

**NORTH EAST REGION  
NORTHUMBRIA AREA  
SYNTHETIC PYRETHROID IMPACT SURVEYS  
1998**



**ENVIRONMENT AGENCY**

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NORTH-EAST REGION**

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# SYNTHETIC PYRETHROID IMPACT SURVEYS NORTHUMBRIA AREA, 1998

## 1.0 Background

It has become increasingly clear over recent years that synthetic pyrethroids are extremely toxic to aquatic life. Synthetic pyrethroids are now being widely used to dip sheep following concerns for human health linked to the organophosphorus dips, unfortunately the new synthetic pyrethroid dips are at least 100 times more toxic to aquatic organisms. In addition to dipping sheep these chemicals are widely employed as pesticides in arable agriculture, wood preservatives and the growing of seedling trees.

A number of particularly devastating pollution incidents involving synthetic pyrethroids in Scotland, Northwest England and Wales have resulted in a depletion of the invertebrate fauna over many kilometres of river. In the Northumbria Area a number of pollution incidents involving synthetic pyrethroids and sheep dips were investigated prior to 1998 however it was decided that a more proactive Area wide approach was required in order to determine the extent of the problem.

## 2.0 Methods

Biological monitoring is a key element when assessing the impact of synthetic pyrethroids. Thorough examination of the invertebrate community at a site can indicate whether such chemicals are felt to be a problem. Absence of the arthropod taxa (insects and crustaceans, in particular the freshwater shrimp) indicate that synthetic pyrethroids are impacting a site. Oligochaeta (worms), flatworms, molluscs and chironomids appear to be more tolerant but complete elimination of the invertebrate fauna has been recorded. In addition to biological surveillance chemical monitoring of water and sediment samples is able confirm the presence or absence and type of synthetic pyrethroids.

It was agreed that a combined biological / chemical approach should be taken in order to assess the extent to which synthetic pyrethroids are a problem within the three catchment areas of the Wear, Tyne and Northumberland rivers.

### 2.1 Enhanced Chemical monitoring

During 1998 the chemical monitoring of the three catchment areas was enhanced in order to investigate the levels of synthetic pyrethroids present in the rivers, in particular with respect to environmental quality standards set for each determinant. Sampling was undertaken monthly.

### 2.2 Biological monitoring

Four types of biological monitoring were carried out:

#### 2.2.1 *Enhanced Routine Monitoring*

A network of sites was agreed between Environmental Protection staff and catchment ecologists. The aim was to provide basic background data on EQS exceedance. Biological samples were collected in the spring and late autumn, after periods of most intensive dipping

and crop spraying. The biological samples were sorted in the laboratory and subject to AQC procedures.

### *2.2.2 Biological Screening*

Areas felt to be at greatest risk from the use of synthetic pyrethroid chemicals were targeted and strategic sites chosen for bankside sorting. This was generally carried out in late autumn during the period of most intense sheep dipping and spraying of crops, however as time allowed further sampling was undertaken throughout the year. Bankside sorting is able to provide information on site and any follow up work can then be carried out immediately. Any problems found were to be reported to Environmental Protection staff.

### *2.2.3 Process Targeted Monitoring*

Two studies were undertaken to assess the impact of known discharges of synthetic pyrethroids. With the permission of a farmer a biological survey was carried out in order to assess the impact of disposal of waste sheep dip to a soakaway in the Upper Wansbeck catchment. With the co-operation of the Forest Enterprise Group a biological survey was undertaken during a period of cypermethrin application to seedling trees in a nursery.

### *2.2.4 Pollution Incident Response*

Results of pollution incident surveys relating to synthetic pyrethroid use are also reported.

## **3.0 Results**

The results are illustrated in Maps 1 TO 9. Maps 1-3 show the biological and chemical enhanced routine monitoring sites, Maps 4-6 illustrate the sites sampled during the targeted biological monitoring and the pollution and screening surveys. Maps 7-9 illustrate those sites where EQS breaches were recorded during chemical sampling or biological sampling revealed problems with synthetic pyrethroids. Raw data can be found in Appendices 1 to 5.

### **3.1 Chemical monitoring**

Chemical monitoring highlighted a number of sites where synthetic pyrethroids were detected above environmental quality standard (EQS) levels.

The only site on the River Wear to show an EQS exceedance for synthetic pyrethroids was that at Shincliffe. Cypermethrin levels were exceeded during November 1998.

In the Tyne catchment a number of EQS exceedances were recorded for synthetic pyrethroids. During January EQS levels for cypermethrin were exceeded in the South Tyne at Warden and on the River Derwent at Clockburn Drift and below Derwent Reservoir. In April exceedances for cypermethrin were recorded in the River Tyne at Wylam, the River North Tyne at Chollerford and the East Allen at the Field Study Centre and The Haining. During May cypermethrin exceeded EQS standards on the North Tyne at Chollerford and Devils Water at Dilston.

In the Northumberland catchment EQS standards for cypermethrin were exceeded in April in the River Tweed at Norham, the Font at Mitford and the Wansbeck at Mitford Castle. In May standards were exceeded in the Tweed at Norham, the Coquet at Warkworth Dam and the Wansbeck at Sheepwash and Mitford Castle.

It is interesting to note that EQS standards were breached during January, April and May in the Tyne catchment, during April and May in the Northumberland catchment and during November on the Wear catchment. It is impossible, with the information available, to determine whether these 'hits' are from crop spraying or sheep dip use.

### 3.2 Biological monitoring

#### 3.2.1 *Enhanced Routine monitoring*

Appendix 2 illustrates the results from the enhanced biological routine monitoring programme for the Northumberland, Tyne and Wear catchments. Only one site, Devils Water at Dilston, showed signs of synthetic pyrethroid contamination however high flows prior to sampling made the results difficult to interpret. Chemical monitoring failed to detect synthetic pyrethroids at this site during November, when the biological sample was taken.

#### 3.2.2 *Biological Screening*

With previous experience of known areas with sheep dip and other synthetic pyrethroid problems and knowledge of land use within the catchments, the catchment ecologists determined the most suitable sites for biological screening. Bankside sorting was carried out so that if a problem were identified it could be followed up immediately. Appendix 3 shows the results from the biological screening programme.

Enhanced routine monitoring identified extremely poor biological quality in the River Wear downstream of Ireshope Burn in the autumn sample. A screening programme carried out to investigate the poor biological quality concluded that the likely cause was metal rich drainage from adjacent spoil tips. Further work in 1999 will investigate this. In the Tyne catchment two tributaries upstream of Whittle Reservoir were impacted by arable pesticides and Low Acton Burn upstream of the East Allen was contaminated by a sheep dip. No sheep dip problems were located in the Northumberland catchment.

#### 3.2.3 *Process Targeted Monitoring*

Appendix 4 shows the results of process targeted monitoring. One known source of sheep dip disposal was targeted for biological monitoring. Disposal of approximately 1000 litres of waste dip is carried out by means of a soak away in an old quarry in the Upper Wansbeck catchment. Sampling was carried out in order to determine whether such a method of disposal resulted in a deterioration of biological quality in two springs emanating from this quarry (Spring 1 and Spring 2). No significant changes in biological quality were observed as a result of the disposal of the waste dip.

During April 1998 an investigation was carried out at the Forest Enterprise Tree Nursery at Kielder. Cypermethrin is used on site in order to treat seedling trees. The biological survey was carried out whilst cypermethrin was applied to the trees in order to determine whether Hawkhope Burn was affected. It was discovered during this and subsequent surveys that more than half a kilometre (km) of Hawkhope Burn was severely impacted by drainage from the site during cypermethrin application. The problematic drain was immediately blocked and follow up surveys were taken at intervals to assess recovery. Within five months of blocking the drain the aquatic ecology had begun to recover.

### 3.2.4 *Pollution Incident Response*

A number of pollution incidents relating to cypermethrin contamination have been investigated within the Northumbria Area over the past few years. Of particular note are three that occurred during 1997. On 30.10.97 the effluent from a sheep dip was discharged to Hayring Burn, a tributary of the Nent, resulting in a fish kill and an almost complete eradication of the invertebrate population. A repeat survey 3 months later showed that the biological quality downstream of the spill area had improved significantly. On 1.11.97 a farmer reported a spillage of sheep dip to a stream feeding Burnhope Reservoir. A biological survey discovered that macro-invertebrates were dead / dying from the spill area to the confluence with the reservoir, a distance of approximately 400 metres. On 17.11.97 a spillage of pesticide containing cypermethrin entered the River Team. 100% mortality of aquatic ecology was recorded immediately downstream, reducing to 15% mortality 3 km downstream.

It is clear from these incidents that synthetic pyrethroid chemicals can have a devastating impact on the aquatic ecology of a watercourse. Two pollution incidents relating to the use of synthetic pyrethroids were responded to during 1998, both within the Wear Catchment.

#### *Houselop Beck*      *Pollution reference: 98/40 & 98/42*

Houselop Beck was initially visited in response to a request to assess the impact of a minewater discharge just downstream of the B6296 road bridge. Sampling of Houselop Beck at this site however indicated that sheep dip chemicals might be restricting the fauna. Further biological and chemical sampling eventually confirmed that poor housekeeping at a farm upstream was causing waste dip to seep into a tributary of Houselop Beck. Approximately 3 kilometres of Houselop Beck had been affected by the sheep dip. Co-operation by the farmer has resulted in improvements to the dip facilities and biological quality of Houselop Beck should improve. This will be monitored during 1999.

#### *Waskerley Beck*      *Pollution reference: 98/60*

An unknown source of pollution was reported and investigated as a result of a fish kill in Waskerley Beck. Biological sampling determined that the most likely cause of the pollution was sheep dip. A small feeder stream of surface water discharges through a farm area where empty sheep dip chemical cans and sheep shearing were discarded. At least 1 kilometre of watercourse was affected.

