

JFW

Biological Assessment Methods - Controlling the Quality of Biological Data.
Package 1

Progress Report for the Period
February 1994 - April 1994

M.T.Furse
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Institute of Freshwater Ecology

May 1994

Progress Report 504/1/S



NRA

National Rivers Authority



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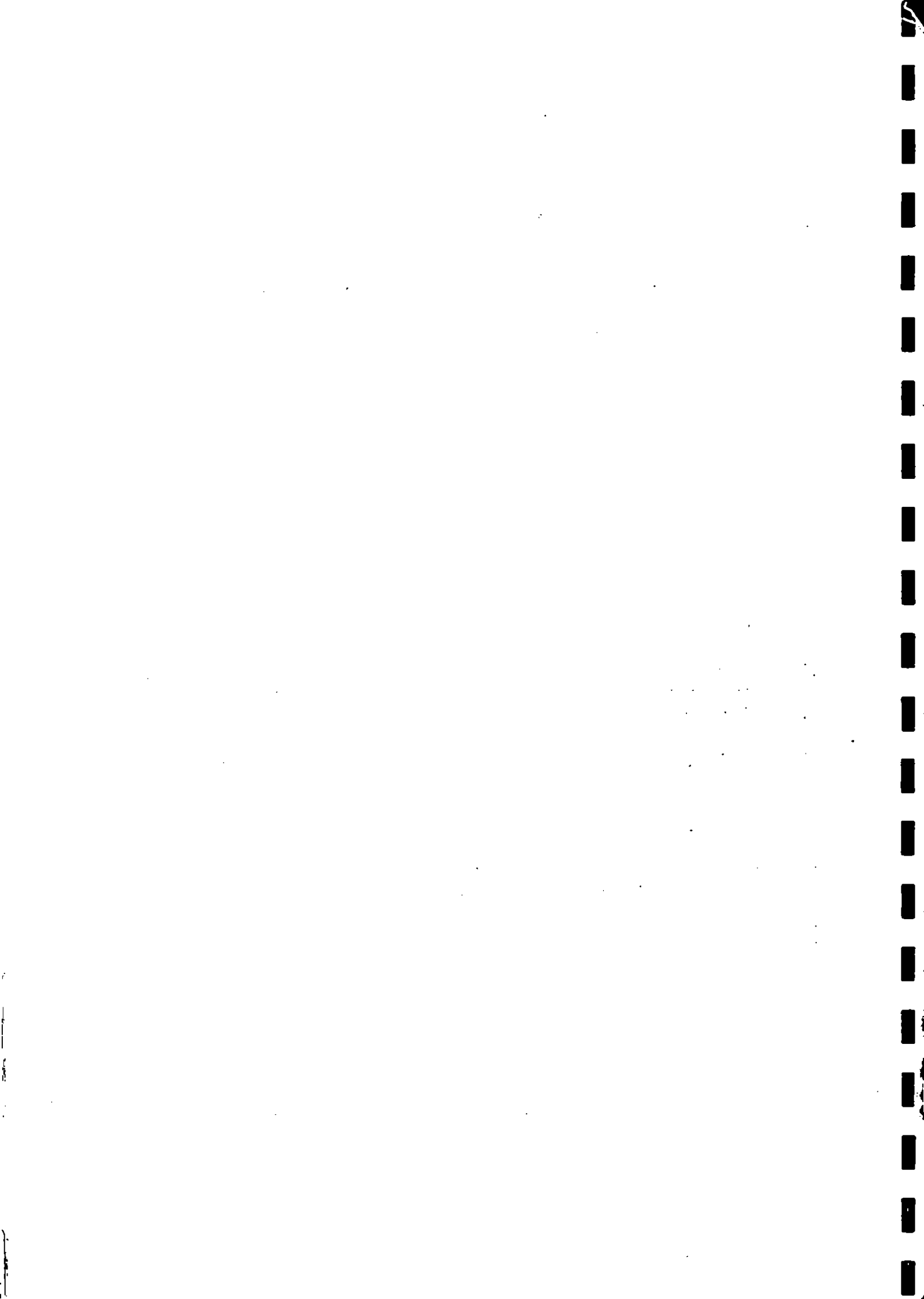
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1. INTRODUCTION

