braan	U/S Tay Confluence	49	2.0	6	32.0	18.8	35.4	16.0	72	28	0	0
Prosen Water	Prosen Bridge	110	11.1	5	25.5	19.7	22.1	23.0	63	37	0	0
Vinny Water	Pitmuies	52	5.6	2	11.5	6.3	7.9	95.0	23	63	7	7
Elliot Water	Elliot	4	12.5	2	11.8	3.3	9.9	112.0	53	42	5	0
Kenly Water	Stravithie	70	50.0	1	10.0	3.8	31.3	120.0	35	53	10	2
Biggar Water	Biggar Public Park	200	1.1	1	6.5	3.8	12.3	78.0	22	67	11	0
Tarth Water	Tarth Water Foot	191	2.3	3	11.0	3.8	30.2	99.0	13	79	8	0
Eden Burn	A6089 Bridge	172	0.1	1	4.8	1.8	10.2	121.0	35	54	10	1

4. SITE SELECTION FOR RIVPACS III

The 155 sites in Scotland potentially available for use in RIVPACS III are listed in Appendix 8. They include 102 sites from RIVPACS II sampled between 1978 and 1986, 17 additional sites sampled under contract to the Nature Conservancy Council in 1989 and 1990 and the 36 sites examined in this contract.

During the examination of the 438 sites in the RIVPACS II data-base by the IFE, funded by the NRA (Wright et al 1991), the detailed assessments provided evidence that a small number of the sites were biologically stressed and should therefore be removed from a future version of RIVPACS.

These findings were acted upon when the IFE examined new methods of classification and prediction under contract to the NRA. From a total of 438 sites in RIVPACS II, 28 sites were rejected, including 11 from Scotland. The major criteria used in the procedure are detailed in a progress report to the NRA (Wright et al 1993c). They included low BMWP Scores, low number of identified taxa, low observed/expected ratios for BMWP Score derived from two separate prediction systems and high dissimilarities with all other sites. Rejected sites included not only those of inadequate biological quality but also a small number whose environmental/biological attributes were very unusual and would have little to offer a prediction system designed for general use.

The 11 sites in Scotland which were rejected prior to the studies on alternative methods of classification and prediction are listed below.

Water of Chon	Kinlochard
R. Forth	Kippen Bridge (Pool sample)
R. Forth	Gargunnoch Bridge (Pool sample)
R. Dee	Linn of Dee
R. Spey	Craigellachie
Balnakeil Stream	Balnakeil
R. Thurso Trib. B	Halsary
R. Balvag	Strathyre
R. Cree	Cordorcan Burn Inflow
Lunan Burn	D/S Loch Clunie
Lunan Burn	Easter Essendy

Note that the R. Forth samples for Kippen Bridge and Gargunnoch Bridge were duplicate samples, restricted to pools and that the riffle samples for these sites were retained.

In the later and separate exercises to decide on the sites to be excluded from RIVPACS III, all 11 of the above sites were excluded. However, the site selection process went through several stages and initially three of the above sites were kept within the data-set for early classification exercises. They included a taxon-poor site (R. Dee, Linn of Dee) and two sites on the Lunan Burn which, in RIVPACS II, had classified with sites south of the border. After further classification and prediction exercises, it was concluded that the samples from the R. Dee at Linn of Dee, together with the samples from two further sites examined in the present contract were not of sufficiently high quality to be acceptable for RIVPACS III.

The latter were:

R. Falloch	Beinglas
Biggar Water	Biggar Public Park

It had been anticipated that the two sites on the Lunan Burn might group with some of the new sites recently added to the Scottish data-base, but in practice they still classified with sites in southern and central England. Therefore they failed to provide a basis for the prediction of similar sites in Scotland and their unusual features lead to their exclusion.

Finally, two further sites:

R. Cree	High Fagan
R. Lonan	Clachadubh

were shown to be very unusual in terms of their species richness and the exceptionally high observed/expected ratios they generated in early prediction systems. Again, their unique qualities would not be useful in the development of a general prediction system and they were rejected.

Initially, 685 sites (155 in Scotland) were considered for RIVPACS III. It was known that a number of these sites, including some of the new headwater stream sites, were of inadequate biological quality and that these, together with a small number of unusual sites, would be rejected before the major RIVPACS III analyses commenced. After the site selection process was complete, the total number of sites remaining was 614, including 140 sites in Scotland. The 15 sites in Scotland which were eventually rejected for RIVPACS III are shown with an asterisk (*) in Appendix 8.

5. ACKNOWLEDGEMENTS

This research was funded by the Scottish Office Environment Department. Mr Richard Arnott provided help and advice before and during the first months of the contract and Mr Malcolm Somerville, the SOEnD nominated officer maintained an active interest in the progress of the work throughout the project. We are grateful to the SOEnD and its staff for their support.

It is also a pleasure to acknowledge the help we have received from each River Purification Board. The biologists in each region went to considerable trouble to collect new samples and complete data forms whilst hydrologists from a number of regions undertook the work to check and correct discharge categories.

Finally we would like to thank Valerie Palmer for typing this report to her usual high standard.

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Appendix 1. Full taxon lists for each new site sampled by Clyde River Purification Board. The three columns for each site represent spring, summer and autumn.
 + = taxon present and O = taxon absent from sample.

1	R. AYR	NETHER WELLWOOD	19 MAY 1992	07 JUL 1993	13 OCT 1992
2	R. AYR	MAINHOLM FORD	19 MAY 1992	07 JUL 1993	13 OCT 1992
3	R. FALLOCH	KEILATOR	12 MAY 1992	18 AUG 1992	17 NOV 1992
4	R. FALLOCH	BEINGLAS	12 MAY 1992	18 AUG 1992	17 NOV 1992

	1	2	3	4
Polycelis felina	+++	000	000	000
Dugesia polychroa group	000	+00	000	000
Potamopyrgus jenkinsi	0++	0++	000	000
Lymnaea peregra	0++	0++	000	000
Ancylus fluviatilis	0++	+0+	000	000
Sphaerium corneum	000	0+0	000	000
Pisidium sp.	0+0	000	000	000
Nais communis group	000	0+0	000	000
Nais communis	000	000	000	0+0
Nais variabilis	000	000	000	0+0
Nais alpina	00+	00+	000	0+0
Nais elinguis	+00	+0+	000	000
Nais bretscheri	+00	000	000	000
Nais pardalis	0+0	000	000	000
Stylaria lacustris	00+	000	000	000
Tubificidae	000	+00	000	000
Tubifex ignotus	000	+00	000	000
Limnodrilus hoffmeisteri	000	+00	000	000
Rhyacodrilus coccineus	+++	+++	000	000
Enchytraeus group	+00	+0+	+00	0++
Lumbriculus variegatus group	00+	000	000	000
Stylodrilus sp.	0+0	000	000	0+0
Stylodrilus heringianus	+00	000	+00	000
Lumbricidae	00+	000	00+	000
Eiseniella tetraedra	+00	000	000	00+
Glossiphonia complanata	00+	0+0	000	000
Helobdella stagnalis	000	0+0	000	000
Erpobdella octoculata	000	+++	000	000
Asellus aquaticus	000	00+	000	000
Gammarus pulex	+++	+++	000	000
Ameletus inopinatus	000	000	+00	+00
Baetis scambus group	0++	0++	0+0	0+0
Baetis rhodani	+++	+++	+++	+++
Baetis muticus	000	000	000	0++
Rhithrogena semicolorata group	+0+	+0+	+++	+++
Heptagenia sulphurea	00+	00+	000	000
Heptagenia lateralis	000	000	+00	+00
Ecdyonurus sp.	0++	+++	0+0	+++
Paraleptophlebia cincta	00+	000	000	000
Ephemerella ignita	0+0	+00	0+0	0+0
Ephemera danica	+00	000	000	000
Caenis luctuosa group	000	+++	000	000
Caenis rivulorum	00+	0++	000	000
Taeniopteryx nebulosa	000	00+	000	000
Brachyptera risi	000	000	000	+0+

	1	2	3	4
Protonemura praecox	000	000	0++	00+
Protonemura meyeri	000	000	00+	00+
Amphinemura sulcicollis	+00	000	00+	+0+
Nemoura avicularis	000	000	000	0+0
Leuctra inermis	000	000	+0+	+0+
Leuctra hippopus	000	000	000	00+
Leuctra fusca	000	0+0	0+0	0+0
Perlodes microcephala	000	000	000	+0+
Diura bicaudata	000	000	000	00+
Isoperla grammatica	+00	+00	00+	00+
Perla bipunctata	+00	000	0++	000
Chloroperla torrentium	000	000	00+	000
Chloroperla tripunctata	000	000	+0+	000
Brychius elevatus	+00	000	000	000
Oreodytes septentrionalis	000	0+0	000	000
Orectochilus villosus	+0+	000	000	000
Elmis aenea	+++	+++	0+0	000
Esolus parallelepipedus	+0+	0+0	000	000
Limnius volckmari	+++	+++	+++	0++
Oulimnius sp.	000	00+	000	000
Oulimnius tuberculatus	+++	000	0+0	00+
Riolus subviolaceus	+00	000	000	000
Rhyacophila dorsalis	0++	+++	0++	000
Glossosoma sp.	0++	+++	000	000
Agapetus sp.	+00	000	000	000
Wormaldia sp.	0+0	000	000	000
Plectrocnemia conspersa	000	000	+00	000
Polycentropus flavomaculatus	000	000	+00	0++
Polycentropus kingi	000	000	000	0+0
Hydropsyche pellucidula	+0+	00+	000	000
Hydropsyche siltalai	+++	+++	000	00+
Hydroptila sp.	0+0	000	000	0+0
Limnephilidae	000	000	+00	000
Potamophylax latipennis	+00	000	000	000
Athripsodes sp.	00+	000	000	000
Athripsodes cinereus	000	+00	000	000
Athripsodes albifrons	000	+00	000	000
Athripsodes bilineatus	+00	000	000	000
Ceraclea annulicornis	000	00+	000	000
Lepidostoma hirtum	+00	+00	000	000
Brachycentrus subnubilus	0+0	+++	000	000
Sericostoma personatum	+0+	000	000	000
Tipula montium group	0++	00+	000	0+0
Limonia sp.	000	000	000	0+0
Antocha vitripennis	000	+00	000	000
Dicranota sp.	0++	0++	0+0	0++
Limnophila (Eloeophila) sp.	+00	000	000	000
Hexatoma sp.	0+0	00+	000	00+
Psychodidae	000	+00	000	000
Ceratopogonidae	+0+	+00	000	000
Trissopelopia longimana	000	000	000	0+0
Diamesa sp.	++0	+00	000	000
Potthastia longimana group	+++	+00	000	0+0
Brillia modesta	000	+00	000	0+0
Cricotopus (Cricotopus) sp.	00+	000	000	000
Eukiefferiella sp.	+00	000	000	000
Eukiefferiella ilkleyensis	0++	+00	000	000
Eukiefferiella minor	0+0	000	000	000
Rheocricotopus sp.	+00	000	000	0+0
Metriocnemus sp.	+00	000	000	000
Thienemanniella sp.	000	0+0	000	0+0
Cricotopus group	+00	+00	+00	000
Tvetenia sp.	+00	+00	++0	0+0
Tvetenia calvescens	0++	0++	000	000

	1	2	3	4
Tvetenia discoloripes group	000	0+0	000	000
Polypedilum sp.	++0	++0	000	0+0
Cladotanytarsus sp.	000	+00	000	000
Rheotanytarsus sp.	+00	000	000	000
Micropsectra group	+00	+00	000	0+0
Simuliidae	000	0+0	000	000
Simulium (Nevermannia) vernal group	000	000	000	++0
Simulium (Nevermannia) cryophilum group	000	000	0++	000
Simulium (Simulium) reptans group	++0	+0+	+00	000
Simulium (Simulium) argyreatum group	0+0	+00	0++	+0+
Simulium (Simulium) argyreatum	000	000	000	0+0
Simulium (Simulium) ornatum group	++0	000	000	000
Chelifera group	+++	000	000	000
Hemerodromia group	0+0	000	000	000
Wiedemannia group	+00	000	000	000
Atherix ibis	+++	+0+	000	000
Limnophora sp.	+0+	000	000	000

Appendix 2. Full taxon lists for each new site sampled by Forth River Purification Board. The three columns for each site represent spring, summer and autumn.
 + = taxon present and O = taxon absent from sample.