## **4.0 DISCUSSION**

Chemical monitoring within the Northumbria Area identified a number of sites where EQS standards for synthetic pyrethroids were exceeded during 1998. It was not possible to identify the source of the problems since relatively few sites were sampled for a large number of watercourses. The information gathered has provided extremely valuable baseline data from which more specific work could help to determine the major sources of synthetic pyrethroids within each catchment.

Enhanced routine biological monitoring identified one site as possibly being impacted by synthetic pyrethroids. Biological screening identified one further problem, whilst process targeted monitoring illustrated the deterioration in biological quality of Hawkhope Burn as a result of tree seedling treatment.

Whilst the results obtained so far are encouraging it is important to note that there may be watercourses affected by synthetic pyrethroids which were not surveyed by this project. Given the resources available it would have been impossible to comprehensively determine the level of synthetic pyrethroid impact throughout the catchments. The results to date, however, do indicate that the problems are localised rather than widespread.

## **5.0 RECOMMENDATIONS**

Monitoring within the Northumbria Area has revealed that synthetic pyrethroids are present in all 3 catchments, Wear, Tyne and Northumberland. Given the toxicity of synthetic pyrethroid chemicals their presence in watercourses at concentrations higher than the EQS levels is a matter of great concern. There are a number of options now available with which to continue the work carried out in 1998.

### **EXTENDED SAMPLING PROGRAMME**

EQS failures throughout the three catchment areas indicate that synthetic pyrethroid chemicals are compromising water quality. Routine biological monitoring and screening failed to identify any further problems indicating that impacts, whilst being widespread, tend to be localised. The most satisfactory follow up to the 1998 survey would involve five components:

- Continue enhanced routine monitoring, both biological and chemical. The routine monitoring programme should also be extended to include those areas not surveyed during 1998, namely the Till subcatchment and the River Aln catchment. In addition it should be reiterated that chemical sampling for a particular watercourse should be undertaken over one day. Due to the spread of days over which samples were taken in 1998 it is impossible to determine the source of the synthetic pyrethroids.
- More detailed monitoring should be carried out upstream of EQS failures in 1998.
  - Tweed catchment upstream of Norham, including the Till. This would involve a substantial amount of work and collaboration with SEPA.
  - River Coquet upstream of Warkworth Dam.
  - Wansbeck and Font catchments following EQS breaches at Sheepwash, Mitford and Mitford Castle.
  - River North Tyne upstream of Chollerford.
  - River South Tyne upstream Warden Bridge and Bellister
  - River Tyne upstream Wylam.
  - River East Allen, along its full length.
  - Devils Water upstream of Dilston.
  - Derwent upstream of Clockburn Drift and below Derwent reservoir.
  - River Wear upstream Shincliffe
- Biological screening should continue in all three catchments. Whilst biological screening failed to identify synthetic pyrethroid problems during 1998 it is clear that it would take many hundreds of samples to confidently assess the Northumbria area. The chemical results from 1998 suggest that screening should be carried out during May, with additional samples on the Wear being taken in November.

- Process targeted monitoring should also continue. Additional work is likely from 1999. The newly introduced Groundwater Regulations will highlight areas where disposal of spent chemicals to soakaway may affect groundwater below.
- Pollution incident response during 1998 highlighted that the problems were linked to poor housekeeping on the farms visited. These findings would indicate that a Campaigns lead education exercise could lead to a substantial reduction of discharges of synthetic pyrethroids. Information should be targeted to the relevant users and concentrate on the importance of maintaining good housekeeping of sheep dip facilities and the value of buffer zones to protect watercourses during crop spraying.

#### **REDUCED SAMPLING PROGRAMME**

If resources were to be reduced following the 1998 survey it would not be possible to carry out the comprehensive survey detailed above. If work were to be prioritised investigation of EQS failures during 1998 should be carried out as a minimum. It would be unfortunate if problems were identified but not investigated. Assessment should also be initiated in catchments not monitored during 1998 that are likely to suffer from synthetic pyrethroid impact, namely the Rivers Till and Aln. Biological screening should also continue (see above).

#### **MINIMAL SAMPLING PROGRAMME**

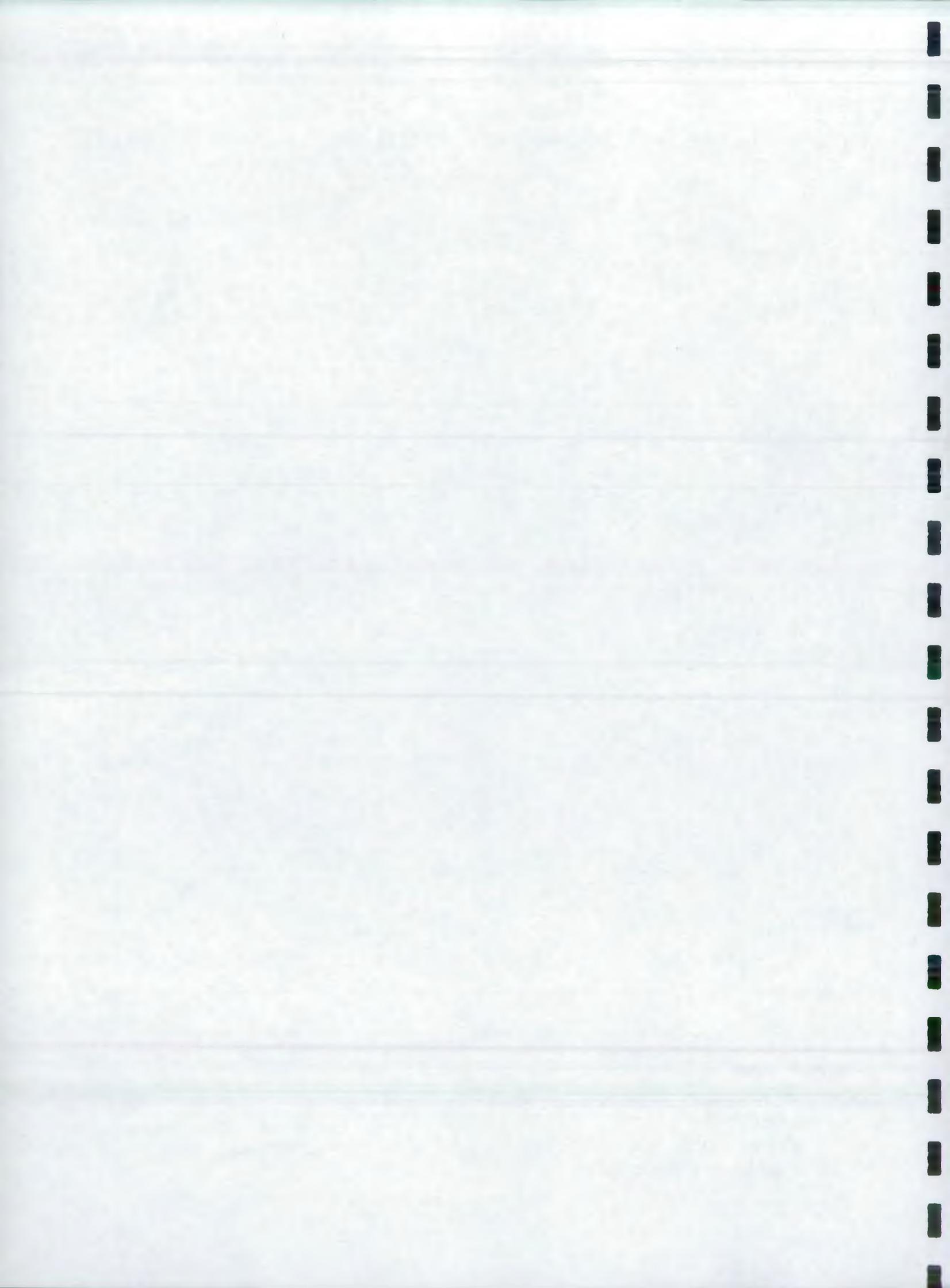
With the absence of any funds available with which to continue chemical monitoring and only limited biological resource synthetic pyrethroid investigations would be much reduced. Biological screening of problem areas could continue, with the timing targeted during May rather than later in the year. Results obtained during 1998 would help to identify those areas most at risk.