1.1 Objectives

The overall project objective is as follows:-

- To quantify and, where possible, control sources of variability in freshwater macro-invertebrate data for a range of river types and biological quality bands in order to increase the value of NRA data in water quality management

There are three specific objectives:-

- To assess the variability of single and combined season observed data (number of taxa, BMWP score and ASPT) due to the sampling process and analytical error.
- To assess the effect on RIVPACS predictions of errors in recording environmental variables by replicated field measurement.
- To assess the overall variability of observed and RIVPACS-predicted data due to the combined effects of the above factors.

1.2 Background

NRA business needs require biological data of a consistently high standard (principally relating to freshwater macro-invertebrates) for the assessment of water and environmental quality. Of particular significance are the NRA Water Quality Classification Scheme and the forthcoming EC directive on the Ecological Quality of Surface Waters (see also the 16th report of the Royal Commission on Environmental Pollution and the NRA response)

The variability inherent in biological sampling and analysis must be quantified and controlled (as is done, in part, for water chemistry) allowing confidence limits to be placed around scores and classifications. This is particularly important for the assessment of change. As replicate sampling is only feasible for detailed studies aimed at detecting small scale impact or change, a practical assessment of variability is essential for all other work.

Further details of the background to the research programme are given in the Project Investment Appraisal (PIA) which is Schedule 2 of the Memorandum of Agreement for Research Contract between the National Rivers Authority (NRA) and the Institute of Freshwater Ecology (IFE).

1.3 Context

The context of the work, as set out in the Memorandum of Agreement is as follows:-

The project affects all NRA activities involving freshwater macro-invertebrate data. It is particularly relevant to the successful use of RIVPACS (A13(90)1) and to the use of the biological data in river quality classification (the output is required for interpreting the results of the 1995 NRA Survey). Information will also be fed into the project on the Development of Biological Monitoring Techniques (Water Quality Monitoring Steering Group). Links will be maintained with biologists in Scotland and Northern Ireland, via the successor to the Freshwater Biology Sub-group. Accreditation of NRA Biology Laboratories can only be achieved if these techniques are in use.

1.4 Work programme

The overall approach involves field and laboratory study, with supervision by the Project Leader, to quantify the variability of freshwater macro-invertebrate data due to sampling and analytical error and to errors in recording RIVPACS environmental variables.

The work programme is of 13 months duration and extends into two financial years (February 1994 to February 1995). The specific work programmes for each year are as follows:-

Year 1

- In consultation with NRA biologists and using data from the 1990 NRA Survey, select sixteen sampling sites covering four biological quality bands for each of the four major RIVPACS site groups.

Year 2

- Collect three replicate samples from each site in each of the three RIVPACS sampling seasons.
- Collect two independent IFE estimates, plus at least two independent estimates from NRA biologists from the region in which the site lies, of RIVPACS environmental variables on each sampling occasion.
- Analyze all samples to BMWP level.
- Quantify the variation in observed data due to analytical error, using information derived from IFE audit data and reports and WRc Report No. CO 2905.
- Assess the error in single season observed data (number of taxa, BMWP score and ASPT) due to the sampling process (i.e. basic sample variability), and its dependence on site type and biological quality band.

- Assess the error in all possible combinations of combined seasons observed data (i.e. the effect of sample variability on combined seasons data).
- Assess the effect on RIVPACS predictions of errors in recording environmental variables.
- Quantify the effect of variations in observed data and RIVPACS predictions on observed/predicted ratios and subsequent quality bandings.
- Describe the overall variation in observed and predicted data and ratios due to the combined effects of the above factors.
- Provide an R&D Note setting out the main findings of the package and any proposed enhancements to RIVPACS.