1	COCKLEMILL BURN KILL CONQUHAR MILL	13 MAY 1992	25 AUG 1992	25 NOV 1992
2	CRAIL BURN A917 ROAD BRIDGE	13 MAY 1992	25 AUG 1992	25 NOV 1992
3	KEIL BURN PITCRUVIE CASTLE	13 MAY 1992	25 AUG 1992	25 NOV 1992

	1	2	3
Polycelis nigra group	0+0	+++	000
Polycelis felina	+++	+++	00+
Potamopyrgus jenkinsi	+++	+++	+++
Bithynia sp.	0+0	000	000
Lymnaea peregra	+++	000	00+
Ancylus fluviatilis	+++	0++	0++
Zonitoides nitidus	000	0+0	000
Pisidium personatum	000	000	0++
Pisidium subtruncatum	0+0	000	000
Nais barbata	0++	000	000
Nais elinguis	000	+00	000
Tubificidae	0+0	00+	+0+
Psammoryctides barbatus	0+0	000	+00
Limnodrilus hoffmeisteri	000	0+0	000
Rhyacodrilus coccineus	+00	+00	000
Enchytraeus group	00+	00+	00+
Lumbriculus variegatus group	000	+++	000
Stylodrilus sp.	+00	000	000
Stylodrilus heringianus	00+	+++	0++
Lumbricidae	+0+	000	+00
Eiseniella tetraedra	0++	+++	00+
Glossiphonia complanata	+++	+++	00+
Helobdella stagnalis	0+0	0+0	000
Hydracarina	+00	+00	000
Asellus aquaticus	000	00+	000
Crangonyx pseudogracilis	000	00+	000
Gammarus pulex	+++	+++	+++
Baetis scambus group	0+0	000	0+0
Baetis rhodani	+++	+++	+++
Rhithrogena semicolorata group	+0+	000	+++
Ecdyonurus sp.	+++	0+0	+++
Paraleptophlebia submarginata	000	00+	000
Habrophlebia fusca	000	+00	000
Ephemerella ignita	0+0	000	0+0
Brachyptera risi	000	000	00+
Protonemura praecox	000	000	00+
Protonemura meyeri	000	000	0++
Amphinemura sulcicollis	000	+0+	00+
Nemurella picteti	000	0+0	000
Nemoura avicularis	000	00+	000
Nemoura cambrica group	000	00+	000
Leuctra geniculata	000	+00	000
Leuctra inermis	000	000	00+
Leuctra hippopus	00+	+0+	00+
Leuctra fusca	0+0	+00	0+0
Capnia bifrons	000	+00	00+
Isoperla grammatica	+0+	+0+	+0+
Chloroperla torrentium	000	000	+0+
Haliplidae	000	+00	000
Halipylus sp.	0+0	000	000
Oreodytes sanmarkii	0+0	000	+00
Platambus maculatus	000	000	00+

	1	2	3
Ilybius sp.	00+	000	000
Hydrophilidae (incl. Hydraenidae)	000	000	00+
Hydraena gracilis	0+0	000	000
Elodes sp.	0++	000	00+
Elmis aenea	+++	+++	+++
Limnius volckmari	0++	000	000
Rhyacophila dorsalis	0++	000	+++
Rhyacophila obliterated	000	000	0+0
Glossosoma sp.	00+	000	000
Agapetus sp.	000	+0+	000
Plectrocnemia conspersa	000	000	+0+
Hydropsyche pellucidula	0++	000	000
Hydropsyche instabilis	+00	+0+	+0+
Hydropsyche siltalai	+++	000	00+
Hydroptila sp.	000	0+0	000
Drusus annulatus	+0+	+++	+++
Limnophilus lunatus group	+0+	000	000
Limnophilus extricatus	00+	0++	000
Potamophylax cingulatus group	000	000	00+
Potamophylax latipennis	+00	000	000
Potamophylax cingulatus	+00	000	000
Micropterna sequax	000	+0+	000
Chaetopteryx villosa	000	000	0+0
Silo pallipes	000	000	0++
Nephrotoma sp.	000	+00	000
Tipula montium group	+++	0+0	0++
Tipula maxima group	000	00+	000
Dicranota sp.	+++	0+0	+++
Limnophila (Eloeophila) sp.	+00	000	00+
Pilaria (Neolimnomyia) sp.	0+0	000	000
Pericoma blandula	000	0+0	000
Pericoma diversa	000	+00	000
Pericoma exquisita	00+	000	000
Pericoma neglecta	00+	000	00+
Pericoma trivialis group	000	00+	000
Ceratopogonidae	+++	000	000
Thienemannimyia group	0++	0++	000
Diamesa sp.	00+	000	+0+
Brillia modesta	+0+	0++	+0+
Eukiefferiella ilkleyensis	0+0	000	000
Nanocladius sp.	0+0	000	000
Rheocricotopus sp.	+00	000	000
Chaetocladius sp.	000	000	+00
Paraphaenocladius sp.	000	000	0+0
Cricotopus group	+0+	000	+0+
Tvetenia sp.	+0+	000	0+0
Tvetenia calvescens	0+0	00+	000
Prodiamesa olivacea	000	0+0	00+
Chironomus sp.	000	0+0	000
Polypedilum sp.	+00	000	+00
Micropsectra sp.	0++	0+0	000
Tanytarsus brundini	0+0	000	000
Micropsectra group	+00	000	0+0
Simulium (Eusimulium) group	000	00+	000
Simulium (Nevermannia) cryophilum group	000	+00	00+
Simulium (Simulium) ornatum group	+++	000	00+
Wiedemannia group	0+0	000	000
Limnophora sp.	0++	000	00+

Appendix 3. Full taxon lists for each new site sampled by Highland River Purification Board. The three columns for each site represent spring, summer and autumn.
 + = taxon present and O = taxon absent from sample.

1	R. FINNAN	GLEN FINNAN	05 MAY 1992	24 JUL 1992	31 OCT 1992
2	R. FOYERS	DALCRAG	05 MAY 1992	28 JUL 1992	08 OCT 1992
3	R. KILLIN	KILLIN LODGE	05 MAY 1992	29 JUL 1992	08 OCT 1992
4	R. SPEAN	CORRIE COILLE	12 MAY 1992	24 JUL 1992	05 DEC 1992
5	R. AILORT	CRAIG GHOBHAIR	05 MAY 1992	24 JUL 1992	31 OCT 1992
6	R. AILORT	MON	05 MAY 1992	24 JUL 1992	31 OCT 1992
7	R. SHIEL	SHIEL BRIDGE	14 MAY 1992	30 JUL 1992	26 OCT 1992
8	R. ARKAIG	STRATHAN	14 MAY 1992	28 JUL 1992	31 OCT 1992
9	R. MEIG	BRIDGEND	15 MAY 1992	29 JUL 1992	19 OCT 1993
10	R. CONON	MOY BRIDGE	15 MAY 1992	29 JUL 1992	08 OCT 1992

	1	2	3	4	5	6	7	8	9	10
Crenobia alpina	000	000	000	000	+00	000	000	000	+00	000
Lymnaea peregra	000	000	000	000	000	+00	+++	000	000	+++
Ancylus fluviatilis	000	0++	000	000	00+	000	+++	+++	00+	+00
Pisidium sp.	000	000	000	000	000	0++	000	000	000	00+
Pisidium casertanum	000	000	000	000	000	+00	+00	000	000	000
Pisidium personatum	000	000	000	000	000	000	000	000	000	0+0
Pisidium hibernicum	000	000	000	000	000	000	000	000	000	+00
Nais communis group	00+	000	0++	000	00+	0+0	0+0	00+	00+	000
Nais alpina	000	000	00+	000	000	000	0++	00+	000	000
Vejdovskyella comata	000	000	000	000	000	00+	000	000	000	000
Tubificidae	000	000	000	00+	000	000	000	000	000	0++
Tubifex ignotus	000	000	000	000	000	000	000	000	000	0++
Rhyacogrillus coccineus	000	000	000	000	000	000	000	000	000	0++
Enchytraeus group	000	000	0+0	+0+	+++	+++	+++	0++	+++	+++
Lumbriculidae	000	000	000	000	0+0	000	000	000	000	000
Lumbriculus variegatus group	000	000	0+0	000	+00	0++	0++	0++	000	0++
Stylodrilus sp.	0+0	000	0+0	00+	00+	+00	+00	000	00+	0++
Stylodrilus heringianus	+0+	000	000	000	000	000	000	00+	000	000
Lumbricidae	00+	000	000	000	+00	+++	000	000	000	000
Eiseniella tetraedra	000	000	000	000	000	000	+++	000	+++	+++
Hydracarina	++0	000	000	0+0	0+0	+00	+++	0+0	0++	++0
Siphonurus lacustris	000	000	000	000	000	000	000	0+0	000	000
Ameletus inopinatus	000	000	+0+	000	00+	000	000	000	000	000
Baetis scambus group	0+0	0+0	0+0	0+0	000	000	0+0	0++	0++	0+0
Baetis rhodani	+++	+++	+++	+++	++0	0+0	+++	+++	+++	+00
Baetis muticus	000	+00	0+0	+++	000	000	000	+00	000	+00
Centroptilum luteolum	000	000	000	0+0	000	000	000	0+0	000	000
Rhithrogena semicolorata group	+0+	+0+	+0+	+0+	000	000	+0+	+00	+0+	+0+
Heptagenia sulphurea	+00	000	000	000	000	000	00+	000	000	+0+
Heptagenia lateralis	++0	+0+	+00	+0+	000	000	000	000	000	000
Ecdyonurus sp.	+++	+++	00+	+++	000	000	+++	+++	0++	0++
Leptophlebia sp.	000	000	000	00+	000	000	000	000	000	000
Leptophlebia marginata	00+	000	000	000	+00	000	000	000	000	000
Paraleptophlebia submarginata	000	000	000	00+	000	000	000	000	000	000
Ephemerella ignita	0+0	0+0	000	0+0	000	0+0	0++	0++	0+0	0+0
Caenis rivulorum	000	000	000	000	000	000	000	000	+00	000
Brachyptera risi	000	000	000	+0+	+00	000	+0+	000	+0+	000
Protonemura praecox	000	00+	000	000	000	000	000	000	00+	000
Protonemura meyeri	00+	00+	+00	000	00+	000	00+	00+	00+	000
Amphinemura sulciollis	+0+	+0+	00+	+0+	+0+	+0+	+0+	+0+	+0+	+0+
Nemoura cinerea	+00	000	000	000	000	000	000	000	000	000
Nemoura avicularis	00+	000	000	000	00+	000	000	00+	000	000
Nemoura cambrica group	000	000	000	00+	000	000	000	000	000	000
Leuctra sp.	000	000	000	000	+00	000	000	000	000	000
Leuctra inermis	+00	+00	+0+	+00	00+	+00	+0+	+00	+0+	+00
Leuctra hippopus	000	00+	000	000	00+	00+	000	000	000	000

