BIOLOGICAL ASSESSMENT OF THE EFFECTS OF IVYBRIDGE SEWAGE TREATMENT WORKS ON THE RIVER ERME

M.R.N. Newton
Manley House
EXETER

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SUMMARY

Biological surveys of the River Erme in relation to the effects of the Ivybridge Sewage Treatment Works were carried out in November 1986, June and November 1987 and April 1988. Biological samples indicate water quality in the River Erme upstream of the Wiggins Teape discharge has remained excellent at all times. The discharge from Wiggins Teape was found to have a deleterious effect on the aquatic invertebrate fauna downstream. These effects were exacerbated by the discharge from Ivybridge Sewage Treatment Works and by poor quality discharges from the Old Mill Stream and the Woodland Stream. Effects on the invertebrate fauna downstream of Ivybridge Sewage Treatment Works were found to be more significant in the Spring, probably as a result of the extended operation of Ivybridge Sewage Treatment Works storm overflow at this time.

CIRCULATION LIST

Environmental Protection Officer (East)

Environmental Scientist (East)

Pollution Inspector (Dart)

Scientific Officer Data and Information

Assistant Environmental Scientists (East)

1. INTRODUCTION

The River Erme below Ivybridge at the Cleeve Bridge monitoring point has consistently failed to comply with its River Quality Objective (R.Q.O.) of 1A, whilst the monitoring point in the town of Ivybridge at Stowford Weir has consistently achieved this objective and a biological survey carried out in 1985 also indicated problems in this area (1). Investigations have been undertaken in order to determine the cause of this non-compliance. The sewage works in particular has been monitored to assess its impact on receiving water quality and consequently the aquatic ecology.

Biological monitoring of the River Erme was carried out in November 1986, June and November 1987 and April 1988. Monitoring sites were chosen to assess the impact of Ivybridge Sewage Treatment Works (including the storm overflow system) on the River Erme. Other discharges which were considered to significantly influence water quality in the vicinity of the sewage treatment works were also assessed.

2. METHODOLOGY

Samples of aquatic macroinvertebrates were obtained by the standard two minute kick method (2). The resultant samples were qualitatively assessed for the presence and abundance of aquatic macroinvertebrate taxa on site. Samples were then preserved in industrial methylated spirit and returned to the laboratory for further analysis. From the resultant data, biotic indices were calculated. The biotic indices used for the purpose of this investigation was the Biological Monitoring Working Party Score (BMWP), a nationally recognised system. This score system attributes high scores to taxa sensitive to pollution (maximum 10) and low scores to taxa tolerant of pollution (minimum 1). Calculation of the average score per taxon (ASPT) value therefore indicates the proportion of pollution tolerant and intolerant taxa present at a particular site. The ASPT value is generally regarded as a better indicator of water quality as it is less susceptible to variations resulting from seasonal factors, physical factors and sampling anomolies.

3. RESULTS

3.1 The sites investigated during the various surveys carried out on the River Erme are shown in Figure 1.

3.2 The site descriptions and resultant biotic scores are shown in Table 1.

3.3 The occurrence and abundance of aquatic macroinvertebrate taxa encountered during the survey are shown in Table 2.,

3.4 The variation in ASPT values along the length of river surveyed are shown graphically in Figure 2.

3.5 The variation in BMWP score along the length of river survey are shown graphically in Figure 3.

4. DISCUSSION

4.1 River Erme upstream of Wiggins Teape

Biological monitoring of the River Erme upstream of the Wiggins Teape discharge has consistently indicated water quality to be excellent, albeit of low trophic status (nutrient poor) which tends to limit productivity.

4.2 River Erme downstream Wiggins Teape discharge

The discharge from Wiggins Teape Paper Mill has consistently been shown to have a detrimental effect on the aquatic ecology of the River Erme. Typically this discharge brings about a reduction in the diversity of the invertebrate fauna and to some extent enhances the numbers of organic pollution tolerant taxa. There have been frequent occurrences of sewage fungus and filamentous blue/green algae in the river immediately downstream of this discharge. This emphasises the enriching effect this discharge has upon the receiving River Erme. Paper Mill effluents are often associated with such growths despite the fact that measured BOD Levels are frequently quite low. The growth is thought to be as a result of the presence of starch and some soluble wood-polysaccharides in the effluent which is readily utilised by bacteria and algae. The growth of sewage fungus and algae tends to be more pronounced under low flow conditions. There are also some indications from the invertebrate monitoring that the effluent may contain a toxic element at times.