1.5 Project Monitoring

The NRA Project Leader will monitor the progress of the study through liaison with the IFE Project Manager and through quarterly reports prepared by the Project Manager. The Project Leader will report on progress to the NRA Topic Leader and hence Water Quality Monitoring Biological Group (WQMBG) via Jaqui Gough.

2. TECHNICAL PROGRESS

2.1 Work programme

2.2 Progress achieved

2.2.1 Site Selection Procedure

The following general procedures have been adopted:-

- Sixteen sites will be surveyed
- Four sites will be surveyed in each quarter of the RIVPACS TWINSPAN classification
- Within each quarter of the classification the four sites will each be selected from the TWINSPAN group containing the greatest number of 1990 River Quality Survey sites, as predicted on environmental grounds.
- The four TWINSPAN groups selected on this basis are six (RIVPACS group 3A), fourteen (5B), twenty (8A) and twenty-four (9B).
- Within each group a single site will be selected from each of the four biological quality bands A - D, based on the EQI values of BMWP score, number of scoring taxa and ASPT.
- All selected sites must have the required quality banding for all three EQIs
- All selected sites must lie fully within the scope of RIVPACS, i.e. they must be suitability class 1.
- All selected sites must have a probability of belonging to one of the four selected TWINSPAN groups of at least $p \geq 0.5$. This minimum value may be increased in some instances.
- These procedures are designed to provide a good coverage of biological assemblage type but to minimise inter-site variation when comparing relative variability in data collection with the biological quality of the watercourses.

The following specific principles have been adopted for each biological quality band:-

Band A sites

- EQI values must fall within the following ranges, centred on unity:-

| | |
|------------|--------------|
| BMWP score | 0.91 to 1.09 |
| No. taxa | 0.94 to 1.06 |
| ASPT | 0.97 to 1.03 |

- Probability of group membership of $p \geq 0.6$

Band B sites

- EQI values must fall within the following ranges:-

| | |
|------------|--------------|
| BMWP score | 0.52 to 0.62 |
| No. taxa | 0.64 to 0.72 |
| ASPT | 0.80 to 0.85 |

Band C sites

- EQI values must fall within the following ranges:-

| | |
|------------|--------------|
| BMWP score | 0.29 to 0.39 |
| No. taxa | 0.41 to 0.53 |
| ASPT | 0.68 to 0.74 |

Band D sites

- EQI values must fall below the following values:-

| | |
|------------|-------|
| BMWP score | <0.18 |
| No. taxa | <0.30 |
| ASPT | <0.60 |

- A special case is Group twenty-four where the only site fully meeting the general principles was selected.

2.2.2 Sampling Procedure

The following general principles have been adopted:-

- Four samples will be taken at each site in each of three separate seasons (spring, summer and autumn).
- The fourth sample, in each case, will be held in reserve in case project resources allow them to be processed.

- The field sampling team will comprise two IFE staff members and two local NRA staff members from the appropriate region.
- Three of the samples will be taken by IFE personnel and the fourth by an NRA staff member.
- Field-measured environmental data, of the type used in RIVPACS (width, depth and substratum) will be recorded by each of the four members of the sampling teams at the time of each biological sampling.
- Map-sourced data, of the type used in RIVPACS (National Grid Reference, altitude, distance from source, slope, and discharge category) will be recorded once only, in the laboratory, by each member of the field sampling teams. 1:50,000 maps will be used except for discharge which will be read from the 1985 (or 1975) river quality maps. Personnel must not confer in making these measurements.