	1	2	3	4	5	6	7	8	9	10
Leuctra fusca	+++	0+0	0+0	++0	0++	0++	+++	0++	+++	0++
Perlodes microcephala	000	000	00+	000	00+	000	000	000	000	000
Isoperla grammatica	+00	+0+	000	+0+	+0+	+0+	+0+	+0+	+0+	+++
Dinocras cephalotes	000	000	000	00+	000	000	000	000	0++	000
Perla bipunctata	000	+00	000	++0	000	000	0+0	+++	+++	000
Chloroperla torrentium	+0+	+0+	+00	+00	+00	+0+	+00	+00	+0+	00+
Chloroperla tripunctata	+0+	+0+	000	+00	+00	000	+00	000	+0+	000
Velia caprai	000	000	000	000	000	00+	000	000	000	000
Brychius elevatus	000	000	000	000	000	000	000	000	00+	000
Dytiscidae (incl. Noteridae)	000	000	000	+00	000	000	000	000	000	000
Oreodytes sp.	0+0	000	0+0	000	000	000	000	0+0	000	000
Oreodytes sanmarkii	+00	000	0+0	0+0	000	000	+00	000	000	0+0
Oreodytes septentrionalis	000	000	000	0+0	000	000	000	000	000	000
Platambus maculatus	000	000	000	000	00+	000	000	000	000	000
Hydrophilidae (incl. Hydraenidae)	0+0	000	000	000	000	000	000	000	000	000
Hydrocyphon deflexicollis	000	000	000	000	000	+00	000	000	+0+	000
Elmis aenea	000	+++	000	000	+++	000	000	+++	00+	+++
Esolus parallelepipedus	000	0++	000	++0	000	000	+0+	00+	+0+	000
Limnius volckmari	+++	+++	0+0	++0	+++	+++	+++	+++	+++	+++
Oulimnius sp.	0+0	000	000	000	000	0+0	00+	000	00+	0+0
Oulimnius tuberculatus	000	++0	000	000	++0	+0+	+++	+++	0+0	00+
Rhyacophila sp.	+00	000	000	000	000	000	000	000	000	000
Rhyacophila dorsalis	0++	00+	00+	00+	00+	00+	+0+	+0+	+++	+++
Rhyacophila obliterata	000	0+0	000	000	000	000	000	000	000	000
Glossosoma sp.	000	000	000	000	000	000	+00	+++	000	000
Agapetus sp.	000	000	000	000	000	000	000	000	000	+0+
Neureclipsis bimaculata	000	000	000	000	000	000	000	000	000	++0
Plectrocnemia conspersa	000	000	00+	000	000	000	000	000	000	000
Polycentropus flavomaculatus	00+	+++	0++	0++	+++	+00	000	+++	+++	000
Polycentropus kingi	0+0	000	000	000	000	000	000	000	00+	000
Cyrnus trimaculatus	000	000	000	00+	000	000	000	000	000	000
Tinodes waeneri	000	000	000	000	0+0	000	000	000	000	000
Psychomyia pusilla	000	000	000	000	000	000	000	+00	000	000
Hydropsyche sp.	000	0+0	000	000	000	000	000	000	000	0+0
Hydropsyche pellucidula	000	00+	000	00+	000	+++	+++	000	+++	+0+
Hydropsyche contubernalis	000	000	000	000	000	000	000	000	000	00+
Hydropsyche siltalai	000	000	000	+00	0++	++0	+++	+++	+0+	+00
Hydroptila sp.	00+	00+	00+	0++	000	+00	+0+	+0+	+0+	++0
Oxyethira sp.	000	0+0	000	000	0+0	000	000	00+	000	000
Limnephilidae	0+0	000	000	000	000	000	000	+00	000	000
Ecclisopteryx guttulata	00+	000	000	000	0+0	000	000	0+0	000	0+0
Potamophylax latipennis group	000	000	000	00+	000	00+	000	000	00+	000
Potamophylax latipennis	000	000	000	000	000	00+	000	000	000	000
Halesus radiatus	000	000	000	000	+0+	000	000	000	0+0	0+0
Allogamus auricollis	000	000	000	000	000	000	000	000	0+0	000
Chaetopteryx villosa	000	000	000	000	0+0	000	000	000	000	000
Athripsodes sp.	000	000	000	000	000	000	0+0	0+0	000	000
Athripsodes albifrons	000	000	000	000	000	000	000	000	000	++0
Athripsodes bilineatus	000	000	000	000	000	+++	+0+	000	0+0	000
Mystacides azurea	000	000	000	000	000	000	000	000	000	0+0
Ceraclia sp.	000	000	000	000	000	000	000	000	000	+00
Ceraclia nigronervosa	000	000	000	000	000	000	000	000	000	0+0
Crunoecia irrorata	000	000	000	00+	000	000	000	000	000	000
Lepidostoma hirtum	000	00+	000	000	000	+0+	000	+00	+0+	+++
Brachycentrus subnubilus	000	000	0+0	000	000	000	000	000	0+0	++0
Sericostoma personatum	00+	000	000	000	000	0+0	00+	+++	+0+	+00
Non-gilled Pyralidae	00+	000	000	000	+00	000	000	000	000	000
Tipula signata group	000	000	000	+00	000	000	000	000	000	000
Tipula montium group	0++	0+0	000	0++	000	+++	000	0+0	0++	00+
Antocha vitripennis	000	000	000	000	000	000	+00	000	00+	000
Dicranota sp.	00+	00+	++0	000	+++	000	+0+	0++	00+	0++
Molophilus sp.	000	000	000	000	000	000	00+	000	000	000
Hexatoma sp.	0++	0+0	0+0	+0+	000	000	000	0++	+++	+++
Macropelopia sp.	0+0	000	000	000	000	000	000	000	000	0+0
Ablabesmyia sp.	000	000	000	000	000	000	000	000	000	0+0
Conchapelopia sp.	0+0	000	000	000	000	0+0	0+0	000	000	000
Nilotanypus dubius	000	000	0+0	000	000	000	000	000	0+0	000
Thienemannimyia group	000	000	000	+00	+0+	00+	+0+	000	000	0+0
Trissopelopia longimana	00+	000	0+0	000	+0+	0+0	000	00+	000	000
Diamesa sp.	000	000	000	+00	000	000	+00	000	000	000
Potthastia gaedii group	0+0	000	0+0	0+0	00+	+00	00+	000	000	0+0
Potthastia longimana group	00+	000	00+	000	000	0++	+0+	00+	+0+	000
Orthocladinae	000	000	+00	000	000	000	000	000	000	000
Brillia longifurca	000	000	000	000	000	000	0+0	000	0+0	000
Brillia modesta	000	000	000	+0+	00+	000	000	00+	00+	000
Cricotopus sp.	000	000	000	000	00+	000	000	000	000	000
Cricotopus (Cricotopus) sp.	000	000	0+0	000	0+0	000	0+0	00+	0+0	0+0
Eukiefferiella brevicar	000	000	000	000	000	000	000	00+	000	000
Eukiefferiella claripennis	000	000	000	000	000	000	000	000	0+0	000
Eukiefferiella ilkleyensis	000	000	000	000	000	000	000	00+	000	000
Heterotrissocladus sp.	000	000	0+0	000	000	0+0	000	0+0	000	000

	1	2	3	4	5	6	7	8	9	10
Paratrichocladius sp.	000	+00	000	000	000	000	000	00+	000	000
Psectrocladius sp.	000	000	000	0+0	000	000	000	000	000	000
Psectrocladius (Psectrocladius) psilopterus	000	000	000	000	000	000	000	000	0+0	000
Psectrocladius (Psectrocladius) octomaculatus	0+0	000	000	000	000	000	000	000	000	000
Rheocricotopus sp.	000	000	000	000	000	0+0	000	000	000	000
Synorthocladus semivirens	000	000	000	000	000	000	000	00+	000	0+0
Chaetocladus sp.	000	000	000	00+	000	000	000	00+	000	000
Corynoneura sp.	000	000	000	000	000	000	00+	00+	000	000
Gymnometriocnemus sp.	0+0	000	000	000	000	000	000	000	000	000
Parametriocnemus stylatus	000	000	000	000	00+	000	000	000	000	000
Pseudosmittia sp.	000	000	000	000	000	00+	000	000	000	000
Thienemanniella sp.	000	000	000	000	+00	000	000	00+	000	000
Cricotopus group	000	000	0+0	+++	+++	+++	+00	+++	0+0	+00
Tvetenia sp.	000	0+0	000	000	000	000	000	+00	000	+++
Tvetenia calvescens	000	000	000	000	000	000	000	00+	0+0	000
Tvetenia discoloripes group	000	000	000	000	000	000	000	00+	0+0	+00
Demicryptochironomus vulneratus	000	000	000	000	000	000	000	0+0	000	000
Microtendipes sp.	000	000	000	0+0	000	+00	000	000	000	0+0
Polypedilum sp.	0+0	0+0	000	0+0	000	000	000	0+0	000	0+0
Cladotanytarsus sp.	000	000	0+0	000	000	000	000	0+0	000	000
Micropsectra sp.	000	000	0+0	000	0+0	000	000	00+	0+0	000
Tanytarsus sp.	000	000	000	000	000	000	000	0+0	000	000
Tanytarsus brundini	000	000	000	000	000	000	000	0+0	0+0	0+0
Rheotanytarsus sp.	0+0	0+0	0+0	0+0	+00	000	0+0	00+	0+0	+++
Stempellinella sp.	000	000	000	000	000	000	000	000	0+0	0+0
Virgatanytarsus sp.	000	000	000	000	000	0++	000	000	000	0+0
Micropsectra group	000	0+0	000	000	+00	000	000	000	000	000
Paratanytarsus group	000	000	000	000	000	000	000	+00	000	000
Prosimulium hirtipes	+00	000	000	000	000	000	000	000	000	000
Prosimulium latimicro	000	000	000	000	000	000	000	000	+00	000
Simulium (Nevermannia) venum group	000	000	000	000	000	000	000	000	0+0	000
Simulium (Nevermannia) cryophilum group	000	000	000	00+	000	000	000	000	000	000
Simulium (Eusimulium) aureum group	000	000	000	000	0+0	000	000	000	000	000
Simulium (Simulium) tuberosum	000	000	000	+00	000	000	000	+00	+00	000
Simulium (Simulium) reptans group	000	0+0	000	+00	000	+00	000	00+	+00	+00
Simulium (Simulium) argyreatum group	+00	000	000	00+	0+0	000	000	000	+++	000
Simulium (Simulium) ornatum group	000	000	0+0	00+	000	000	000	00+	000	000
Empididae	000	+00	000	000	000	+00	000	000	000	000
Chelifera group	000	000	000	000	000	0+0	000	000	000	000
Wiedemannia group	000	000	000	000	+00	000	000	00+	000	000
Dolichopodidae	000	000	000	00+	000	000	000	000	000	000

Appendix 4. Full taxon lists for each new site sampled by North East River Purification Board.
 The three columns for each site represent spring, summer and autumn.
 + = taxon present and O = taxon absent from sample.