#### **NO SAMPLING**

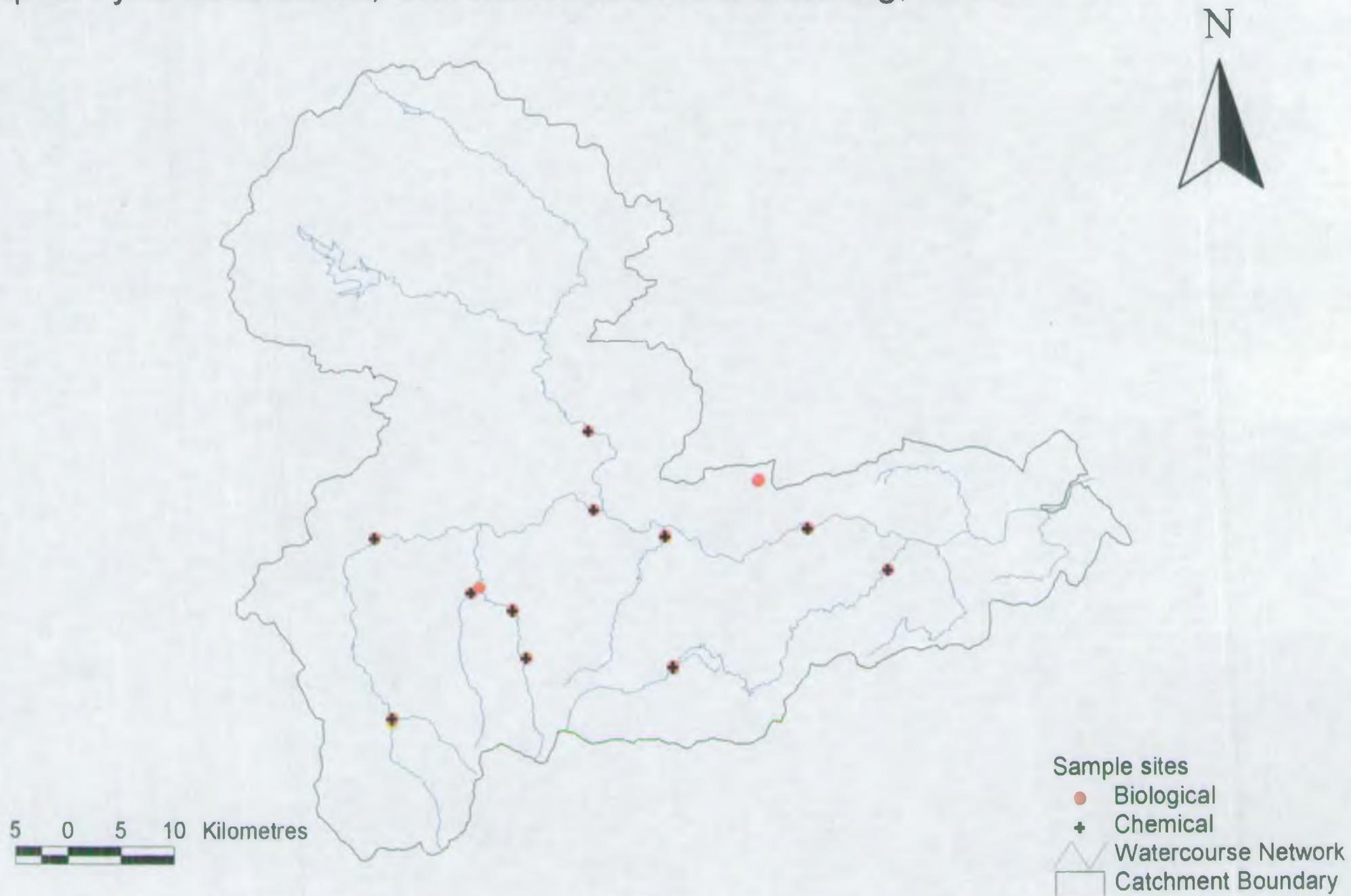
Whilst EQS exceedances were identified in all 3 catchments, the problems identified were localised rather than widespread. As a result of these findings it is likely that resources will be reallocated away from this project. This carries with it a risk of future problems since none of the sources of synthetic pyrethroid, which lead to EQS failure during 1998, were identified.