The following guidance notes were discussed with co-ordinating NRA staff members in each region participating in the study:-

- It is preferable that the same two NRA members come to an individual site in each of the three sampling seasons.
- The two NRA staff members at each site should preferably include at least one person experienced in biological sampling and environmental data-collection for RIVPACS. Inexperienced staff members should view the NRA/IFE training video prior to participating in the study.
- The methodology of biological sampling will be set by IFE and will be in accord with the procedures expected to be adopted for the 1995 River Quality Survey. Essentially, three minutes of active pond-netting will be undertaken for each sample, accompanied by up to one minute of continuous searching for and removal of individual animals from stones and sticks.
- Environmental data will be recorded using the normal methods and equipment used by the participating personnel but should always comply with the principles outlined in the NRA/IFE training video.

The following specific sampling practices were adopted at each site:-

- At each site all biological samples will be collected before any environmental measuring is started.
- One IFE person (person A) will take two biological samples, each of which will be processed.
- The other person (B) will take one biological sample which will be held in reserve.

- One NRA person (C) will take one biological sample which will be processed.
- The order of sampling will be A, C, A, B.
- Wherever possible persons A, B and C will be constant for each season within a site but will not be constant between sites.
- Where the full width of the river can be safely accessed, the three minutes of active sampling will progress diagonally upstream from one bank to another. Sample one will start at lower extreme of the left bank (looking upstream) of the sampling area and will work from left to right. Sample two will start from the lower extreme of the right bank and will proceed from right to left. Sample three will start slightly upstream of sample one and will follow an upstream diagonal parallel to the path of sample one. The path of sample four will be parallel to and slightly upstream of that of sample two.
- Where both margins of the site are easily and safely accessible but the centre of the stream is not, the first sample will start at the lower extreme of the left bank and follow a directly upstream course. Sample two will be parallel to sample one but on the opposite, right-hand bank. Sample three will be directly upstream of sample one and sample four upstream of sample two.
- Where only one margin of the site is easily and safely accessible then the samples will be taken successively upstream along that bank.
- Whichever sampling strategy is used, individual samples will involve collecting from individual habitats in proportion to their occurrence. However, where one habitat type exists only as a small patch, which will be totally disturbed before all four samples can be taken, then it will be excluded from all samples.
- The environmental data will be recorded for the full width of the watercourse for the full length of the watercourse from the lowermost point of the first sample to the uppermost point of the fourth sample.

2.3.2 Project monitoring

The NRA Project Leader (Dr.R.A.Dines), the IFE Project Manager (Mr.M.T.Furse) and the NRA, Southern Region R&D Co-ordinator (Ms.T.Crawshaw) have liaised, as necessary, throughout the reporting period.

Contractual terms for the project have largely been agreed between NRA and NERC although the matter of annual revaluation remains to be clarified. No delay in the conduct of the work has resulted from the immediate failure to resolve this issue.

3. INTERIM RESULTS

Details of the sites selected and their actual (April) or proposed (May) spring sampling dates are shown in the following table.

| DATE | SITE 1 | SITE 2 |
|----------------|----------------------|-------------------|
| MON 25th APRIL | TANTON'S PLAIN | SOUTH DORNAFORD |
| TUE 26th APRIL | JENNY MILL | SEEND BRIDGE |
| WED 27th APRIL | WOODFORD | BOWLISH |
| THU 28th APRIL | HASLINGBOURNE BRIDGE | FERRY SLUICE |
| MON 2nd MAY | B6313 BRIDGE | CROXDALE HOUSE |
| TUE 3rd MAY | CHERRY COB | BRIGG |
| WED 4th MAY | U/S SKELLINGTHORPE | SWARKESTONE |
| THU 5th MAY | SORFORTON LANE | PTC BEDFORD BROOK |

All April samples have been successfully collected and May sampling is expected to be on schedule.

4. WORK PROGRAMME FOR THE NEXT REPORTING PERIOD

- Spring sampling will be completed.
- Each of the first three samples collected from each site in spring will be identified to family level and \log_{10} categories of abundance will be attached to each family record.
- All sorted spring sample material will be retained and re-preserved in case project resources permit biological audit of IFE's sample processing efficiency.
- All summer samples will be collected.