1	R. LOSSIE	CLODDACH	14 APR 1993	04 AUG 1992	07 DEC 1992
2	R. LOSSIE	D/S BLACKBURN	14 APR 1993	04 AUG 1992	07 DEC 1992
3	R. BERVIE	INVERBERVIE G.S.	15 APR 1992	28 JUL 1992	11 NOV 1992
4	R. CARRON	TEWEL FORD	28 MAY 1992	30 JUL 1992	11 NOV 1992
5	R. CARRON	STONEHAVEN	28 MAY 1992	30 JUL 1992	11 NOV 1992

	1	2	3	4	5
Hydridae	0+0	0+0	000	000	0+0
Polycelis nigra group	000	00+	000	000	000
Polycelis felina	000	000	00+	+++	++0
Potamopyrgus jenkinsi	0+0	0+0	+++	000	+++
Lymnaea peregra	+++	++0	000	0+0	000
Ancylus fluviatilis	+++	+++	+0+	+++	+++
Pisidium sp.	000	0+0	000	+0+	000
Pisidium casertanum	000	00+	000	000	000
Pisidium personatum	000	000	00+	000	00+
Pisidium hibernicum	000	00+	000	000	000
Chaetogaster diaphanus	000	000	000	000	0+0
Nais communis group	000	000	00+	000	000
Nais alpina	+0+	000	+0+	+0+	0+0
Nais barbata	000	000	000	000	0++
Nais elinguis	000	000	000	000	+0+
Nais pardalis	0+0	0+0	00+	+00	0+0
Tubificidae	000	00+	00+	000	000
Rhyacodrilus coccineus	+00	000	000	000	+++
Enchytraeus group	+++	+00	0+0	+++	+++
Lumbriculus variegatus group	000	0++	000	000	+++
Stylodrilus sp.	00+	0+0	000	0++	0+0
Stylodrilus heringianus	+00	+0+	+++	000	000
Lumbricidae	000	000	+00	0++	+++
Eiseniella tetraedra	+0+	+00	0+0	+0+	000
Helobdella stagnalis	000	000	000	000	00+
Erpobdella octoculata	000	000	+0+	000	00+
Hydracarina	0+0	+++	000	000	+0+
Gammarus pulex	000	00+	+++	+0+	+0+
Baetis scambus group	0+0	0+0	0+0	000	000
Baetis rhodani	+++	+++	+++	+++	+++
Baetis muticus	+++	+++	000	00+	000
Centroptilum luteolum	000	0+0	000	000	000
Rhithrogena semicolorata group	+0+	+0+	+++	0++	+0+
Ecdyonurus sp.	0++	+0+	+++	+0+	+++
Paraleptophlebia submarginata	000	000	000	000	00+
Ephemerella ignita	0+0	0+0	0++	+00	+0+
Ephemerella danica	000	+0+	000	000	000
Caenis rivulorum	+0+	000	+00	00+	+++
Taeniopteryx nebulosa	000	000	00+	000	000
Brachyptera risi	000	000	000	00+	000
Protonemura sp.	0+0	000	000	000	000
Protonemura praecox	00+	000	000	+0+	000
Protonemura meyeri	00+	000	00+	0+0	000
Amphinemura sp.	000	0+0	000	000	000
Amphinemura sulcicollis	+0+	+0+	00+	00+	+0+
Nemurella picteti	000	000	000	000	00+

	1	2	3	4	5
Nemoura cambrica group	000	000	000	000	00+
Leuctra geniculata	000	000	++0	000	000
Leuctra inermis	+0+	000	000	0+0	000
Leuctra hippopus	00+	000	000	000	00+
Leuctra fusca	0+0	0+0	0++	00+	++0
Capnia sp.	000	000	000	000	00+
Perlodes microcephala	00+	00+	00+	000	000
Isoperla grammatica	00+	00+	+0+	0++	+0+
Dinocras cephalotes	+++	000	000	+++	+++
Perla bipunctata	0++	00+	000	000	000
Chloroperla torrentium	+0+	00+	+00	00+	+00
Oreodytes sanmarkii	000	0+0	000	000	0+0
Platambus maculatus	000	00+	000	000	000
Hydraena gracilis	000	0+0	000	+++	00+
Elmis aenea	+++	+++	+++	+++	+++
Esolus parallelepipedus	+++	+++	+++	000	000
Limnius volckmari	+++	+++	+++	+++	+++
Oulimnius tuberculatus	000	+++	000	000	000
Rhyacophila sp.	000	000	000	0+0	000
Rhyacophila dorsalis	+++	+++	+++	+0+	+0+
Rhyacophila obliterata	000	000	000	00+	000
Glossosoma sp.	000	000	000	0++	++0
Glossosoma boltoni	0+0	000	000	000	000
Agapetus sp.	+++	+++	000	+0+	+00
Plectrocnemia conspersa	000	000	000	000	+00
Polycentropus flavomaculatus	0++	000	+++	000	+0+
Psychomyia pusilla	000	+0+	000	000	000
Hydropsyche pellucidula	+++	+++	+++	000	00+
Hydropsyche instabilis	+0+	+00	000	+++	+0+
Hydropsyche siltalai	0++	000	+++	00+	000
Limnephilidae	000	000	0+0	0+0	000
Drusus annulatus	000	000	000	00+	+00
Ecclisopteryx guttulata	+++	0++	+00	000	00+
Anabolia nervosa	000	0+0	000	000	000
Potamophylax cingulatus group	00+	000	000	000	000
Potamophylax latipennis	000	000	+00	000	000
Halesus sp.	0+0	000	000	000	000
Halesus radiatus	000	000	000	00+	000
Athripsodes sp.	0+0	000	000	000	000
Athripsodes bilineatus	000	+++	000	000	000
Athripsodes commutatus	000	+00	000	000	000
Silo sp.	00+	000	000	000	000
Silo pallipes	+00	+0+	000	000	000
Lepidostoma hirtum	+0+	+0+	000	000	000
Sericostoma personatum	+++	0++	000	+++	+0+
Tipula montium group	000	00+	000	000	0+0
Tipula maxima group	000	000	000	000	00+
Pedicia (Pedicia) group	000	000	000	000	++0
Dicranota sp.	+++	+++	++0	+++	+++
Limnophila (Eloeophila) sp.	000	0+0	000	0++	+00
Hexatoma sp.	+++	+++	000	000	000
Pericoma neglecta	000	000	000	000	00+
Ceratopogonidae	000	+0+	+++	0++	0++
Conchapelopia sp.	000	000	000	+00	0+0
Thienemannimyia group	00+	000	0+0	000	+00
Diamesa sp.	000	000	000	000	+++
Potthastia gaedii group	0+0	0+0	000	000	000
Potthastia longimana group	+00	000	000	00+	000
Sympotthastia zavreli	+00	000	000	000	000
Brillia modesta	00+	0+0	0++	+++	+++
Cricotopus sp.	000	000	000	000	0+0
Cricotopus (Cricotopus) sp.	000	0+0	000	+00	++0
Cricotopus (Cricotopus) trifascia	000	0+0	0+0	000	000

	1	2	3	4	5
Eukiefferiella claripennis	000	+00	000	000	000
Eukiefferiella clypeata	++0	000	000	00+	000
Eukiefferiella ilkleyensis	0+0	000	++0	+00	++0
Orthocladius (Euorthocladius) rivulorum	+00	000	000	000	000
Orthocladius (Euorthocladius) thienemanni	+00	000	000	000	++0
Paratrachocladius sp.	0+0	0+0	0+0	000	0++
Rheocricotopus sp.	000	000	++0	000	+00
Synorthocladius semivirens	0+0	000	000	000	000
Cricotopus group	++0	0+0	++0	000	+++
Tvetenia sp.	+00	000	+00	000	000
Tvetenia calvescens	0++	++0	0++	++0	0+0
Tvetenia discoloripes group	0++	000	000	+++	0++
Microtendipes sp.	000	000	00+	000	000
Polypedilum sp.	++0	0+0	++0	+0+	0++
Stictochironomus sp.	000	0+0	000	000	000
Cladotanytarsus sp.	000	0+0	000	+00	000
Micropsectra sp.	+0+	000	0+0	++0	0++
Tanytarsus sp.	000	0+0	000	00+	++0
Tanytarsus brundini	000	0+0	000	000	0+0
Rheotanytarsus sp.	+00	0+0	+00	000	000
Stempellinella sp.	+00	000	000	000	000
Micropsectra group	000	000	+00	000	000
Simulium (Nevermannia) cryophilum group	+0+	000	000	000	00+
Simulium (Wilhelmia) sp.	000	0+0	000	000	000
Simulium (Simulium) reptans group	+00	000	+0+	0++	000
Simulium (Simulium) argyreatum group	00+	000	00+	0+0	000
Simulium (Simulium) ornatum group	000	000	0+0	++0	0++
Empididae	000	+00	000	000	0+0
Chelifera group	000	000	+00	00+	00+
Wiedemannia group	+00	0++	000	0+0	+0+
Dolichopodidae	000	000	000	00+	000
Atherix ibis	0++	+++	000	000	000
Ephydriidae	000	000	000	000	00+
Limnophora sp.	000	000	0+0	000	000

Appendix 5. Full taxon lists for each new site sampled by Solway River Purification Board. The three columns for each site represent spring, summer and autumn.

+ = taxon present and O = taxon absent from sample.

1	R. URR	CORSOCK	02 MAY 1990	20 AUG 1990	20 NOV 1990
2	R. URR	HAUGH OF URR	08 MAY 1990	20 AUG 1990	20 NOV 1990
3	SOUTHWICK BURN	NR. SOUTHWICK HOUSE	14 MAY 1992	30 JUL 1992	12 OCT 1993

	1	2	3
Polycelis felina	+00	000	+++
Dendrocoelum lacteum	0+0	000	000
Valvata piscinalis	0+0	000	000
Potamopyrgus jenkinsi	000	+++	0+0
Lymnaea peregra	000	+++	000
Bathyomphalus contortus	0+0	000	000
Ancylus fluviatilis	0++	+++	00+
Pisidium sp.	000	+00	000
Pisidium nitidum	000	0+0	000
Nais alpina	+00	000	+++
Tubificidae	000	00+	000
Rhyacodrilus coccineus	000	+00	000
Aulodrilus pluriseta	000	++0	000
Enchytraeus group	00+	+++	00+
Lumbriculus variegatus group	++0	000	+++
Stylodrilus sp.	+++	00+	000
Stylodrilus heringianus	000	++0	00+
Lumbricidae	000	+00	00+
Eiseniella tetraedra	00+	00+	0+0
Glossiphonia complanata	00+	00+	000
Erpobdella octoculata	+0+	000	000
Dina lineata	0++	000	000
Trocheta bykowskii	000	+++	000
Hydracarina	+00	++0	0++
Gammarus pulex	+++	+++	0++
Baetis scambus group	++0	++0	++0
Baetis rhodani	+++	0++	+++
Baetis muticus	+00	0+0	000
Centroptilum luteolum	0+0	000	000
Procloeon bifidum	0+0	000	000
Rhithrogena semicolorata group	+0+	+0+	+0+
Heptagenia sulphurea	00+	000	000
Heptagenia lateralis	000	000	+00
Ecdyonurus sp.	0++	+++	+++
Leptophlebia sp.	00+	000	000
Leptophlebia marginata	0+0	000	000
Paraleptophlebia submarginata	0++	000	000
Ephemerella ignita	++0	++0	0+0
Caenis rivulorum	+++	+++	000
Taeniopteryx nebulosa	00+	000	000
Nemouridae	0+0	000	000
Protonemura meyeri	00+	00+	0++
Amphinemura sulcicollis	+00	+0+	+0+
Leuctra geniculata	0+0	+00	000
Leuctra hippopus	00+	00+	000
Leuctra fusca	0+0	++0	++0
Capnia bifrons	000	00+	000
Perlodes microcephala	0++	0++	00+
Isoperla grammatica	+0+	+00	+0+
Perla bipunctata	+00	+++	000