Map1. Northumberland Catchment, Enhanced Routine Monitoring, 1998





Map 2. Tyne Catchment, Enhanced Routine Monitoring, 1998





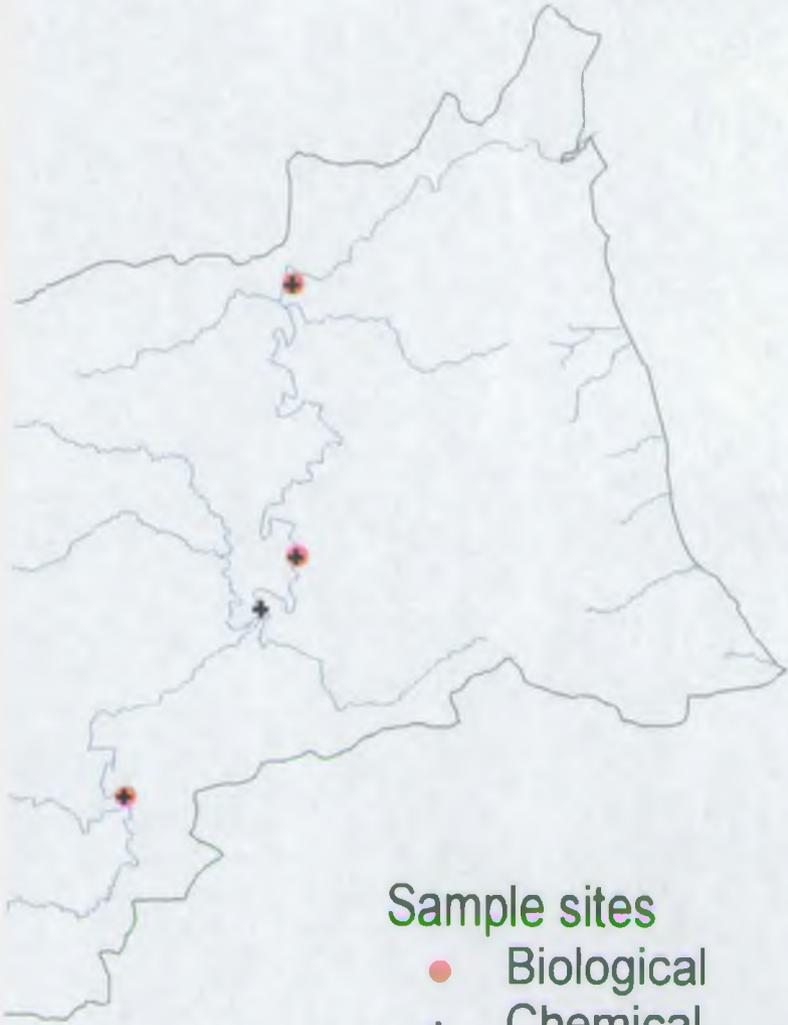
# Map 3. Enhanced Routine Monitoring,



3 0 3 6 Kilometres

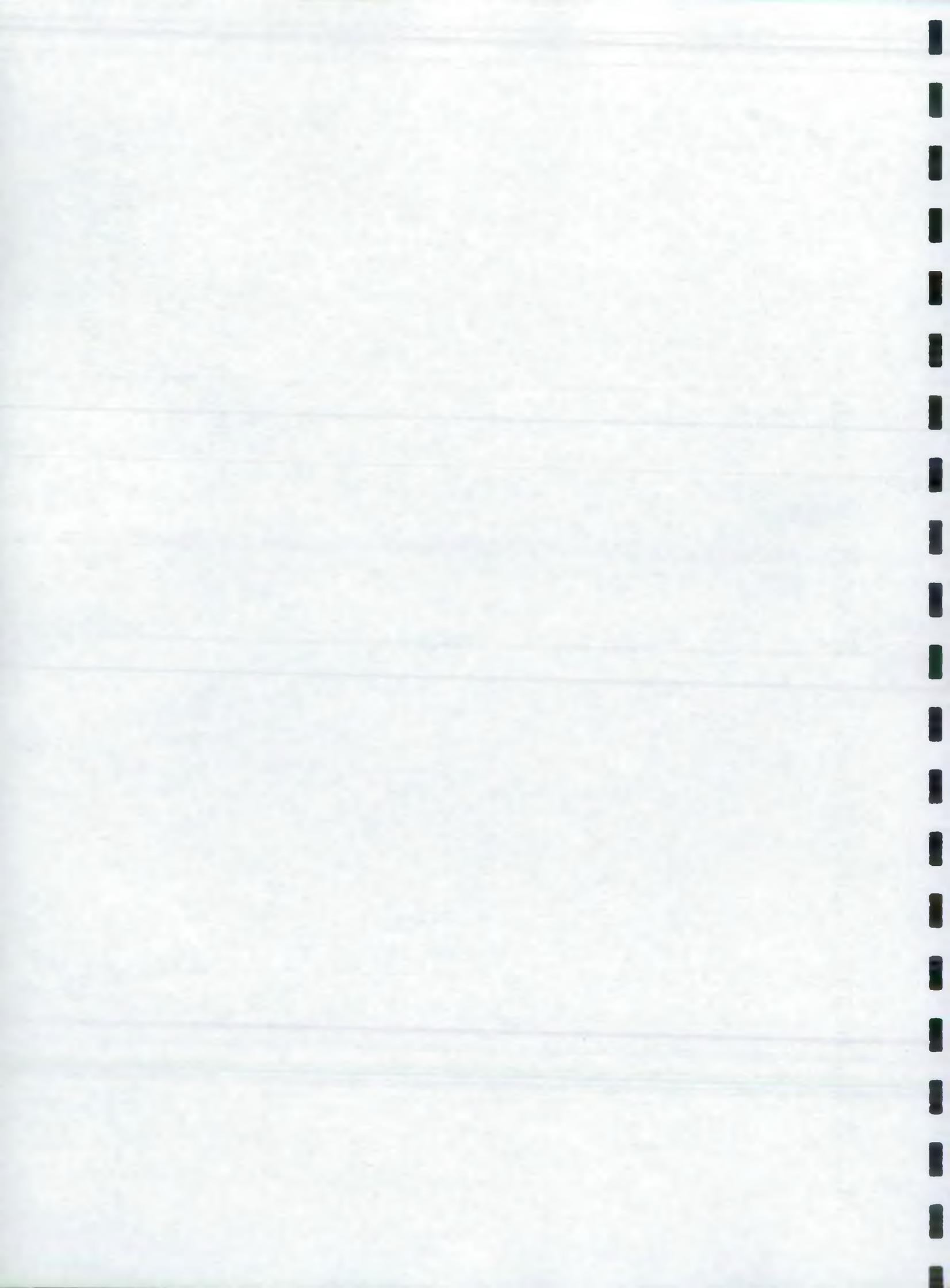


# River Wear Catchment, 1998



## Sample sites

-  Biological
-  Chemical
-  Watercourse Network
-  Catchment Boundary



Map 4. Northumberland Catchment, non routine monitoring, 1998



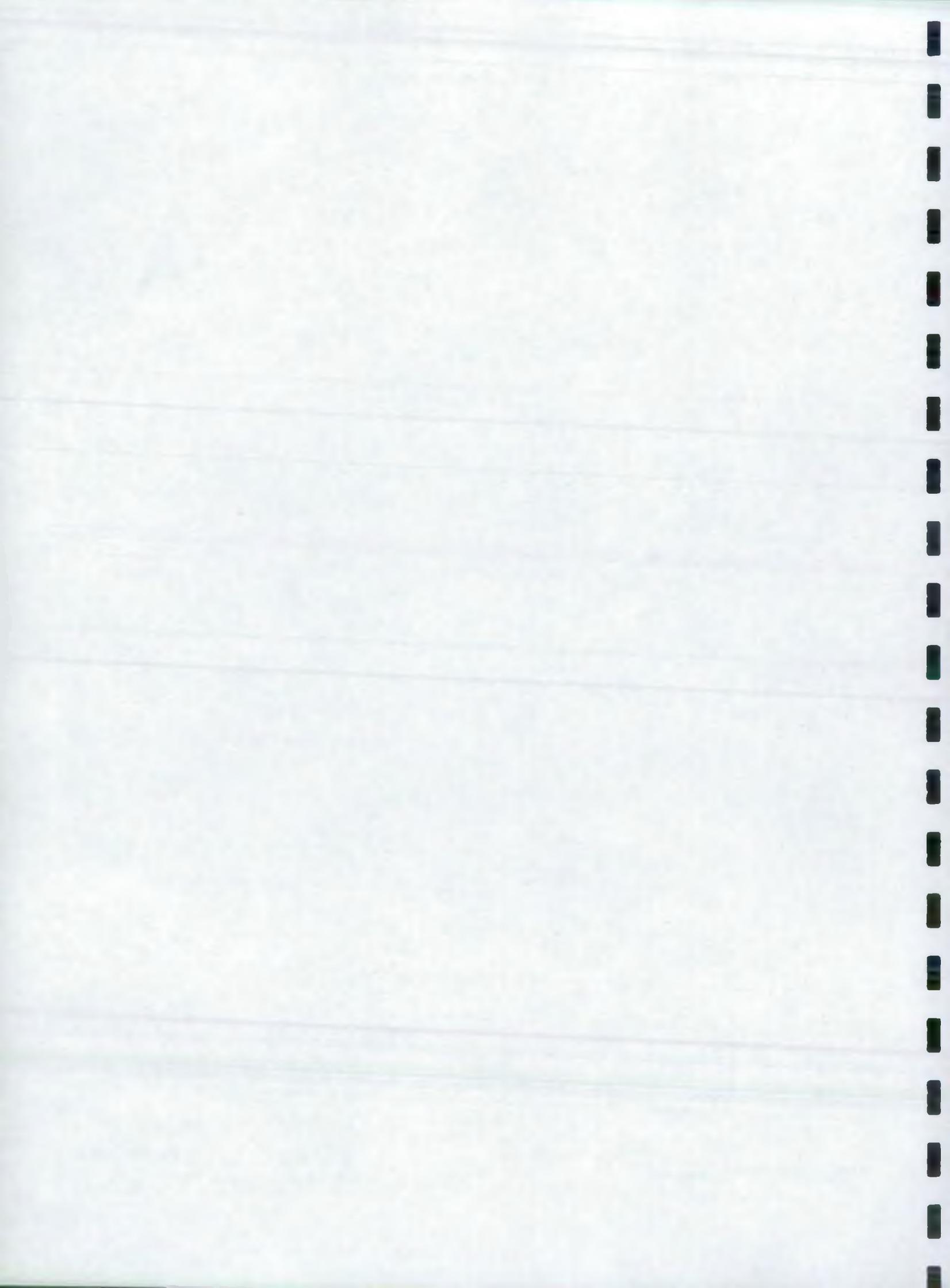
Sample sites

- pollution survey
- screening
- targetted sampling

- Watercourse Network
- Catchment Boundary

8 0 8 16 Kilometres





Map 5. Tyne Catchment, non routine monitoring, 1998



N



Sampling sites

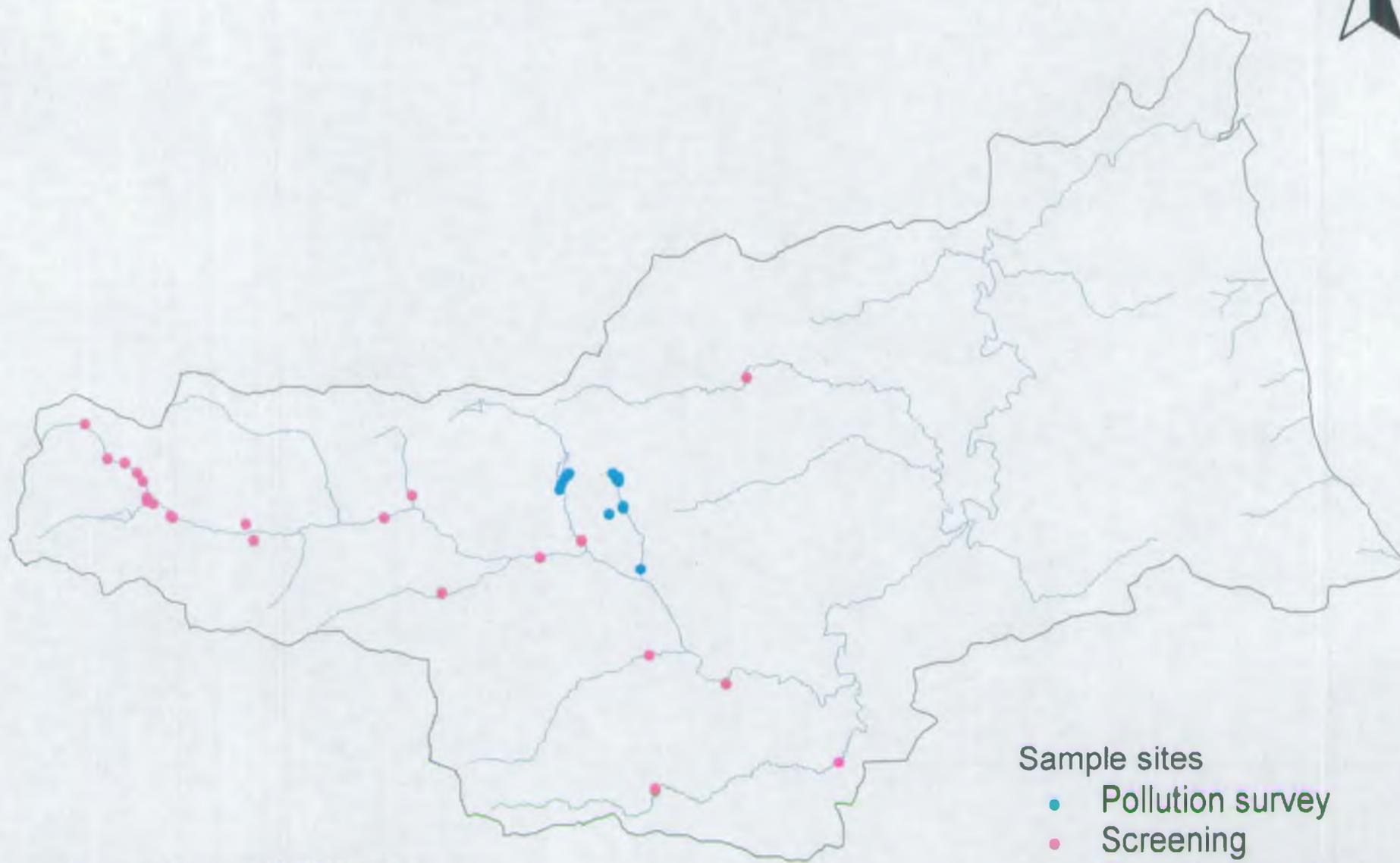
- pollution survey
- screening
- targetted monitoring