5. COST OF WORK DURING THE REPORTING PERIOD

The cost of the work during the reporting period is likely to be generally in line with the project Memorandum of Agreement.

Detailed costings will be made available to the NRA, via the IFE Finance Office.

6. ESTIMATE OF THE TOTAL COSTS OF THE WORK

The total cost of the work is expected to be in line with the budget listed in Section 10 of the PLA and Schedule 8 of the project contract.

7. ESTIMATE OF COSTS FOR THE NEXT REPORTING PERIOD

Costs for the next three months are expected to be in line with the project Memorandum of Agreement.

8. FACTORS LIKELY TO AFFECT THE SATISFACTORY COMPLETION OF THE WORK

No delay in completing the work is currently anticipated.

The principle factor with potential to disrupt the timetable is the conflicting demands of other NRA projects involving the IFE staff. If conflicts should arise IFE will take advice from NRA on the scheduling of priorities.

TWINSpan GROUP SIX

| | | | | |
|------------------------------|------|-----------------|-----------------|--------------|
| BAND A: 30690001240065601415 | SoWe | River Okement | South Dornaford | (SS 600 000) |
| BAND B: 30690001980064401109 | SoWe | River Darracott | Tanton's Plain | (SS 494 198) |
| BAND C: 30290001190117200951 | Nthb | River Croxdale | Croxdale House | (NZ 272 379) |
| BAND D: 30290001280115900934 | Nthb | Twyzell Burn | B6313 Bridge | (NZ 257 517) |

TWINSpan GROUP FOURTEEN

| | | | | |
|-------------------------------|------|----------------|----------------------|--------------|
| BAND A: 30590001410055301192 | Sthn | Perworth Brook | Haslingbourne Bridge | (SU 982 204) |
| BAND B: 30990002440059900974 | Wssx | Sheppey River | Woodford | (ST 537 441) |
| BAND C: 30990001870054200917 | Wssx | Sheppey River | Bowlsh | (ST 613 440) |
| BAND D: 303900016770167801679 | NorW | Moss Brook | PTC Bedford Brook | (SJ 676 983) |

TWINSpan GROUP TWENTY

| | | | | |
|------------------------------|------|-----------------|-------------------------------|--------------|
| BAND A: 30990002890064401019 | Wssx | Summerham Brook | Seend Bridge | (ST 945 595) |
| BAND B: 30490000110113702088 | SvTr | Cuttle Brook | Swarkestone | (SK 375 288) |
| BAND C: 30990002920064701022 | Wssx | Paulshot Stream | Jenny Mill | (ST 979 592) |
| BAND D: 31090000870057401082 | York | River Rother | Storforton Lane, Chesterfield | (SK 387 694) |