	1	2	3
Chloroperla torrentium	+0+	+0+	+00
Chloroperla tripunctata	000	+00	+++
Potamonectes depressus	+00	000	000
Stictotarsus duodecimpustulatus	0+0	000	000
Oreodytes sanmarkii	+00	0+0	+00
Platambus maculatus	0+0	000	0+0
Orectochilus villosus	+00	+00	000
Hydraena gracilis	+00	+++	0++
Helophorus brevipalpis	0+0	000	000
Hydrocyphon deflexicollis	+++	000	000
Elmis aenea	+++	+++	+++
Esolus parallelepipedus	+00	+++	0++
Limnius volckmari	+++	+++	+++
Oulimnius sp.	0++	00+	000
Oulimnius tuberculatus	+00	000	+00
Sialis fuliginosa	0+0	000	000
Rhyacophila dorsalis	+00	+++	+++
Glossosoma sp.	000	0+0	000
Agapetus sp.	+00	+++	00+
Philopotamus montanus	000	000	0+0
Polycentropus flavomaculatus	0++	+++	0++
Polycentropus kingi	000	000	00+
Psychomyia pusilla	000	+00	000
Hydropsyche sp.	000	000	00+
Hydropsyche pellucidula	0++	0++	000
Hydropsyche siltalai	+++	+++	+++
Hydroptila sp.	+++	0+0	000
Limnephilidae	000	0+0	000
Drusus annulatus	00+	000	+00
Ecclisopteryx guttulata	000	000	0++
Potamophylax cingulatus group	00+	00+	000
Potamophylax latipennis	000	000	00+
Halesus radiatus	000	000	+00
Odontocerum albicorne	000	0+0	+0+
Athripsodes sp.	00+	000	000
Athripsodes bilineatus	000	+00	000
Ceraclea annulicornis	0+0	000	000
Lepidostoma hirtum	+0+	+0+	000
Brachycentrus subnubilus	000	0++	000
Sericostoma personatum	0++	+++	+++
Tipula montium group	0+0	+00	0+0
Dicranota sp.	000	0+0	+++
Limnophila (Eloeophila) sp.	000	000	00+
Pericoma fallax	000	00+	000
Ceratopogonidae	000	+00	000
Ablabesmyia sp.	0+0	000	000
Conchapelopia sp.	000	0+0	000
Nilotanypus dubius	+00	000	000
Trissopelopia longimana	0+0	000	000
Zavreliomyia group	0+0	000	000
Diamesa sp.	000	+00	+00
Potthastia gaedii group	0+0	+00	000
Potthastia longimana group	000	00+	000
Brillia modesta	000	000	+++
Eukiefferiella sp.	+00	0+0	000
Eukiefferiella ilkleyensis	000	000	+00
Nanocladius sp.	0+0	000	000
Rheocricotopus sp.	000	000	00+
Synorthocladius semivirens	+00	+00	000
Corynoneura sp.	000	000	00+
Thienemanniella sp.	0+0	000	0++
Cricotopus group	+00	+00	+00
Tvetenia sp.	+00	+00	0+0

	1	2	3
Tvetenia calvescens	000	000	00+
Microtendipes sp.	0++	+++	000
Polypedilum sp.	++0	++0	0+0
Micropsectra sp.	000	000	00+
Paratanytarsus sp.	0+0	000	000
Rheotanytarsus sp.	++0	0+0	+++
Stempellinella sp.	000	000	0+0
Micropsectra group	0++	0+0	0+0
Simulium (Nevermannia) venum group	000	000	0+0
Simulium (Nevermannia) cryophilum group	000	000	0++
Simulium (Eusimulium) aureum group	000	0+0	0+0
Simulium (Wilhelmia) sp.	000	0+0	000
Simulium (Simulium) tuberosum	+00	000	000
Simulium (Simulium) reptans group	++0	0+0	0+0
Simulium (Simulium) argyreatum group	000	0+0	0+0
Simulium (Simulium) ornatum group	000	00+	000
Chelifera group	+00	000	000
Wiedemannia group	000	++0	0+0
Atherix ibis	00+	000	000
Atherix marginata	+00	000	000

Appendix 6. Full taxon lists for each new site sampled by Tay River Purification Board. The three columns for each site represent spring, summer and autumn.

+ = taxon present and O = taxon absent from sample.

1	R. EARN	FORTEVIOT	19 MAY 1992	29 JUL 1992	20 OCT 1992			
2	R. ISLA	WESTER CARDEAN	20 MAY 1992	29 JUL 1992	20 OCT 1992			
3	SOUTH ESK	STANNOCHY BRIDGE	28 MAY 1992	06 AUG 1992	20 OCT 1992			
4	R. BRAAN	U/S TAY CONFLUENCE	18 MAY 1992	05 AUG 1992	20 OCT 1992			
5	PROSEN WATER	PROSEN BRIDGE	20 MAY 1992	06 AUG 1992	20 OCT 1992			
6	VINNY WATER	PITMUIES	20 MAY 1992	05 AUG 1992	21 OCT 1992			
7	ELLIOT WATER	ELLIOT	20 MAY 1992	30 JUL 1992	21 OCT 1992			
8	KENLY WATER	STRAVITHIE	27 MAY 1992	30 JUL 1992	21 OCT 1992			

	1	2	3	4	5	6	7	8
Polycelis felina	000	000	000	+00	000	000	000	00+
Dendrocoelum lacteum	000	000	00+	000	000	000	000	000
Potamopyrgus jenkinsi	000	0++	+++	000	000	+++	0++	+++
Lymnaea palustris	000	000	000	000	000	000	0+0	000
Lymnaea peregra	0+0	0+0	+++	+++	000	+0+	+0+	+0+
Armiger crista	000	000	000	000	000	0+0	0+0	00+
Bathynomphalus contortus	000	000	000	0+0	000	000	000	000
Ancylus fluviatilis	0++	00+	+00	000	000	+++	+0+	+0+
Margaritifera margaritifera	000	000	+00	000	000	000	000	000
Pisidium sp.	000	000	000	000	000	0+0	000	000
Pisidium casertanum	000	000	000	000	000	00+	000	000
Pisidium personatum	000	000	000	000	000	000	00+	000
Nais pardalis	000	000	000	+0+	0+0	000	+00	000
Tubificidae	+00	0+0	00+	000	000	00+	000	00+
Tubifex ignotus	000	+00	000	000	000	000	000	000
Psammoryctides barbatus	000	000	000	000	000	000	000	+00
Rhyacodrilus coccineus	000	000	+00	000	000	000	000	000
Aulodrilus plurisetia	000	00+	000	000	000	000	000	000
Enchytraeus group	+0+	+++	+++	+0+	0++	0++	+00	00+
Lumbriculus variegatus group	000	00+	000	000	000	000	000	00+
Stylodrilus sp.	00+	000	000	+00	0+0	0++	+00	00+
Stylodrilus heringianus	000	0++	00+	000	000	000	00+	000
Lumbricidae	+00	+++	+00	+00	++0	+++	++0	000
Eiseniella tetraedra	000	000	0+0	00+	000	000	000	000
Glossiphonia complanata	000	00+	000	000	000	000	000	0++
Helobdella stagnalis	000	000	000	000	000	000	000	00+
Erpobdella octoculata	000	+++	+0+	000	000	+0+	++0	+0+
Hydracarina	+++	+00	0+0	+++	0+0	000	0+0	+0+
Asellus sp.	0+0	000	000	000	000	000	000	000
Asellus aquaticus	+0+	000	000	+0+	000	000	000	+0+
Crangonyx pseudogracilis	+00	000	000	000	000	00+	000	000
Gammarus pulex	+00	+++	+++	+++	0+0	+++	+++	+++
Siphonurus lacustris	+00	000	000	000	000	000	000	000
Baetis scambus group	++0	0+0	++0	++0	0+0	000	0+0	+00
Baetis rhodani	+++	+++	+0+	+++	+++	+++	+++	+++
Baetis muticus	+00	++0	+00	+00	++0	000	000	000
Centroptilum luteolum	+0+	000	000	000	000	000	000	000
Proclleon bifidum	000	0+0	000	000	000	000	000	000
Rhithrogena semicolorata group	+++	+++	+++	+++	+++	+0+	00+	+0+
Heptagenia sp.	000	000	000	00+	000	000	000	000

	1	2	3	4	5	6	7	8
Heptagenia sulphurea	+++	000	000	0+0	000	000	000	000
Ecdyonurus sp.	+++	++0	+++	++0	+++	0++	0++	0++
Leptophlebiidae	000	000	000	000	000	000	00+	000
Habrophlebia fusca	000	000	000	000	000	000	000	0+0
Ephemerella ignita	++0	++0	++0	++0	0+0	+00	++0	++0
Ephemerella notata	000	+00	000	000	000	000	000	000
Caenis rivulorum	+00	+0+	+00	+00	+++	+0+	+00	00+
Taeniopteryx nebulosa	000	00+	000	000	000	000	000	000
Protonemura sp.	000	000	000	000	0+0	000	000	000
Protonemura meyeri	000	00+	000	00+	00+	000	000	000
Amphinemura sp.	000	0+0	000	0+0	000	00+	000	000
Amphinemura sulcicollis	000	+0+	000	00+	+0+	+00	000	000
Nemoura cambrica group	000	000	000	000	000	000	00+	000
Leuctra geniculata	++0	+00	+00	0+0	000	000	+00	0+0
Leuctra inermis	000	+00	000	+00	+00	000	000	000
Leuctra hippopus	000	00+	000	000	00+	00+	+0+	00+
Leuctra fusca	0+0	0+0	++0	++0	0+0	0+0	0+0	0+0
Perlodes microcephala	0++	00+	0++	00+	000	000	000	000
Isoperla grammatica	+00	+0+	+00	+00	000	00+	00+	00+
Dinocras cephalotes	00+	+++	+00	000	+++	000	000	000
Perla bipunctata	000	+++	+++	000	+++	000	000	000
Chloroperla torrentium	+00	+00	+00	+00	00+	000	+00	000
Velia sp.	000	000	000	000	000	+00	000	0+0
Micronecta sp.	+00	000	00+	000	000	000	000	000
Haliphus sp.	0+0	000	000	000	000	000	000	00+
Haliphus lineatocollis	000	000	+00	000	000	000	000	000
Potamonectes depressus	+00	000	000	000	000	000	000	+00
Stictotarsus duodecimpustulatus	0+0	000	000	000	000	000	000	000
Oreodytes sanmarkii	000	++0	0+0	+00	0+0	+00	0+0	+++
Oreodytes septentrionalis	+00	000	++0	000	000	000	000	000
Agabus sp.	000	000	000	000	000	000	000	0+0
Platambus maculatus	000	000	000	000	000	000	0+0	+0+
Orectochilus villosus	+0+	000	000	00+	000	000	000	000
Hydraena gracilis	000	+00	000	00+	0++	000	+++	+0+
Helophorus sp.	+00	000	000	000	000	000	000	000
Elodes sp.	000	000	000	000	000	000	000	+0+
Elmis aenea	+++	+++	+++	+++	+++	+++	+++	+++
Esolus parallelepipedus	+++	+++	+++	00+	+++	0+0	000	000
Limnius volckmari	+++	+++	+++	+++	+++	+++	+++	+++
Oulimnius sp.	0++	00+	000	00+	000	000	000	000
Oulimnius tuberculatus	+00	0+0	000	0+0	+00	000	000	000
Riolus cupreus	000	000	000	0+0	000	000	000	000
Riolus subviolaceus	000	000	+00	000	000	000	000	000
Sialis fuliginosa	000	00+	000	000	000	000	000	000
Rhyacophila sp.	000	000	000	000	000	000	000	00+
Rhyacophila dorsalis	+++	+++	+++	+++	+++	000	0++	++0
Rhyacophila oblitterata	000	0+0	+00	000	000	000	000	000
Glossosoma sp.	+++	0++	0++	+++	+++	000	000	000
Agapetus sp.	+++	+++	+++	0+0	+++	00+	000	000
Philopotamus montanus	000	000	000	000	00+	000	000	000
Plectrocnemia sp.	000	000	000	000	000	000	00+	000
Polycentropus flavomaculatus	0+0	0++	++0	+++	000	000	000	000
Psychomyia pusilla	000	000	+00	+00	000	000	000	000
Hydropsyche sp.	000	0+0	000	000	000	000	00+	000
Hydropsyche pellucidula	0++	00+	+++	0++	0++	0++	000	000
Hydropsyche instabilis	000	+0+	000	+00	+++	000	000	+00
Hydropsyche siltalai	+++	+0+	+0+	0++	000	+++	+0+	+0+
Cheumatopsyche lepida	000	000	000	+0+	000	000	000	000
Hydroptila sp.	000	000	000	+00	000	000	000	000
Limnephilidae	000	000	000	000	000	000	000	0+0
Drusus annulatus	000	+00	++0	000	000	000	00+	+0+
Ecclisopteryx guttulata	000	0+0	00+	000	00+	000	000	000
Limnephilus sp.	000	+00	000	000	000	000	000	00+