Watercourse Network  
Catchment Boundary



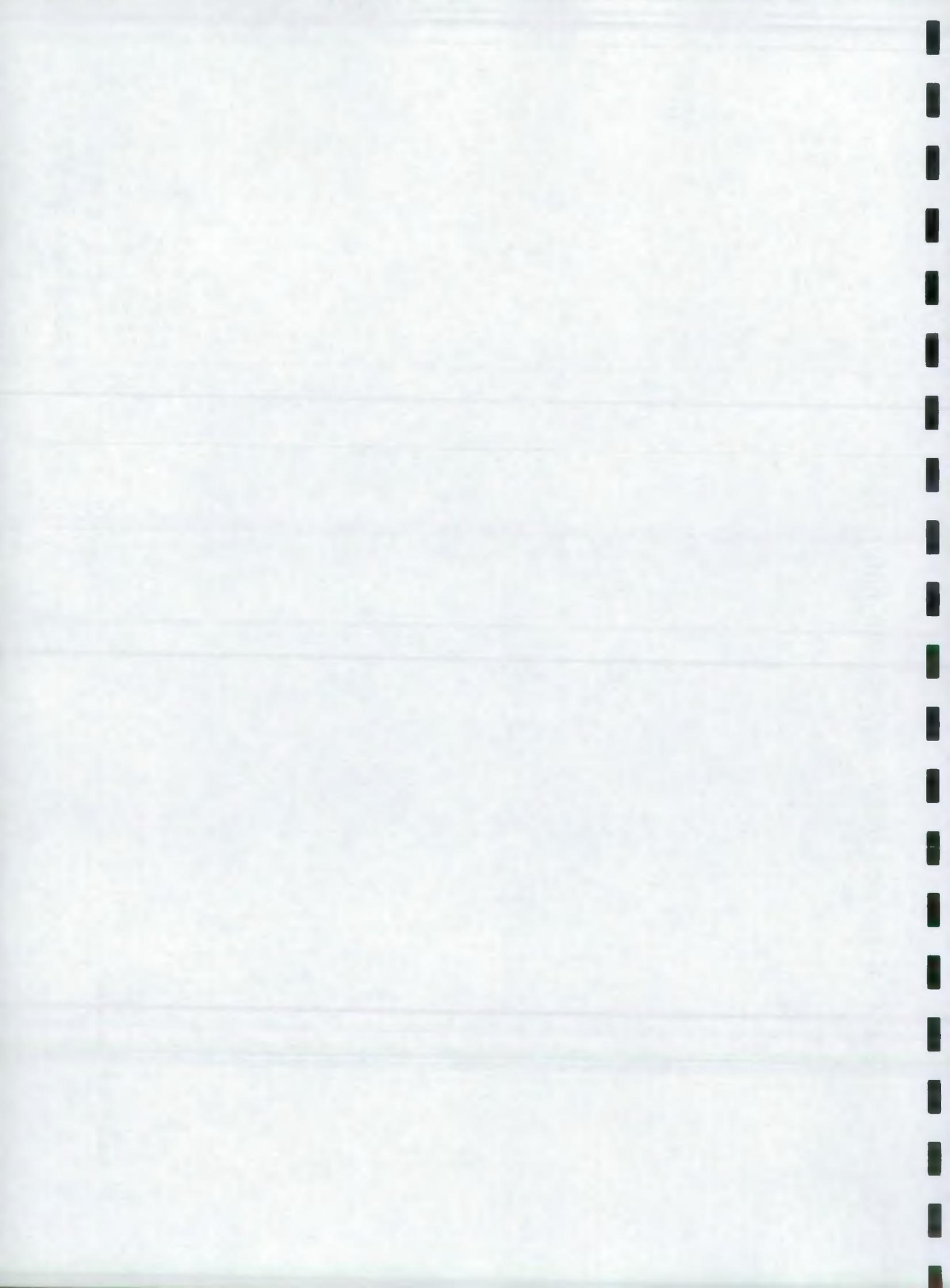
Map 6 . Wear Catchment, non routine sampling, 1998



Sample sites

- Pollution survey
- Screening
- Targetted monitoring
- Watercourse Network
- Catchment Boundary

5 0 5 10 Kilometres



Map 7. Northumberland Catchment, location of synthetic pyrethroid impact



Chemical impact



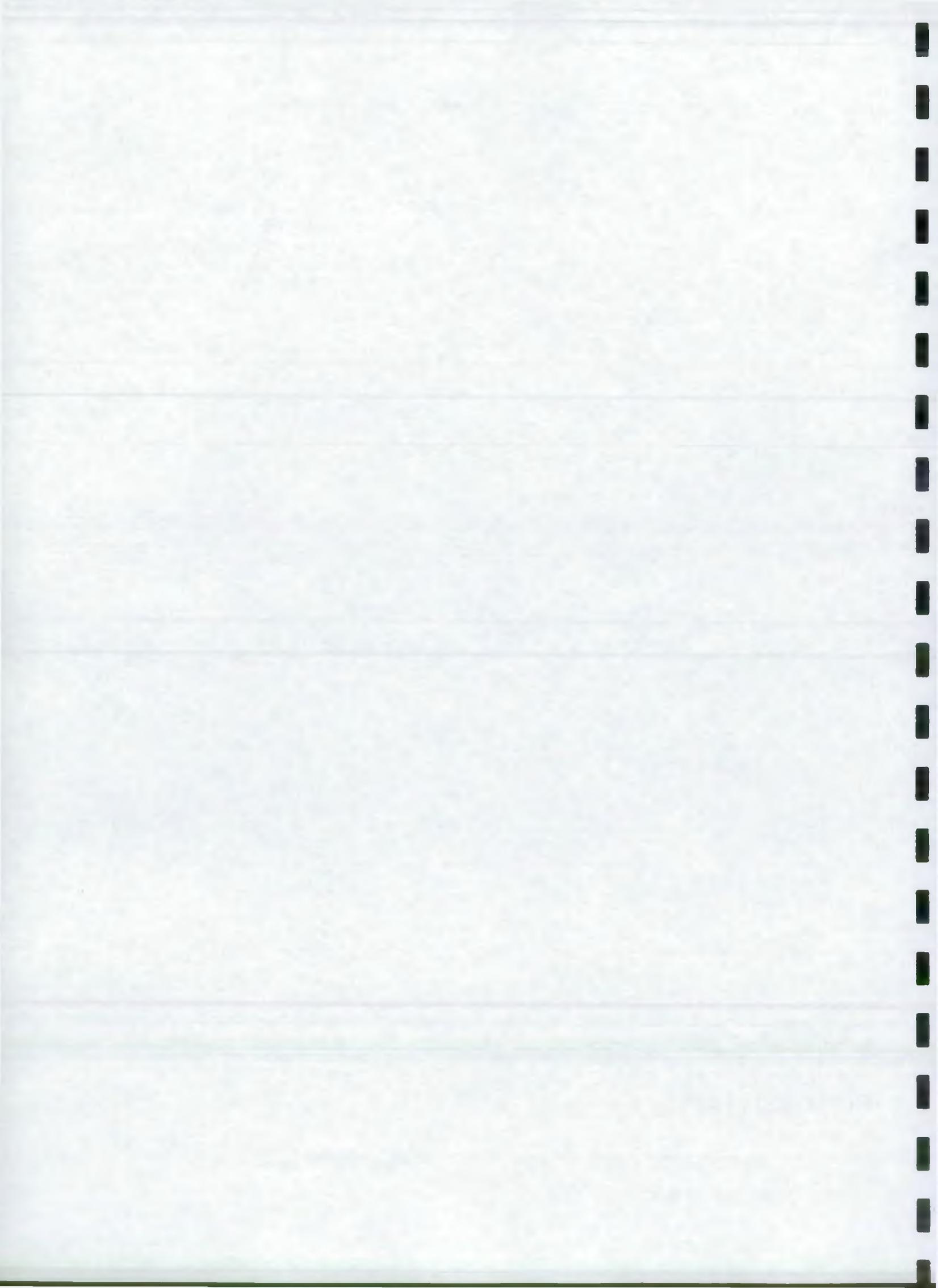
Biological impact



 Watercourse Network  
 Catchment Boundary

7 0 7 14 Kilometres





Map 8. Tyne Catchment, location of synthetic pyrethroid impact





Chemical impact



Biological impact



Watercourse Network

Catchment Boundary

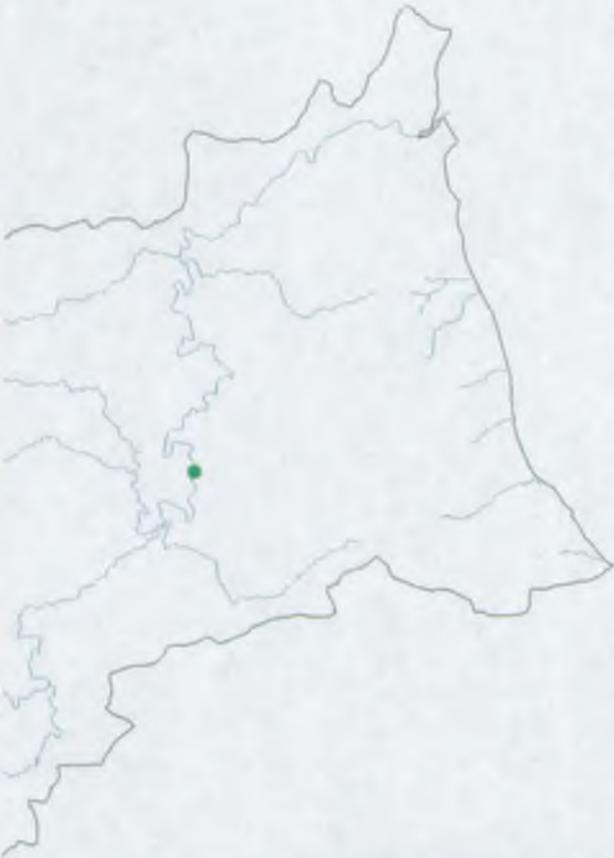


Map 9. Wear Catchment, location of synthetic pyrethroid impact



6 0 6 12 Kilometres

A scale bar is located at the bottom left of the map. It consists of a horizontal line with alternating black and white segments. The segments are labeled with the numbers 6, 0, 6, and 12, representing distances in kilometres. The total length of the bar is 12 kilometres.