4.3 Ivybridge Sewage Treatment Works

The site upstream of Ivybridge Sewage Treatment Works used to assess the effect of Ivybridge Sewage Treatment Works is situated at the A38 roadbridge. A relatively depleted invertebrate fauna has frequently been encountered at this site and it has been noticeable that a larger than expected proportion of the fauna consisted of organic pollution tolerant taxa. The cause of the deterioration in the quality of the invertebrate fauna is not immediately obvious, although it would seem likely it is the result of the continued effect of Wiggins Teape discharge. However, the Millhouse Stream which is culverted and enters the River Erme just upstream of the A38 bridge is obviously receiving intermittent crude sewage discharge and is exhibiting a variable quality and must at times be highly eutrophic to cause the dense growth of filamentous green algae occurring on the spillway. Consequently, this stream could also be affecting this site.

Downstream of Ivybridge Sewage Treatment Works discharge the invertebrate fauna has consistently shown a further decline when compared with the fauna at the upstream A38 site. This decline has taken the form of replacement of organic pollution sensitive taxa with organic pollution tolerant taxa. When this site was sampled in April 1988 both objectionable material and sewage fungus were recorded amongst the substratum of the river. This suggests either a further deterioration in effluent quality or that the storm overflow was having an increasing influence on water quality.

Biological investigation of the effects of the storm overflow system of Ivybridge sewerage was undertaken in June and November 1987. At the time of these investigations no major problems were attributable to these overflow systems, although a surface water drain in Ivybridge town was seen to be connected to a domestic waste supply causing the presence of sewage fungus and fat accumulations in the river downstream. It would appear that storm overflow operation particularly at the works is more frequent in the Spring and this may be a more appropriate period to assess the effects of storm overflow operation.

4.4 Woodland Stream

The Woodland Stream joins the River Erme immediately adjacent to the Ivybridge Sewage Treatment Works outfall. The stream has been sampled biologically on two occasions. On each occasion a restricted invertebrate fauna was encountered with few taxa present and the majority of those present being organic pollution tolerant. Heavy siltation of the substrate was observed on both occasions and severe discolouration of the stream was observed on one occasion which was reported to the Pollution Inspectorate. Whilst the excessive suspended solids level that this stream experiences at times may well be largely responsible for the poor quality invertebrate fauna, there were indications in the fauna that the organic loading to the stream is also excessive at times.

5. CONCLUSIONS

5.1 The water quality of the River Erme upstream of Wiggins Teape discharge is excellent and of low trophic status.

5.2 The discharge from Wiggins Teape is having a detrimental effect on the invertebrate fauna of the River Erme and is causing limited growths of sewage fungus and blue/green algae in the river downstream especially under low flow conditions.

5.3 The Old Mill Stream which is culverted and enters the River Erme upstream of the A38 bridge receives intermittent crude sewage discharges and is relatively eutrophic. This discharge could be contributing to poor quality observed at the A38 bridge site.

5.4 The storm overflow system of Ivybridge Sewage Works (excluding the storm tank discharge) did not appear to be effecting the quality of the invertebrate fauna of the River Erme at the times they were monitored.

5.5 The discharge from Ivybridge Sewage Treatment Works was causing a further deterioration of the invertebrate fauna in the river downstream. However, this effect could be largely attributable to the frequent operation of the storm tank overflow which combines with the final effluent. Objectionable material recorded amongst the substrata downstream of the final effluent discharge was almost certainly due to the storm tank overflow.

5.6 The Woodland Stream is suffering severe intermittent suspended solids discharges which has restricted the invertebrate fauna as a result of excessive siltation an element of organic pollution may also be intermittently affecting this stream.

6. RECOMMENDATIONS

6.1 The consent for Wiggins Teape discharge should be reviewed in order to protect the biological and aesthetic objectives set for the River Erme.

6.2 The source of poor quality in the Old Mill Stream should be investigated and resolved.

6.3 The source of poor quality in the Woodland Stream should be investigated and resolved.

6.4 The consent condition for Ivybridge Sewage Treatment Works should be reviewed to ensure protection of the biological and aesthetic objectives set for the River Erme.