	1	2	3	4	5	6	7	8
Limnephilus lunatus group	000	000	000	000	000	000	000	+00
Anabolia nervosa	+00	+00	+00	000	000	000	000	000
Potamophylax group	000	+00	+00	000	000	000	000	000
Potamophylax sp.	000	000	000	000	00+	000	000	000
Potamophylax cingulatus group	000	000	00+	000	000	000	000	00+
Potamophylax latipennis	000	000	000	000	+00	000	000	000
Halesus sp.	000	+00	000	000	000	+00	+00	000
Micropterna sequax	000	000	000	000	000	000	000	00+
Odontocerum albicorne	000	000	000	000	0+	000	000	000
Athripsodes sp.	000	+00	000	000	+00	000	000	000
Athripsodes cinereus	+0+	+00	000	000	000	000	000	000
Athripsodes albifrons	+0+	000	+++	000	000	000	000	000
Athripsodes bilineatus	000	000	+00	000	000	+00	000	000
Athripsodes commutatus	000	00+	+0+	000	000	000	000	000
Mystacides azurea	+00	000	000	000	000	000	000	000
Ceraclea dissimilis	000	000	000	+00	000	000	000	000
Silo pallipes	000	+0+	000	000	0++	00+	000	000
Lepidostoma hirtum	+0+	+0+	+0+	+0+	+00	+00	000	000
Brachycentrus subnubilus	00+	000	+++	0++	0+0	000	000	000
Sericostoma personatum	0+0	+++	+++	+00	+++	+++	00+	+00
Tipula montium group	0++	0++	00+	00+	000	+++	+00	00+
Limonia sp.	000	000	000	000	000	000	000	0+0
Antocha vitripennis	000	+0+	000	000	000	000	000	000
Dicranota sp.	+00	+00	+00	000	+++	000	000	00+
Hexatoma sp.	000	000	+++	000	0+0	000	000	000
Pericoma sp.	000	000	000	000	000	000	000	00+
Pericoma blandula	000	000	000	000	000	000	0+0	000
Pericoma diversa	000	000	000	000	000	000	+00	000
Pericoma neglecta	000	000	000	000	000	00+	000	+0+
Ceratopogonidae	000	+00	0+0	000	000	000	+00	00+
Apsectrotanypus trifascipennis	000	+00	000	000	000	000	000	000
Macropelopia sp.	000	+00	000	000	000	000	000	000
Ablabesmyia sp.	000	000	000	0+0	000	000	000	000
Conchapelopia sp.	000	000	000	000	000	+00	000	000
Thienemannimyia group	+00	000	000	+00	0+0	000	000	000
Thienemannimyia sp.	+00	000	000	000	000	000	0+0	000
Trissopelopia longimana	000	000	000	0+0	000	000	000	0+0
Diamesa sp.	000	000	000	000	000	+00	+00	+00
Potthastia gaedii group	+00	000	0+0	+00	000	000	000	000
Potthastia longimana group	+0+	000	000	0+0	000	00+	000	+0+
Brillia longifurca	000	000	000	000	0+0	000	000	000
Brillia modesta	000	00+	+00	000	0+0	0+0	+++	+++
Cricotopus sp.	+00	000	+00	+00	+00	000	000	000
Cricotopus (Cricotopus) sp.	000	000	000	0+0	000	000	000	000
Cricotopus (Cricotopus) trifascia	000	000	000	000	000	000	000	00+
Cricotopus (Isocladius) sp.	0+0	000	000	000	000	000	000	000
Eukiefferiella claripennis	000	000	000	000	000	000	+++	+++
Eukiefferiella clypeata	+00	0+0	000	000	000	000	000	000
Eukiefferiella ilkleyensis	000	000	+00	000	+00	000	000	+00
Eukiefferiella minor	000	000	+00	+00	000	000	+00	000
Orthocladius sp.	000	000	000	000	000	+00	000	000
Orthocladius (Euorthocladius) rivulorum	000	000	+00	000	000	000	000	000
Orthocladius (Euorthocladius) thienemanni	+00	000	+00	000	000	000	000	+00
Paratrachocladius sp.	+00	+00	+00	0+0	000	000	000	000
Rheocricotopus sp.	+00	000	+00	+00	0+0	000	000	0+0
Synorthocladius semivirens	000	000	0+0	000	000	000	+00	000
Metriocnemus sp.	000	000	000	000	000	000	+00	000
Paratrissocladius excerptus	000	+00	000	000	000	000	000	000
Thienemanniella sp.	+00	000	000	000	000	000	000	000
Cricotopus group	+++	0+0	0+0	+00	000	000	+00	+0+
Tvetenia sp.	000	000	000	000	+00	00+	000	000
Tvetenia calvescens	+00	+00	0+0	0+0	0+0	+00	+++	+++
Tvetenia discoloripes group	000	0+0	+00	0++	0++	+00	0+0	0+0

	1	2	3	4	5	6	7	8
Demicryptochironomus vulneratus	+00	000	000	000	000	000	000	000
Microtendipes sp.	0++	00+	000	0++	000	000	000	00+
Paratendipes sp.	000	+00	000	000	000	000	000	000
Polypedilum sp.	++0	++0	++0	++0	++0	++0	++0	++0
Stictochironomus sp.	0+0	00+	000	000	000	000	000	00+
Cladotanytarsus sp.	000	+00	000	000	000	000	000	000
Micropsectra sp.	00+	+0+	0+0	+00	+++	000	0++	+++
Paratanytarsus sp.	0+0	000	0+0	000	000	000	0+0	000
Tanytarsus sp.	0+0	000	0+0	000	000	000	000	000
Tanytarsus brundini	0+0	0+0	0+0	0+0	000	000	000	000
Rheotanytarsus sp.	+00	000	++0	++0	+++	000	+00	000
Simulium (Nevermannia) cryophilum group	000	000	000	000	000	000	+00	0+0
Simulium (Nevermannia) cryophilum	000	000	000	000	000	000	000	+00
Simulium (Eusimulium) aureum group	000	000	000	000	000	00+	000	000
Simulium (Wilhelmia) sp.	000	0++	000	000	000	000	000	000
Simulium (Simulium) reptans group	+++	++0	+00	000	0+0	000	000	000
Simulium (Simulium) argyreatum group	+00	00+	000	00+	00+	000	000	000
Simulium (Simulium) ornatum group	0+0	0+0	000	000	000	+++	+++	+++
Empididae	000	000	000	0+0	000	0+0	000	000
Chelifera group	+00	000	+00	+00	000	000	000	000
Hemerodromia group	00+	000	+00	000	000	000	+00	000
Atalanta group	000	000	000	000	000	000	0+0	000
Wiedemannia group	0+0	000	+00	000	000	000	000	+00
Atherix ibis	+++	0++	0++	+++	000	000	000	000
Phaonia group	000	000	000	000	000	000	00+	000
Limnophora sp.	000	0+0	000	000	000	000	0+0	+0+

Appendix 7. Full taxon lists for each new site sampled by Tweed River Purification Board. The three columns for each site represent spring, summer and autumn.

+ = taxon present and O = taxon absent from sample.

1	BIGGAR WATER	BIGGAR PUBLIC PARK	18 MAY 1992	30 JUN 1993	15 OCT 1992
2	TARTH WATER	TARTH WATER FOOT	22 APR 1992	29 JUL 1992	22 OCT 1992
3	EDEN BURN	A6089 BRIDGE	29 MAY 1992	05 AUG 1992	10 NOV 1992

	1	2	3
Polycelis felina	0+0	000	000
Lymnaea peregra	000	+00	000
Ancylus fluviatilis	+++	000	+0+
Pisidium sp.	000	000	00+
Pisidium subtruncatum	000	000	0+0
Nais elinguis	0+0	000	000
Psammoryctides barbatus	000	00+	000
Limnodrilus hoffmeisteri	000	00+	000
Rhyacodrilus coccineus	000	+++	000
Enchytraeus group	+++	+00	000
Lumbriculus variegatus group	000	+0+	000
Stylodrilus sp.	000	00+	000
Lumbricidae	+++	+00	+0+
Eiseniella tetraedra	000	0+0	000
Glossiphonia complanata	000	00+	00+
Helobdella stagnalis	000	0++	000
Erpobdellidae	000	000	00+
Erpobdella octoculata	000	0++	000
Hydracarina	0+0	000	00+
Gammarus pulex	+++	+++	+++
Baetis scambus group	000	0+0	000
Baetis vernus	000	0+0	000
Baetis rhodani	+++	+++	+++
Rhithrogena semicolorata group	+++	+0+	+00
Ecdyonurus sp.	000	0+0	+++
Paraleptophlebia submarginata	000	000	00+
Habrophlebia fusca	000	000	0++
Ephemerella ignita	0+0	0+0	+00
Taeniopteryx nebulosa	000	0+0	000
Brachyptera risi	+00	+00	000
Protonemura meyeri	000	00+	000
Amphinemura sulcicollis	000	000	+00
Leuctra sp.	000	000	+00
Leuctra inermis	000	+00	000
Leuctra fusca	0+0	0+0	0+0
Capnia bifrons	000	000	00+
Diura bicaudata	000	000	00+
Isoperla grammatica	0+0	+00	+00
Chloroperla torrentium	0+0	+00	000
Chloroperla tripunctata	+00	000	000
Velia sp.	0+0	000	000
Brychius elevatus	000	0+0	+00
Oreodytes sanmarkii	000	0+0	+00
Hydraena gracilis	000	0+0	+0+
Helophorus brevipalpis	000	000	0+0
Elodes sp.	000	0+0	+00
Elmis aenea	+++	0++	+++
Esolus parallelepipedus	+00	000	000
Limnius volckmari	+++	+00	+++
Oulimnius tuberculatus	000	0+0	+00