Biological impact

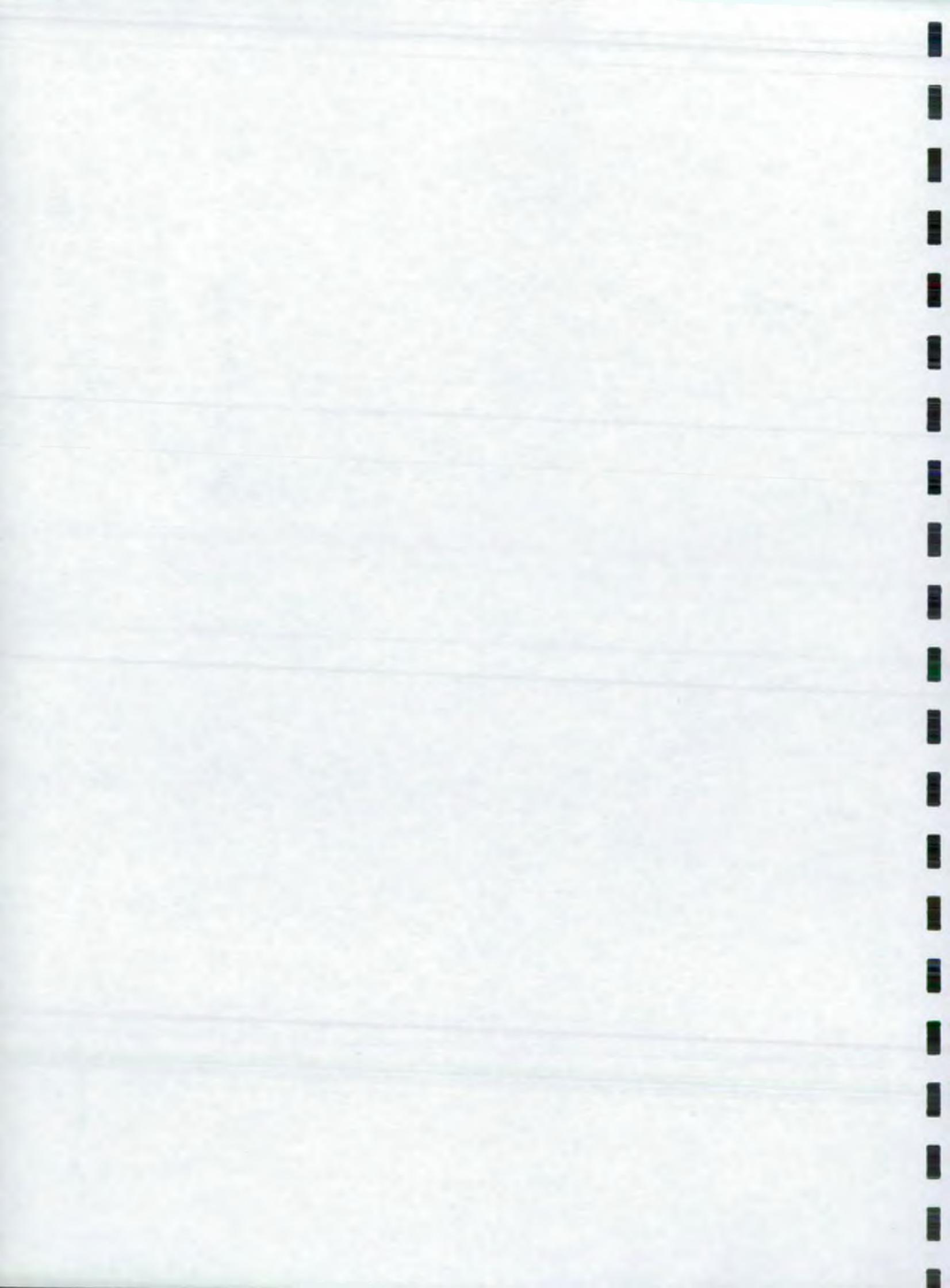


Chemical impact detected



Watercourse Network

Catchment Boundary



Appendix 1. EQS exceedance during 1998 chemical enhanced routine monitoring

| RIVER              | SITE               | DATE    | CYPERMETHRIN ug/l | FLUMETHRIN ug/l |
|--------------------|--------------------|---------|-------------------|-----------------|
| Tweed              | Norham             | 16.4.98 | 0.12              |                 |
|                    |                    | 19.5.98 | 0.036             |                 |
| Coquet             | Warkworth Dam      | 26.5.98 | 0.02              |                 |
| Wansbeck           | Sheepwash          | 21.5.98 | 0.033             |                 |
| Font               | Mitford            | 16.4.98 | 0.06              |                 |
| Wansbeck           | Mitford Castle     | 16.4.98 | 0.02              |                 |
|                    |                    | 21.5.98 | 0.02              |                 |
|                    |                    |         |                   |                 |
|                    |                    |         |                   |                 |
| North Tyne         | Chollerford        | 30.4.98 | 0.04              |                 |
|                    |                    | 19.5.98 | 0.023             |                 |
| South Tyne         | Warden Bridge      | 16.2.98 | 0.06              |                 |
| South Tyne         | Bellister          | 16.6.98 | 0.04??            |                 |
| East Allen         | Field Study centre | 16.4.98 | 0.02              |                 |
| East Allen         | Hainins            | 16.4.98 | 0.03              |                 |
| Tyne               | Wylam              | 30.4.98 | 0.08              |                 |
| Devils Water       | Dilston Hall       | 27.5.98 | 0.05              |                 |
| Derwent            | Clockburn Drift    | 16.2.98 | 0.05              |                 |
| Derwent            | below Derwent res  | 18.2.98 | 0.04              |                 |
|                    |                    |         |                   |                 |
|                    |                    |         |                   |                 |
|                    |                    |         |                   |                 |
| Tunstall reservoir |                    | 6.1.98  |                   | 0.012           |
|                    |                    | 25.2.98 | 0.03              |                 |
|                    |                    | 23.3.98 | 0.01              |                 |
| Wear               | Lamb Bridge        | 30.4.98 | 0.02              |                 |
|                    |                    |         |                   |                 |

## APPENDIX 2

## RESULTS FROM ENHANCED ROUTINE MONITORING PROGRAMME 1998

| Site Ref. | River                 | Location           | NGR         | Spring   |      |      |      |                 | Autumn   |      |      |      |                 |
|-----------|-----------------------|--------------------|-------------|----------|------|------|------|-----------------|----------|------|------|------|-----------------|
|           |                       |                    |             | Date     | BMWP | Taxa | ASPT | Impact          | Date     | BMWP | Taxa | ASPT | Impact          |
| 10        | Tweed                 | Norham             | NT 89304740 | 20.05.98 | 141  | 24   | 5.87 | no              | 29.09.98 | 147  | 23   | 5.88 | no              |
| 41        | Till                  | Twizel Mill        | NT 88504260 | 20.05.98 | 154  | 26   | 5.92 | no              | 23.09.98 | 132  | 22   | 6    | no              |
| 340       | Aln                   | Bridge of Aln      | NU 08701230 | 21.05.98 | 136  | 24   | 5.66 | no              | 11.11.98 | 103  | 20   | 5    | no              |
| 410       | Coquet                | Warkworth Ford     | NU 23700500 | 12.05.98 | 171  | 28   | 6.1  | no              |          |      |      |      |                 |
| 450       | Coquet                | Pauperhaugh        | NZ 10109960 | 21.05.98 | 186  | 30   | 6.2  | no              | 12.10.98 | 171  | 29   | 5.9  | no              |
| 480       | Coquet                | Alwinton           | NY 92200550 | 21.05.98 | 141  | 23   | 6.1  | no              | 12.10.98 | 130  | 23   | 5.65 | no              |
| 770       | Wansbeck              | Bothal             | NZ 23508620 | 18.05.98 | 148  | 25   | 5.92 | no              | 18.11.98 | 78   | 16   | 4.9  | ??              |
| 795       | Wansbeck              | Mitford Castle     | NZ 17108560 | 18.05.98 | 160  | 26   | 6.2  | no              |          |      |      |      |                 |
| 860       | Font                  | Mitford            | NZ 1730860  | 18.05.98 | 166  | 25   | 6.62 | no              | 19.11.98 | 131  | 21   | 6.24 | no              |
| 930       | Blyth                 | Bellasis           | NZ 19007770 | 28.05.98 | 145  | 27   | 5.7  | no              | 27.11.98 | 148  | 24   | 4.9  | no              |
| 1140      | Tyne                  | Wylam              | NZ 11106430 | 15.05.98 | 145  | 22   | 6.59 | no              | 20.11.98 | 134  | 21   | 6.38 | no              |
| 1190      | North Tyne            | Chollerford        | NY 90407330 | 15.05.98 | 142  | 25   | 5.68 | no              | 27.11.98 | 167  | 27   | 6.18 | no              |
| 1330      | Derwent               | Clockburn Drift    | NZ 18706040 | 27.05.98 | 138  | 23   | 6    | no              | 6.11.98  | 138  | 24   | 5.75 | no              |
| 1400      | Derwent               | Ruffside           | NY 98305140 | 27.05.98 | 135  | 20   | 6.75 | no              | 9.11.98  | 104  | 16   | 6.5  | no              |
| 1530      | u/s Whittle Reservoir | North trib         | NZ 06506880 | 15.05.98 | 100  | 19   | 5.26 | no              | 20.11.98 | 132  | 23   | 5.73 | no              |
| 1540      | u/s Whittle Reservoir | South trib         | NZ 06406870 | 15.05.98 | 114  | 21   | 5.42 | no              | 20.11.98 | 100  | 17   | 5.88 | no              |
| 1570      | Devils Water          | Dilston            | NY 97606360 | 15.05.98 | 173  | 27   | 6.4  | no              | 20.11.98 | 86   | 14   | 6.14 | yes             |
| 1580      | South Tyne            | Warden             | NY 90906600 | 19.05.98 | 148  | 22   | 6.73 | no              | 27.11.98 | 100  | 16   | 6.25 | no              |
| 1620      | South Tyne            | Haltwhistle        | NY 70106340 | 19.05.98 | 117  | 18   | 6.5  | no              | 27.11.98 | 82   | 14   | 5.85 | uncertain cause |
| 1680      | Allen                 | Cupola             | NY 80005880 | 28.05.98 | 122  | 18   | 6.77 | no              | 30.11.98 | 56   | 10   | 5.6  | high flows      |
| 1690      | East Allen            | d/s Allendale      | NY83105670  | 28.05.98 | 115  | 19   | 6.05 | no              | 30.11.98 | 62   | 11   | 5.63 | high flows      |
| 1695      | East Allen            | Sinderhope         | NY 84405220 | 28.05.98 | 112  | 17   | 6.58 | no              | 30.11.98 | 83   | 13   | 6.38 | high flows      |
| 1710      | West Allen            | Burnmouth          | NY79205830  | 28.05.98 | 105  | 15   | 7    | no              | 30.11.98 | 76   | 12   | 6.33 | high flows      |
| 1790      | Nent                  | Alston             | NY71704670  | 19.05.98 | 17   | 4    | 5.76 | uncertain cause | 27.11.98 | 40   | 8    | 5    | improving       |
| 2070      | Wear                  | Lambton Bridge     | NZ 28505220 | 23.03.98 | 68   | 14   | 4.86 | no              | 17.11.98 | 63   | 14   | 4.5  | no              |
| 2110      | Wear                  | Shincliffe         | NZ 28704100 | 30.03.98 | 92   | 20   | 4.6  | no              | 17.11.98 | 91   | 17   | 5.35 | no              |
| 2135      | Wear                  | u/s Vinovium STW   | NZ 21403100 | 24.03.98 | 145  | 26   | 5.58 | no              | 17.11.98 | 175  | 30   | 5.83 | no              |
| 2150      | Wear                  | Witton-le-Wear     | NZ 14703070 | 29.04.98 | 136  | 22   | 6.18 | no              | 17.11.98 | 107  | 18   | 5.94 | no              |
|           | Wear                  | Wolsingham         | NZ 08103690 | 29.04.98 | 141  | 22   | 6.41 | no              | 18.11.98 | 67   | 12   | 5.58 | no              |
|           | Wear                  | d/s Bollihope Burn | NZ 05003710 | 29.04.98 | 149  | 23   | 6.48 | no              | 18.11.98 | 88   | 16   | 5.5  | no              |
|           | Wear                  | d/s Rookhope Burn  | NY 95703840 | 24.03.98 | 134  | 20   | 6.7  | no              | 18.11.98 | 92   | 14   | 6.57 | no              |
|           | Wear                  | d/s Ireshope Burn  | NY 86903870 | 29.04.98 | 119  | 17   | 7    | no              | 18.11.98 | 21   | 4    | 5.25 | no              |
|           | Wear                  | Killhope           | NY 82504330 | 29.04.98 | 135  | 20   | 6.75 | no              | 18.11.98 | 80   | 11   | 7.27 | no              |