TWINSpan GROUP TWENTY-FOUR

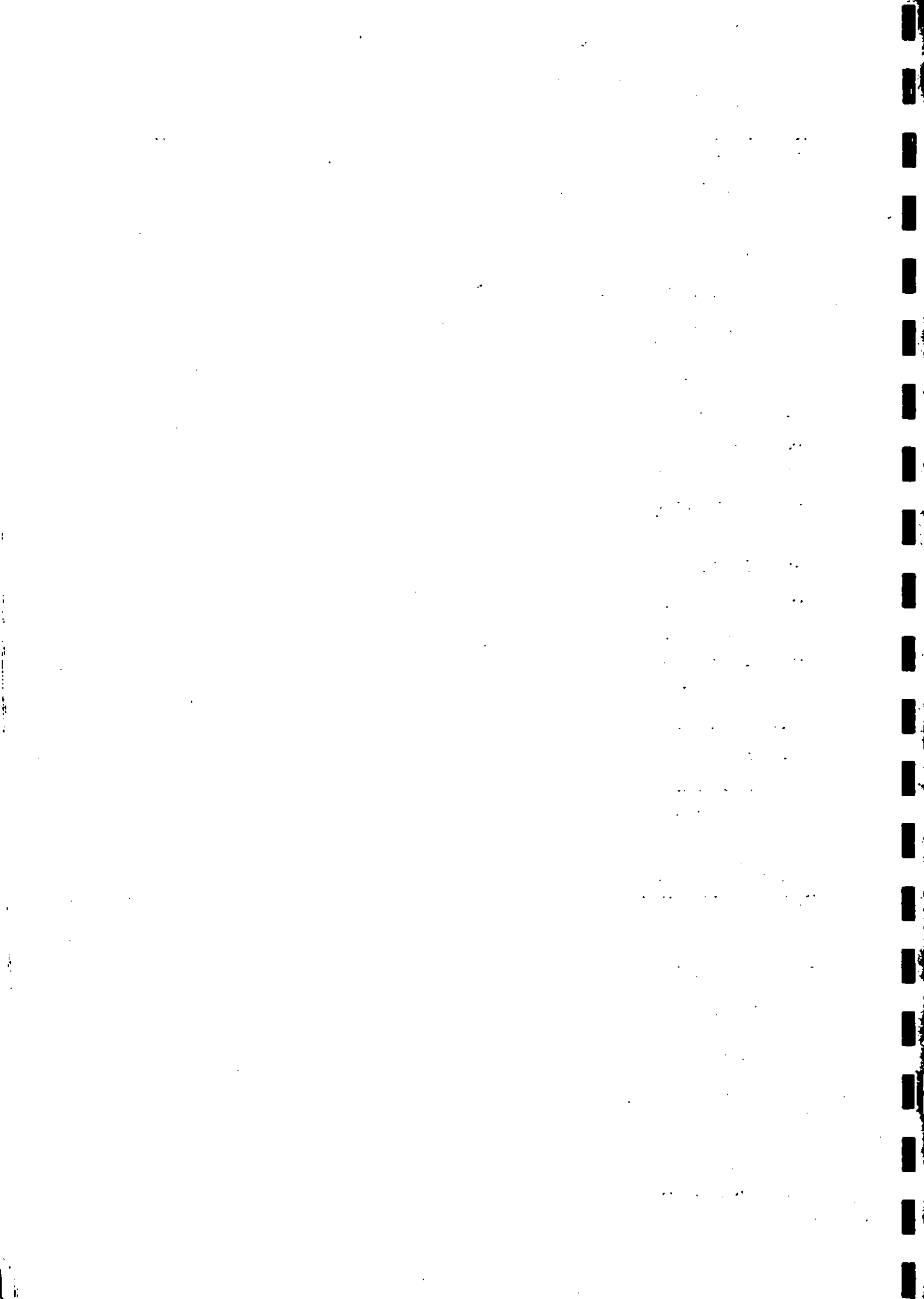
| | | | | |
|------------------------------|------|---------------------------|--------------------|--------------|
| BAND A: 30190005650106301064 | Angl | Old River Ancholme | Brigg | (TA 001 065) |
| BAND B: 30590002800057100678 | Sthn | Broad Rife | Ferry Sluice | (SZ 854 963) |
| BAND C: 30190012620126301264 | Angl | Skellingthorpe Main Drain | U/S Skellingthorpe | (SK 937 727) |
| BAND D: 31090002030043300834 | York | Keyingham Drain | Cherry Cob | (TA 219 224) |

Key to abbreviations to NRA regions (as at the time of the 1990 River Quality Survey)

| | | | | | |
|------|---|--------------------|------|---|-------------------|
| Angl | = | Anglian | NorW | = | North West |
| Nthb | = | Former Northumbria | SoWe | = | Former South West |
| Sthn | = | Southern | SvTr | = | Severn Trent |
| Wssx | = | Former Wessex | York | = | Former Yorkshire |

South West and Wessex Regions are now amalgamated as South Western Region.

Northumbria and Yorkshire Regions are now amalgamated as Northumbria & Yorkshire Region.



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