	1	2	3
<i>Sialis lutaria</i>	000	000	00+
<i>Rhyacophila</i> sp.	0+0	000	0+0
<i>Rhyacophila dorsalis</i>	000	+++	000
<i>Rhyacophila septentrionis</i>	000	000	+0+
<i>Rhyacophila obliterata</i>	000	000	+00
<i>Glossosoma</i> sp.	+0+	000	000
<i>Agapetus</i> sp.	0+0	0+0	0++
<i>Hydropsyche pellucidula</i>	000	+00	000
<i>Hydropsyche siltalai</i>	+00	++0	000
<i>Drusus annulatus</i>	+++	+++	+++
<i>Ecclisopteryx guttulata</i>	00+	+0+	000
<i>Limnephilus lunatus</i> group	000	000	+00
<i>Anabolia nervosa</i>	000	000	+00
<i>Potamophylax cingulatus</i> group	000	000	+0+
<i>Potamophylax latipennis</i>	000	+00	000
<i>Silo pallipes</i>	000	00+	+0+
<i>Lepidostoma hirtum</i>	000	+00	000
<i>Brachycentrus subnubilus</i>	000	+00	000
<i>Sericostoma personatum</i>	000	+00	000
<i>Tipula montium</i> group	000	++0	00+
<i>Pedicia</i> (<i>Pedicia</i>) group	000	+00	000
<i>Dicranota</i> sp.	+++	+++	+++
<i>Limnophila</i> (<i>Eloeophila</i>) sp.	000	+00	+00
<i>Pericoma neglecta</i>	0+0	000	000
<i>Macropelopia</i> sp.	000	000	0+0
<i>Thienemannimyia</i> group	000	000	+++
<i>Diamesa</i> sp.	++0	000	000
<i>Potthastia longimana</i> group	0+0	000	000
<i>Brillia modesta</i>	0+0	000	+0+
<i>Rheocricotopus</i> sp.	000	000	0+0
<i>Cricotopus</i> group	0+0	000	0+0
<i>Tvetenia calvescens</i>	000	0+0	++0
<i>Tvetenia discoloripes</i> group	0+0	000	000
<i>Prodiamesa olivacea</i>	000	000	00+
<i>Polypedilum</i> sp.	0+0	++0	000
<i>Micropsectra</i> sp.	000	000	0++
<i>Tanytarsus</i> sp.	000	000	0++
<i>Rheotanytarsus</i> sp.	000	000	00+
<i>Simulium</i> (<i>Nevermannia</i>) <i>cryophilum</i> group	000	000	00+
<i>Simulium</i> (<i>Nevermannia</i>) <i>angustitarse</i> group	000	000	00+
<i>Simulium</i> (<i>Wilhelmia</i>) sp.	0+0	00+	000
<i>Simulium</i> (<i>Wilhelmia</i>) <i>equinum</i>	000	0+0	000
<i>Simulium</i> (<i>Simulium</i>) <i>ornatum</i> group	0+0	0++	0++
<i>Chelifera</i> group	0+0	+00	000
<i>Wiedemannia</i> group	++0	000	000
<i>Atherix ibis</i>	000	0++	000
<i>Limnophora</i> sp.	000	000	0+0

Appendix 8. The full list of sites in Scotland available for use in RIVPACS III. After further consideration, sites marked with an asterisk (*) were rejected. See text for further details.

R. TEITH	TEITH BRIDGE, CALLANDER	NN 628 078	29 MAY 78	30 AUG 78	31 OCT 78
R. TEITH	LAIGHLANDS	NN 668 045	29 MAY 78	01 SEP 78	31 OCT 78
R. TEITH	BRIDGE OF TEITH, DOUNE	NN 723 013	29 MAY 78	01 SEP 78	31 OCT 78
*WATER OF CHON	KINLOCHARD	NN 435 035	24 MAY 78	14 AUG 78	31 OCT 78
R. FORTH	ABERFOYLE BRIDGE	NN 507 014	24 MAY 78	30 AUG 78	31 OCT 78
R. FORTH	PARKS OF GARDEN	NS 599 974	24 MAY 78	29 AUG 78	30 OCT 78
R. FORTH	KIPPEN BRIDGE	NS 669 960	23 MAY 78	29 AUG 78	30 OCT 78
*R. FORTH	KIPPEN BRIDGE (POOL)	NS 669 960	26 MAY 78	29 AUG 78	13 OCT 78
R. FORTH	GARGUNNOCK BRIDGE	NS 710 956	23 MAY 78	29 AUG 78	30 OCT 78
*R. FORTH	GARGUNNOCK BRIDGE (POOL)	NS 710 956	25 MAY 78	31 AUG 78	13 OCT 78
R. FORTH	DRIP BRIDGE	NS 770 955	23 MAY 78	02 AUG 78	30 OCT 78
R. TYNE (FORTH RPB)	CRICHTON	NT 378 618	29 MAY 78	15 AUG 78	28 NOV 78
R. TYNE (FORTH RPB)	ORMISTON	NT 413 689	29 MAY 78	15 AUG 78	28 NOV 78
R. TYNE (FORTH RPB)	EASTER PENCAITLAND	NT 459 690	30 MAY 78	15 AUG 78	28 NOV 78
R. TYNE (FORTH RPB)	HADDINGTON WEIR	NT 513 733	30 MAY 78	15 AUG 78	28 NOV 78
R. TYNE (FORTH RPB)	EAST LINTON	NT 593 772	01 JUN 78	15 AUG 78	28 NOV 78
*R. DEE	LINN OF DEE	NO 061 896	04 MAY 78	12 SEP 78	23 OCT 79
R. DEE	BRAEMAR	NO 143 915	04 MAY 78	12 SEP 78	23 OCT 79
R. DEE	BALMORAL	NO 271 944	31 MAY 78	11 OCT 78	23 OCT 79
R. DEE	D/S BALLATER	NO 385 965	22 MAY 78	12 SEP 78	23 OCT 79
R. DEE	D/S ABOYNE	NO 557 980	22 MAY 78	12 SEP 78	22 OCT 79
R. DEE	POTARCH BRIDGE	NO 608 973	22 MAY 78	06 OCT 78	23 OCT 79
R. DEE	D/S BANCHORY	NO 719 964	22 MAY 78	06 OCT 78	22 OCT 79
R. DEE	CULTS	NJ 904 023	22 MAY 78	06 OCT 78	22 OCT 79
R. SPEY	GARVA BRIDGE	NN 522 947	07 MAY 79	05 JUN 78	11 OCT 78
R. SPEY	LAGGAN BRIDGE	NN 614 943	07 MAY 79	05 JUN 78	11 OCT 78
R. SPEY	NEWTONMORE	NN 708 980	07 MAY 79	05 JUN 78	11 OCT 78
R. SPEY	BOAT OF GARTEN	NH 946 188	07 MAY 79	06 JUN 78	11 OCT 78
R. SPEY	GRANTOWN	NJ 038 264	07 MAY 79	06 JUN 78	11 OCT 78
R. SPEY	MARYPARK	NJ 183 388	07 MAY 79	09 AUG 79	11 OCT 78
*R. SPEY	CRAIGELLACHIE	NJ 283 452	08 MAY 79	09 AUG 79	11 OCT 78
R. SPEY	GARMOUTH	NJ 343 610	08 MAY 79	06 JUN 78	11 OCT 78
R. STINCHAR	HIGHBRIDGE	NX 395 956	09 JUN 78	10 JUL 79	01 OCT 79
R. STINCHAR	D/S DALQUHAIRN	NX 321 957	31 MAR 78	10 JUL 79	01 OCT 79
R. STINCHAR	D/S BARR	NX 272 937	31 MAR 78	10 JUL 79	01 OCT 79
R. STINCHAR	PINMORE BRIDGE	NX 204 899	09 JUN 78	10 JUL 79	01 OCT 79
R. STINCHAR	D/S COLMONELL	NX 140 858	31 MAR 78	10 JUL 79	01 OCT 79
R. STINCHAR	BALLANTRAE	NX 089 825	31 MAR 78	10 JUL 79	01 OCT 79
R. ANNAN	ABOVE ERICSTANE	NT 073 110	10 APR 81	17 JUN 81	07 SEP 81
R. ANNAN	MOFFAT	NT 079 058	10 APR 81	17 JUN 81	07 SEP 81
R. ANNAN	NEWTON BRIDGE	NY 109 949	10 APR 81	17 JUN 81	07 SEP 81
R. ANNAN	MILLHOUSE BRIDGE	NY 105 854	10 APR 81	17 JUN 81	07 SEP 81
R. ANNAN	WILLIAMWATH BRIDGE	NY 118 760	10 APR 81	17 JUN 81	07 SEP 81
R. ANNAN	BRYDEKIRK	NY 187 707	10 APR 81	17 JUN 81	07 SEP 81
ALLT COIRE CRUBAIDH	ALLT COIRE CRUBAIDH	NH 086 531	04 MAY 81	03 AUG 81	29 SEP 81
R. LAIR	ACHNASHELLACH LODGE	NH 002 481	04 MAY 81	03 AUG 81	29 SEP 81
FIONN-ABHAINN	FIONN-ABHAINN	NG 957 453	04 MAY 81	03 AUG 81	29 SEP 81
R. CARRON	D/S LOCH DAMHAIN	NH 081 520	04 MAY 81	03 AUG 81	29 SEP 81
R. CARRON	CRAIG	NH 023 488	04 MAY 81	03 AUG 81	29 SEP 81
R. CARRON	BALNACRA	NG 978 458	04 MAY 81	03 AUG 81	29 SEP 81
R. CARRON	NEW KELSO	NG 940 425	04 MAY 81	03 AUG 81	29 SEP 81
R. TRALIGILL	GLENBAIN	NC 250 218	06 MAY 81	15 JUL 81	03 DEC 81
R. LOANAN	D/S LOCH AWE	NC 250 162	06 MAY 81	15 JUL 81	03 DEC 81
R. LOANAN	INCHADAMPH	NC 246 216	06 MAY 81	15 JUL 81	03 DEC 81
R. INVER	LITTLE ASSYNT	NC 154 250	06 MAY 81	15 JUL 81	03 DEC 81
R. INVER	LOCHINVER	NC 097 232	06 MAY 81	15 JUL 81	03 DEC 81
*BALNAKEIL STREAM	BALNAKEIL	NC 392 686	21 APR 81	11 AUG 81	03 NOV 81
DURNESS STREAM	U/S DURNESS	NC 403 669	21 APR 81	11 AUG 81	03 NOV 81
R. HALLADALE	FORSINARD LODGE	NC 893 438	28 APR 81	04 AUG 81	20 OCT 81
R. HALLADALE	FORSINAIN	NC 903 486	28 APR 81	04 AUG 81	20 OCT 81
R. HALLADALE	MILLBURN	NC 890 560	28 APR 81	04 AUG 81	20 OCT 81
R. HALLADALE	GOLVAL	NC 896 618	28 APR 81	04 AUG 81	20 OCT 81
BURN OF AULTACHLEVEN	U/S LOCH RANGAG	ND 180 420	05 MAY 81	28 JUL 81	17 NOV 81
LITTLE RIVER	TACHER	ND 170 469	05 MAY 81	28 JUL 81	17 NOV 81
R. THURSO	WESTERDALE	ND 130 518	05 MAY 81	28 JUL 81	17 NOV 81
R. THURSO	SORDALE	ND 143 621	05 MAY 81	28 JUL 81	17 NOV 81
R. TWEED	FINGLAND	NT 055 194	27 APR 81	05 AUG 81	22 OCT 81
R. TWEED	NETHER RIGS	NT 080 230	27 APR 81	05 AUG 81	22 OCT 81
R. TWEED	KINGLEDORES	NT 109 285	27 APR 81	05 AUG 81	22 OCT 81
R. TWEED	CROWNHEAD BRIDGE	NT 165 355	27 APR 81	05 AUG 81	22 OCT 81
R. TWEED	PEEBLES GAUGE	NT 258 400	27 APR 81	05 AUG 81	22 OCT 81
R. TWEED	OLD TWEED BRIDGE	NT 488 323	28 APR 81	06 AUG 81	21 OCT 81
R. TWEED	DRY GRANGE BRIDGE	NT 576 347	28 APR 81	06 AUG 81	19 OCT 81
R. TWEED	D/S BIRGHAM	NT 814 393	28 APR 81	06 AUG 81	19 OCT 81
R. TWEED	CANNY ISLAND	NT 893 465	28 APR 81	06 AUG 81	19 OCT 81
CAORUNN ACHAIDH	COMER	NN 386 043	02 MAY 84	03 AUG 84	02 NOV 84
ALLT TAIRBH	TEAPOT	NN 440 032	02 MAY 84	03 AUG 84	02 NOV 84