## APPENDIX 3

## RESULTS FROM BIOLOGICAL SCREENING PROGRAMME 1998

| Site Ref. | River           | Location          | Grid Ref.  | SUMMER      |      |      |      |        | AUTUMN / WINTER |      |      |      |        |
|-----------|-----------------|-------------------|------------|-------------|------|------|------|--------|-----------------|------|------|------|--------|
|           |                 |                   |            | Sample date | BMWP | Taxa | ASPT | Impact | Sample date     | BMWP | Taxa | ASPT | Impact |
| 800       | Wansbeck        | Meldon Park       | NZ11908500 |             |      |      |      |        | 12.11.98        | 92   | 14   | 6.6  | no     |
| 810       | Wansbeck        | Angerton          | NZ09308430 |             |      |      |      |        | 12.11.98        | 100  | 17   | 5.9  | no     |
|           | Trib. Wansbeck  | Middleton         | NZ06108510 |             |      |      |      |        | 12.11.98        | 50   | 12   | 4.2  | no     |
|           | Trib. Wansbeck  | u/s Middleton     | NZ05108560 |             |      |      |      |        | 12.11.98        | 35   | 8    | 4.4  | no     |
|           | Trib. Wansbeck  | u/s Middleton (2) | NZ04908570 |             |      |      |      |        | 12.11.98        | 37   | 8    | 4.6  | no     |
|           | Trib. Wansbeck  | d/s Cambo         | NZ02608510 |             |      |      |      |        | 12.11.98        | 28   | 7    | 4    | no     |
|           | Wansbeck        | d/s Cambo         | NZ03308390 |             |      |      |      |        | 12.11.98        | 98   | 18   | 5.4  | no     |
|           | Trib. Wansbeck  | d/s Broom House   | NZ01408450 |             |      |      |      |        | 12.11.98        | 40   | 9    | 4.4  | no     |
|           | Wansbeck        | Dean House        | NZ00908430 |             |      |      |      |        | 12.11.98        | 82   | 13   | 6.3  | no     |
|           | Wansbeck        | u/s NR02.820      | NZ05308410 |             |      |      |      |        | 19.11.98        | 80   | 14   | 5.7  | no     |
|           | Trib. Wansbeck  | d/s Kirkhale      | NZ02608350 |             |      |      |      |        | 19.11.98        | 61   | 11   | 5.5  | no     |
|           | Trib. Wansbeck  | d/s Holy Well     | NZ00208450 |             |      |      |      |        | 17.11.98        | 95   | 16   | 5.9  | no     |
|           | Wansbeck        | near STW          | NZ99908450 |             |      |      |      |        | 17.11.98        | 88   | 16   | 5.5  | no     |
|           | Wansbeck        |                   | NZ99908440 |             |      |      |      |        | 17.11.98        | 87   | 14   | 6.2  | no     |
|           | Wansbeck        | Ray Burn          | NY98108520 |             |      |      |      |        | 17.11.98        | 96   | 15   | 6.4  | no     |
|           | Wansbeck        |                   | NY98108510 |             |      |      |      |        | 17.11.98        | 95   | 15   | 6.2  | no     |
|           | Ray Burn        | Kirkwhelpington   | NY99308450 |             |      |      |      |        | 17.11.98        | 86   | 14   | 6.1  | no     |
|           | Wansbeck        | u/s Ray Burn      | NY99308440 |             |      |      |      |        | 17.11.98        | 94   | 14   | 6.7  | no     |
|           | Alwin           | Alwinton          | NT92400610 |             |      |      |      |        | 16.12.98        | 59   | 10   | 5.9  | no     |
|           | Alwin           | u/s Clennel       | NT92700770 |             |      |      |      |        | 16.12.98        | 84   | 11   | 7.6  | no     |
|           | Trib. Alwin     | u/s Alwin         | NT92600830 |             |      |      |      |        | 16.12.98        | 88   | 12   | 7.3  | no     |
|           | Allenhope Burn  | u/s Alwin         | NT9201010  |             |      |      |      |        | 16.12.98        | 71   | 9    | 7.9  | no     |
|           | White Burn      | u/s Alwin         | NT91601050 |             |      |      |      |        | 16.12.98        | 82   | 10   | 8.2  | no     |
|           | Yoke Burn       | u/s Alwin         | NT91601050 |             |      |      |      |        | 16.12.98        | 79   | 13   | 6.1  | no     |
|           | Alwin           | u/s discharge     | NT92600730 |             |      |      |      |        | 16.12.98        | 52   | 8    | 6.5  | no     |
|           | Alwin           | d/s discharge     | NT92700720 |             |      |      |      |        | 16.12.98        | 60   | 9    | 6.7  | no     |
|           | Low Acton Burn  | u/s dip           | NY82705190 |             |      |      |      |        | 02.12.98        | 50   | 9    | 5.5  | no     |
|           | Low Acton Burn  | d/s dip           | NY83005200 |             |      |      |      |        | 02.12.98        | 9    | 3    | 3    | yes    |
|           | Low Acton Burn  | u/s East Allen    | NY83705270 |             |      |      |      |        | 02.12.98        | 8    | 2    | 4    | yes    |
|           | Sinderhope Burn | Sinderhope        | NY84505230 |             |      |      |      |        | 02.12.98        | 76   | 13   | 5.84 | no     |
|           | Acton Burn      | u/s East Allen    | NY83805230 |             |      |      |      |        | 02.12.98        | 106  | 15   | 7.06 | no     |