GREEN BURN	DALMARY	NS 515 955	02 MAY 84	03 AUG 84	02 NOV 84
R. CARRON	U/S LOCH SGAMHAIN	NH 116 537	25 APR 84	10 AUG 84	16 OCT 84
R. THURSO TRIBUTARY A	ACHAVANICH	ND 180 408	17 APR 84	28 AUG 84	08 NOV 84
*R. THURSO TRIBUTARY B	HALSARY	ND 173 482	17 APR 84	28 AUG 84	08 NOV 84
R. THURSO TRIBUTARY C	WESTERDALE	ND 123 517	17 APR 84	28 AUG 84	08 NOV 84
R. BRAN	LEDGOWAN	NH 128 553	25 APR 84	10 AUG 84	16 OCT 84
R. TEITH	BLACKDUB	NS 763 966	21 MAY 86	06 AUG 86	23 OCT 86
R. LARIG	BLAIRCREICH	NN 437 181	21 MAY 86	07 AUG 86	23 OCT 86
*R. BALVAG	STRATHYRE	NN 559 168	21 MAY 86	07 AUG 86	23 OCT 86
R. CREE	WHEEB BRIDGE	NX 302 806	15 MAY 86	31 JUL 86	16 OCT 86
*R. CREE	HIGH FAGAN	NX 341 774	15 MAY 86	31 JUL 86	16 OCT 86
*R. CREE	CORDORCAN BURN INFLOW	NX 380 709	15 MAY 86	31 JUL 86	16 OCT 86
R. CREE	NEWTON STEWART	NX 415 648	15 MAY 86	31 JUL 86	16 OCT 86
R. STRONTIAN	ARIUNDE OAKWOOD NNR	NM 843 641	16 MAY 86	01 AUG 86	17 OCT 86
R. STRONTIAN	ANAHEILT	NM 816 624	16 MAY 86	01 AUG 86	17 OCT 86
CNOCLOISGTE WATER	U/S LOCH CALUIM	ND 025 511	19 MAY 86	03 AUG 86	19 OCT 86
FORSS WATER	ACHALONE	ND 041 630	18 MAY 86	04 AUG 86	19 OCT 86
FORSS WATER	CROSSKIRK	ND 029 699	18 MAY 86	04 AUG 86	19 OCT 86
BURN OF LATHERONWHEEL	DEN MOSS	ND 179 360	17 MAY 86	03 AUG 86	19 OCT 86
BURN OF LATHERONWHEEL	LANDHALLOW	ND 184 332	18 MAY 86	03 AUG 86	19 OCT 86
R. OYKEL	CAPLICH	NC 351 028	17 MAY 86	05 AUG 86	20 OCT 86
R. OYKEL	STRATH OYKEL	NC 438 014	17 MAY 86	04 AUG 86	20 OCT 86
LUNAN BURN	FORNETH	NO 097 452	20 MAY 86	06 AUG 86	22 OCT 86
*LUNAN BURN	D/S LOCH CLUNIE	NO 125 443	20 MAY 86	06 AUG 86	22 OCT 86
*LUNAN BURN	EASTER ESSENDY	NO 148 433	20 MAY 86	05 AUG 86	22 OCT 86
R. BRORA	DALNESSIE	NC 631 155	16 APR 89	08 JUL 89	14 OCT 89
R. BRORA	U/S BALNACOIL	NC 789 106	15 APR 89	09 JUL 89	14 OCT 89
R. BRORA	D/S LOCH BRORA	NC 870 046	14 APR 89	08 JUL 89	16 OCT 89
R. BLACKWATER	CREAG DHUBH	NC 684 202	15 APR 89	09 JUL 89	15 OCT 89
R. BLACKWATER	POLLIE	NC 747 160	15 APR 89	09 JUL 89	15 OCT 89
R. LAXFORD	D/S LOCH STACK	NC 257 447	15 APR 89	11 JUL 89	16 OCT 89
WHITEADDER	CRANSHAWS	NT 689 626	20 APR 90	21 AUG 90	15 NOV 90
WHITEADDER	PRESTON HAUGH	NT 774 577	20 APR 90	27 AUG 90	15 NOV 90
WHITEADDER	U/S ALLANTON	NT 864 547	19 APR 90	24 AUG 90	12 NOV 90
WHITEADDER	CHESTERFIELD FORD	NT 937 536	20 APR 90	24 AUG 90	12 NOV 90
BLACKADDER	HALLIBURTON BRIDGE	NT 677 478	18 APR 90	23 AUG 90	9 NOV 90
BLACKADDER	FOGO	NT 770 491	18 APR 90	23 AUG 90	9 NOV 90
BLACKADDER	BLACKADDER WATER FOOT	NT 864 545	18 APR 90	24 AUG 90	12 NOV 90
R. BLADNOCH	GLASSOCH BRIDGE	NX 333 695	11 APR 90	30 AUG 90	21 NOV 90
R. BLADNOCH	SPITTAL	NX 360 579	?? MAY 90	30 AUG 90	?? NOV 90
*R. LONAN	CLACHADUBH	NM 937 280	04 APR 90	24 JUL 90	05 NOV 90
LUSRAGAN BURN	CLUNY VILLA	NM 908 327	04 APR 90	24 JUL 90	05 NOV 90
R. AYR	NETHER WELLWOOD	NS 659 262	19 MAY 92	07 JUL 93	13 OCT 92
R. AYR	MAINHOLM FORD	NS 363 215	19 MAY 92	07 JUL 93	13 OCT 92
R. FALLOCH	KELLATOR	NN 370 238	12 MAY 92	18 AUG 92	17 NOV 92
*R. FALLOCH	BEINGLAS	NN 319 187	12 MAY 92	18 AUG 92	17 NOV 92
COCKLEMILL BURN	KILL CONQUHAR MILL	NO 482 025	13 MAY 92	25 AUG 92	25 NOV 92
CRAIL BURN	A917 ROAD BRIDGE	NO 611 079	13 MAY 92	25 AUG 92	25 NOV 92
KEIL BURN	PITCRUVIE CASTLE	NO 413 045	13 MAY 92	25 AUG 92	25 NOV 92
R. FINNAN	GLEN FINNAN	NM 907 808	05 MAY 92	24 JUL 92	31 OCT 92
R. FOYERS	DALCRAG	NH 495 187	05 MAY 92	28 JUL 92	08 OCT 92
R. KILLIN	KILLIN LODGE	NH 530 093	05 MAY 92	29 JUL 92	08 OCT 92
R. SPEAN	CORRIE COILLE	NN 252 808	12 MAY 92	24 JUL 92	05 DEC 92
R. AILORT	MON	NM 774 830	05 MAY 92	24 JUL 92	31 OCT 92
R. AILORT	CRAIG GHOBHAIR	NM 853 817	05 MAY 92	24 JUL 92	31 OCT 92
R. SHIEL	SHIEL BRIDGE	NG 940 188	14 MAY 92	30 JUL 92	26 OCT 92
R. ARKAIG	STRATHAN	NM 979 913	14 MAY 92	28 JUL 92	31 OCT 92
R. MEIG	BRIDGEND	NH 323 549	15 MAY 92	29 JUL 92	19 OCT 93
R. CONON	MOY BRIDGE	NH 477 547	15 MAY 92	29 JUL 92	08 OCT 92
R. LOSSIE	CLODDACH	NJ 203 584	14 APR 93	04 AUG 92	07 DEC 92
R. LOSSIE	U/S BLACKBURN	NJ 185 620	14 APR 93	04 AUG 92	07 DEC 92
R. BERVIE	INVERBERVIE G.S.	NO 824 735	15 APR 92	28 JUL 92	11 NOV 92
R. CARRON	TEWEL FORD	NO 828 853	28 MAY 92	30 JUL 92	11 NOV 92
R. CARRON	STONEHAVEN	NO 874 858	28 MAY 92	30 JUL 92	11 NOV 92
R. URR	CORSOCK	NX 766 757	02 MAY 90	20 AUG 90	20 NOV 90
R. URR	HAUGH OF URR	NX 806 660	08 MAY 90	20 AUG 90	20 NOV 90
SOUTHWICK BURN	NR. SOUTHWICK HOUSE	NX 929 574	14 MAY 92	30 JUL 92	12 OCT 93
R. EARN	FORTEVIOT	NO 048 184	19 MAY 92	29 JUL 92	20 OCT 92
R. ISLA	WESTER CARDEAN	NO 294 466	20 MAY 92	29 JUL 92	20 OCT 92
SOUTH ESK	STANNOCHY BRIDGE	NO 584 592	28 MAY 92	06 AUG 92	20 OCT 92
R. BRAAN	U/S TAY CONFLUENCE	NO 023 423	18 MAY 92	05 AUG 92	20 OCT 92
PROSEN WATER	PROSEN BRIDGE	NO 394 586	20 MAY 92	06 AUG 92	20 OCT 92
VINNY WATER	PITMUIES	NO 568 496	20 MAY 92	05 AUG 92	21 OCT 92
ELLIOT WATER	ELLIOT	NO 620 394	20 MAY 92	30 JUL 92	21 OCT 92
KENLY WATER	STRAVITHIE	NO 537 112	27 MAY 92	30 JUL 92	21 OCT 92
*BIGGAR WATER	BIGGAR PUBLIC PARK	NT 047 371	18 MAY 92	30 JUN 93	15 OCT 92
TARTH WATER	TARTH WATER FOOT	NT 165 429	22 APR 92	29 JUL 92	22 OCT 92
EDEN BURN	A6089 BRIDGE	NT 627 451	29 MAY 92	05 AUG 92	10 NOV 92

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REPORT REF: RL/T040711b1/3

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