| Site Ref. | River                 | Location            | Grid Ref.   | SUMMER      |      |      |      |        | AUTUMN / WINTER |      |      |      |          |
|-----------|-----------------------|---------------------|-------------|-------------|------|------|------|--------|-----------------|------|------|------|----------|
|           |                       |                     |             | Sample date | BMWP | Taxa | ASPT | Impact | Sample date     | BMWP | Taxa | ASPT | Impact   |
|           | East Allen            | d/s Low Acton Burn  | NY83605280  |             |      |      |      |        | 02.12.98        | 86   | 14   | 6.14 | no       |
|           | Watsons Well          | u/s footbridge      | NY83805290  |             |      |      |      |        | 02.12.98        | 87   | 13   | 6.69 | no       |
|           | Swinhope Burn         | Top road            |             |             |      |      |      |        | 15.10.98        | 46   | 7    | 6.57 | possible |
|           | Swinhope Burn         | u/s farm            |             |             |      |      |      |        | 15.10.98        | 59   | 10   | 5.9  | NO       |
|           | Hayring Burn          | u/s dip pen         | NY 76604460 |             |      |      |      |        | 15.10.98        | 78   | 13   | 6    | NO       |
|           | Hayring Burn          | d/s dip pen         | NY76604660  |             |      |      |      |        | 15.10.98        | 78   | 13   | 6    | NO       |
|           | Upper Swinburn        | u/s A68             | NY94007630  | 30.06.98    | 118  | 21   | 5.61 | NO     |                 |      |      |      |          |
| 1530      | u/s Whittle Reservoir | North trib          | NZ06506890  |             |      |      |      |        | 08.12.98        | 68   | 13   | 5.23 | no       |
| 1540      | u/s Whittle Reservoir | South trib          | NZ06406870  |             |      |      |      |        | 08.12.98        | 40   | 8    | 5    | no       |
| 2810      | Middlehope Burn       | Westgate            | NY90603840  | 05.08.98    | 113  | 16   | 7.1  | NO     |                 |      |      |      |          |
| 2840      | Burnhope Burn         | Wearhead            | NY85603950  | 05.08.98    | 117  | 19   | 6.16 | NO     |                 |      |      |      |          |
| 2760      | Stanhope Burn         | Stanhope            | NY99003980  | 06.08.98    | 122  | 19   | 6.42 | NO     |                 |      |      |      |          |
| 2750      | Bollihope Burn        | Whitfield           | NY00503500  | 06.08.98    | 137  | 20   | 6.85 | NO     |                 |      |      |      |          |
| 2820      | Ireshope Burn         | Ireshope            | NY86803880  | 05.08.98    | 117  | 19   | 6.16 | NO     |                 |      |      |      |          |
| 2800      | Swinhope Burn         | Swinhope            | NY91003760  | 06.08.98    | 161  | 24   | 6.71 | NO     |                 |      |      |      |          |
|           | Bedburn Beck          | Bedburn             | NZ11003200  |             |      |      |      |        | 18.12.98        | 119  | 18   | 6.61 | NO       |
|           | Horsley Beck          | u/s River Wear      | NZ97603870  |             |      |      |      |        | 18.12.98        | 83   | 13   | 6.38 | NO       |
|           | Unnamed trib.         | u/s River Wear      | NZ05503680  |             |      |      |      |        | 18.12.98        | 46   | 9    | 5.11 | Organic  |
|           | Lindburn Beck         | u/s River Wear      | NZ14903050  |             |      |      |      |        | 18.12.98        | 118  | 18   | 6.56 | NO       |
|           | Browney               | Throstle Nest       | NZ16004560  |             |      |      |      |        | 18.12.98        | 115  | 17   | 6.76 | NO       |
|           | Waskerley Beck        | Wolsingham          | NZ07603760  |             |      |      |      |        | 19.11.98        | 108  | 16   | 6.75 | NO       |
| 2669      | Gaunless              | Fielden Bridge      | NZ20602670  |             |      |      |      |        | 14.10.98        | 110  | 21   | 5.24 | no       |
| 2680      | Gaunless              | Butterknowle        | NZ11302540  |             |      |      |      |        | 13.10.98        | 121  | 22   | 5.5  | no       |
|           | Wear/Killhope Burn    | d/s Ireshope Burn   | NY 869387   |             |      |      |      |        | 15.12.98        | 39   | 7    | 5.57 | metals   |
|           | Wear/Killhope Burn    | d/s Burnhope Burn   | NY 859394   |             |      |      |      |        | 15.12.98        | 45   | 8    | 5.63 | metals   |
|           | Wear/Killhope Burn    | u/s Burnhope Burn   | NY 856397   |             |      |      |      |        | 15.12.98        | 42   | 7    | 6    | metals   |
|           | Wear/Killhope Burn    | Cowshill            | NY 854405   |             |      |      |      |        | 15.12.98        | 12   | 4    | 3    | metals   |
|           | Wear/Killhope Burn    | d/s Low Allers      | NY 851409   |             |      |      |      |        | 17.12.98        | 34   | 6    | 5.67 | metals   |
|           | Wear/Killhope Burn    | d/s Heathery Bridge | NY 845414   |             |      |      |      |        | 17.12.98        | 48   | 7    | 6.86 | metals   |
|           | Wear/Killhope Burn    | d/s Wellhope        | NY 836416   |             |      |      |      |        | 17.12.98        | 73   | 11   | 6.64 | metals   |
|           | Wear/Killhope Burn    | Killhope            | NY 825433   |             |      |      |      |        | 15.12.98        | 70   | 11   | 6.36 | metals   |

APPENDIX 4 RESULTS FROM PROCESS TARGETTED MONITORING PROGRAMME 1998

| River         | Location                      | NGR        | Date     | BMWP | Taxa | ASPT | Impact |
|---------------|-------------------------------|------------|----------|------|------|------|--------|
| Hawkhope Burn | u/s tree nursery discharge    | NY71508810 | 30.04.98 | 92   | 14   | 6.57 | no     |
| Hawkhope Burn | 30m d/s discharge             | NY71508800 | 30.04.98 | 3    | 2    | 1.5  | yes    |
| Hawkhope Burn | 100m d/s discharge            | NY71508790 | 30.04.98 | 3    | 2    | 1.5  | yes    |
| Hawkhope Burn | 650m d/s discharge            | NY71708770 | 30.04.98 | 16   | 4    | 4    | yes    |
| Hawkhope Burn | u/s tree nursery discharge    | NY71508810 | 14.05.98 | 92   | 14   | 6.57 | no     |
| Hawkhope Burn | 30m d/s discharge             | NY71508800 | 14.05.98 | 3    | 2    | 1.5  | yes    |
| Hawkhope Burn | 100m d/s discharge            | NY71508790 | 14.05.98 | 3    | 2    | 1.5  | yes    |
| Hawkhope Burn | 650m d/s discharge            | NY71708770 | 14.05.98 | 11   | 3    | 3.67 | yes    |
| Hawkhope Burn | u/s tree nursery discharge    | NY71508810 | 25.06.98 | 84   | 14   | 6    | no     |
| Hawkhope Burn | 30m d/s discharge             | NY71508800 | 25.06.98 | 22   | 5    | 4.4  | yes    |
| Hawkhope Burn | 100m d/s discharge            | NY71508790 | 25.06.98 | 11   | 3    | 3.67 | yes    |
| Hawkhope Burn | 650m d/s discharge            | NY71708770 | 25.06.98 | 9    | 3    | 3    | yes    |
| Hawkhope Burn | u/s tree nursery discharge    | NY71508810 | 11.11.98 | 69   | 11   | 6.27 | no     |
| Hawkhope Burn | 30m d/s discharge             | NY71508800 | 11.11.98 | 69   | 10   | 6.9  | no     |
| Hawkhope Burn | 100m d/s discharge            | NY71508790 | 11.11.98 | 45   | 8    | 5.63 | no     |
| Hawkhope Burn | 650m d/s discharge            | NY71708770 | 11.11.98 | 45   | 7    | 6.43 | no     |
| Spring 1      | d/s soak away                 | NY99108350 | 11.11.98 | 49   | 10   | 4.9  | no     |
| Spring 1      | d/s soak away, after disposal | NY99108350 | 14.11.98 | 53   | 11   | 4.8  | no     |
| Spring 1      | u/s Wansbeck                  | NY99308440 | 14.11.98 | 64   | 11   | 5.8  | no     |
| Spring 2      | d/s soak away                 | NY99108350 | 11.11.98 | 42   | 10   | 4.2  | no     |
| Spring 2      | d/s soak away, after disposal | NY99108350 | 14.11.98 | 54   | 11   | 4.9  | no     |
| Spring 2      | u/s Wansbeck                  | NZ00908410 | 14.11.98 | 45   | 8    | 5.6  | no     |

## APPENDIX 5

## RESULTS FROM POLLUTION SURVEYS 1998

| River                   | Location            | Grid Ref.  | SUMMER      |      |      |      |          | AUTUMN / WINTER |      |      |      |        |
|-------------------------|---------------------|------------|-------------|------|------|------|----------|-----------------|------|------|------|--------|
|                         |                     |            | Sample date | BMWP | Taxa | ASPT | Impact   | Sample date     | BMWP | Taxa | ASPT | Impact |
| Waskerley Beck          | d/s WTW d/s STW     | NZ06604040 |             |      |      |      |          | 02.11.98        | 19   | 5    | 3.8  | YES    |
| Trib. Waskerley Beck    | u/s Waskerley Beck  | NZ06504010 |             |      |      |      |          | 02.11.98        | 102  | 16   | 6.34 | NO     |
| Trib.(2) Waskerley Beck | u/s Waskerley Beck  | NZ06804070 |             |      |      |      |          | 02.11.98        | 6    | 2    | 3    | YES    |
| Trib.(2) Waskerley Beck | u/s farm            | NZ07004090 |             |      |      |      |          | 02.11.98        | 32   | 6    | 5.33 | NO     |
| Trib.(2) Waskerley Beck | d/s farm drainage   | NZ06904080 |             |      |      |      |          | 02.11.98        | 5    | 1    | 5    | YES    |
| Waskerley Beck          | u/s farm drainage   | NZ06954085 |             |      |      |      |          | 02.11.98        | 48   | 10   | 4.8  | NO     |
| Houselop Beck           | Bradley             | NZ10603620 | 02.07.98    | 62   | 13   | 4.76 | Possible |                 |      |      |      |        |
| Houselop Beck           | d/s minewater       | NZ09003890 | 30.06.98    | 35   | 8    | 4.34 | YES      |                 |      |      |      |        |
| Trib. Houselop Beck     | u/s Houselop Beck   | NZ09703920 | 30.06.98    | 144  | 22   | 6.54 | NO       |                 |      |      |      |        |
| Houselop Beck           | u/s trib.           | NZ09703930 | 30.06.98    | 28   | 6    | 4.67 | YES      |                 |      |      |      |        |
| Houselop Beck           | d/s pond at farm    | NZ09504050 | 08.07.98    | 31   | 8    | 3.88 | YES      |                 |      |      |      |        |
| Houselop Beck           | d/s trib. Adj. Farm | NZ09404060 | 09.07.98    | 32   | 8    | 4    | YES      |                 |      |      |      |        |
| Houselop Beck           | u/s trib. Adj. Farm | NZ09404070 | 09.07.98    | 57   | 11   | 5.18 | NO       |                 |      |      |      |        |
| Houselop Beck           | trib. D/s dip       | NZ09404070 | 09.07.98    | 18   | 5    | 3.6  | YES      |                 |      |      |      |        |
| Houselop Beck           | trib. U/s dip       | NZ09504070 | 09.07.98    | 29   | 7    | 4.14 | NO       |                 |      |      |      |        |
| Houselop Beck           | u/s Low Houselop    | NZ09204090 | 02.07.98    | 66   | 12   | 5.5  | NO       |                 |      |      |      |        |