6.5 The excessive operation of Ivybridge Sewage Treatment Works storm tank overflow should be stopped. Measures should be taken to ensure the discharge is screened and will only operate when the river is truly in spate.

6.6 Biological monitoring should be used to assess the effectiveness of any management actions.

7. REFERENCES

1. Biological Survey of the River Erme catchment - March 1985. M.R.M. NEWTON July 1985 S.W.W. Exeter.

2. Standing Committee of Analysts (1978) Handnet Sampling of Aquatic Macroinvertebrates - HMSO London

FIGURE 1
Biological Sampling Sites, River Erme 1986-1988

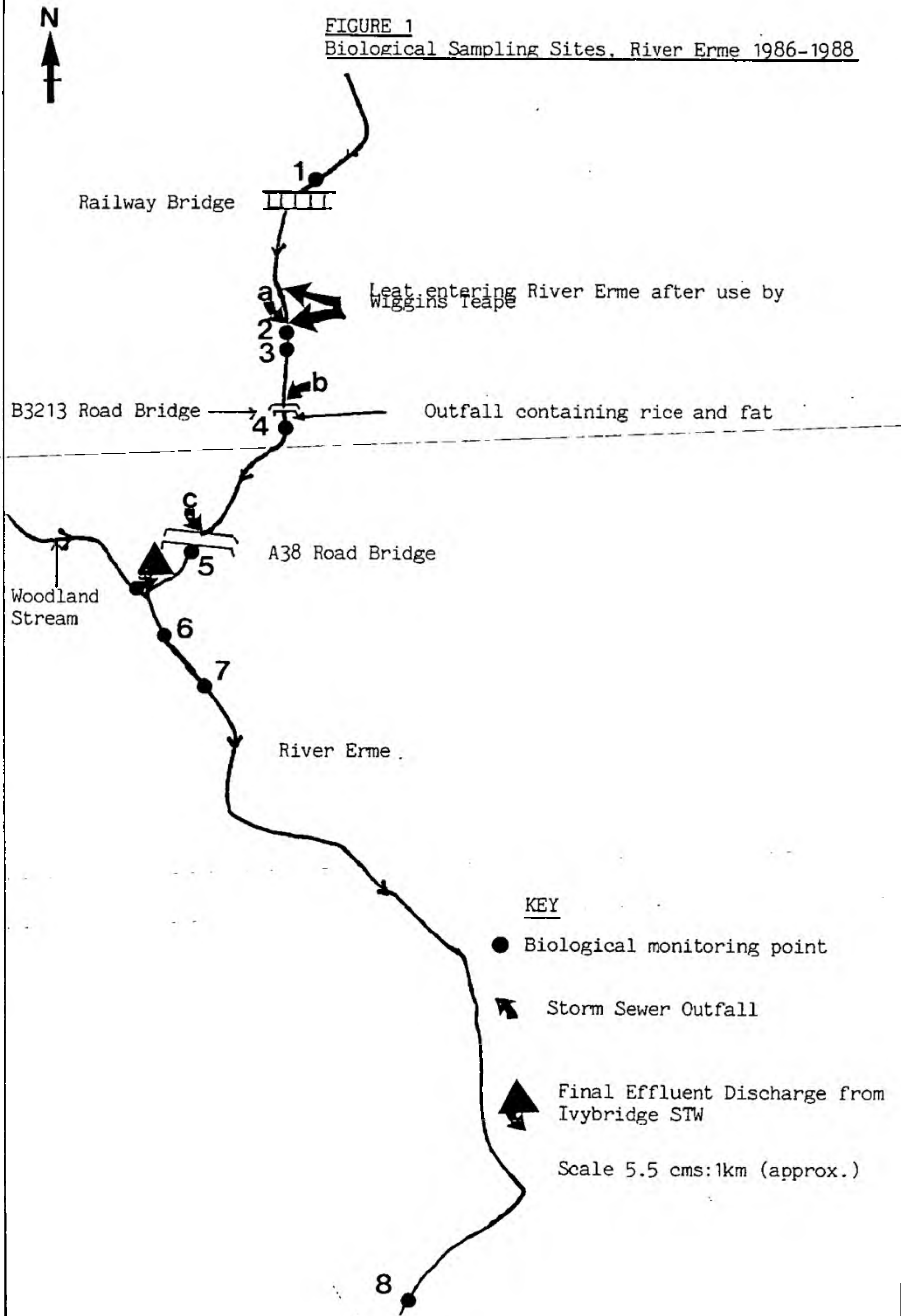
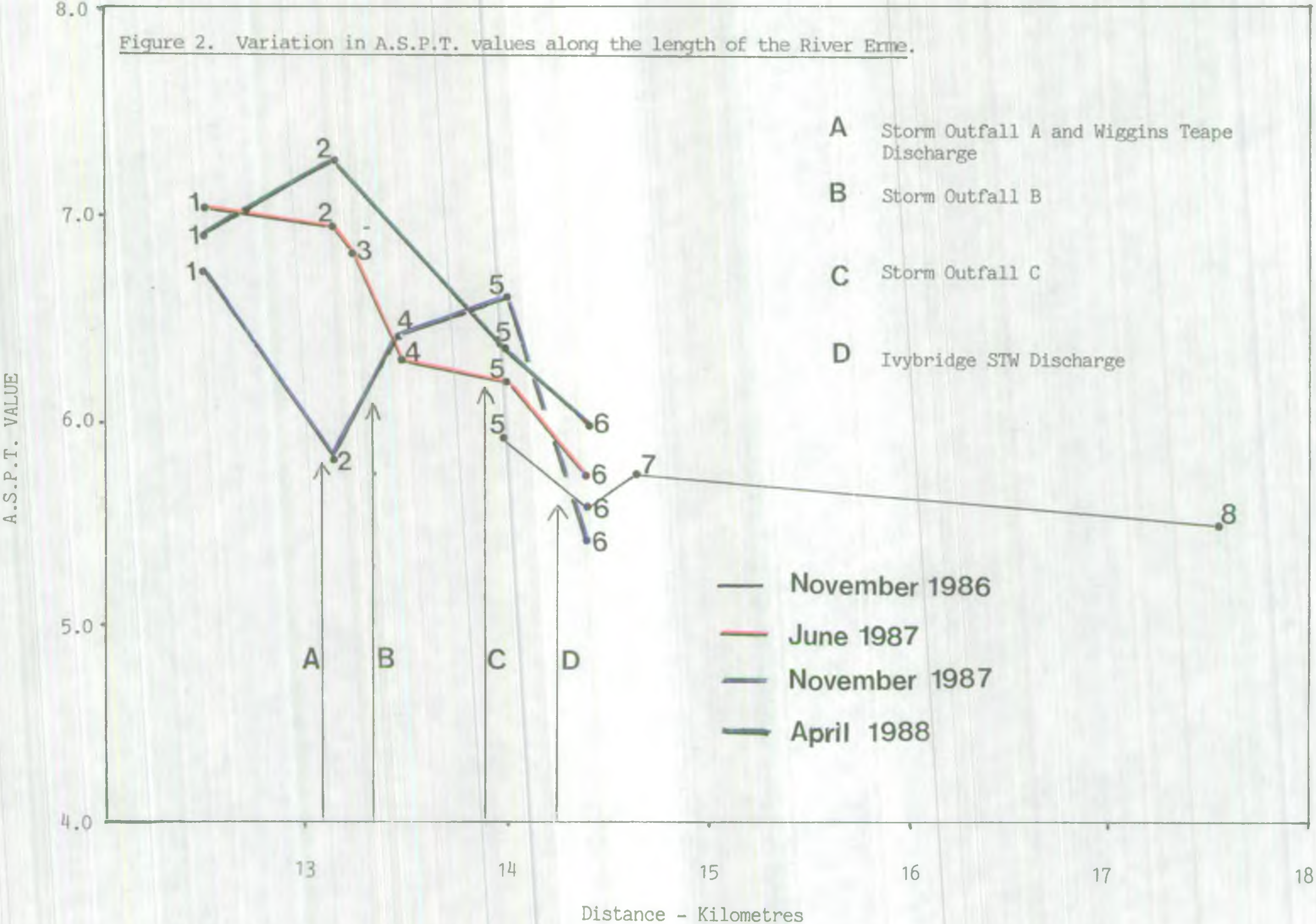


Figure 2. Variation in A.S.P.T. values along the length of the River Erme.



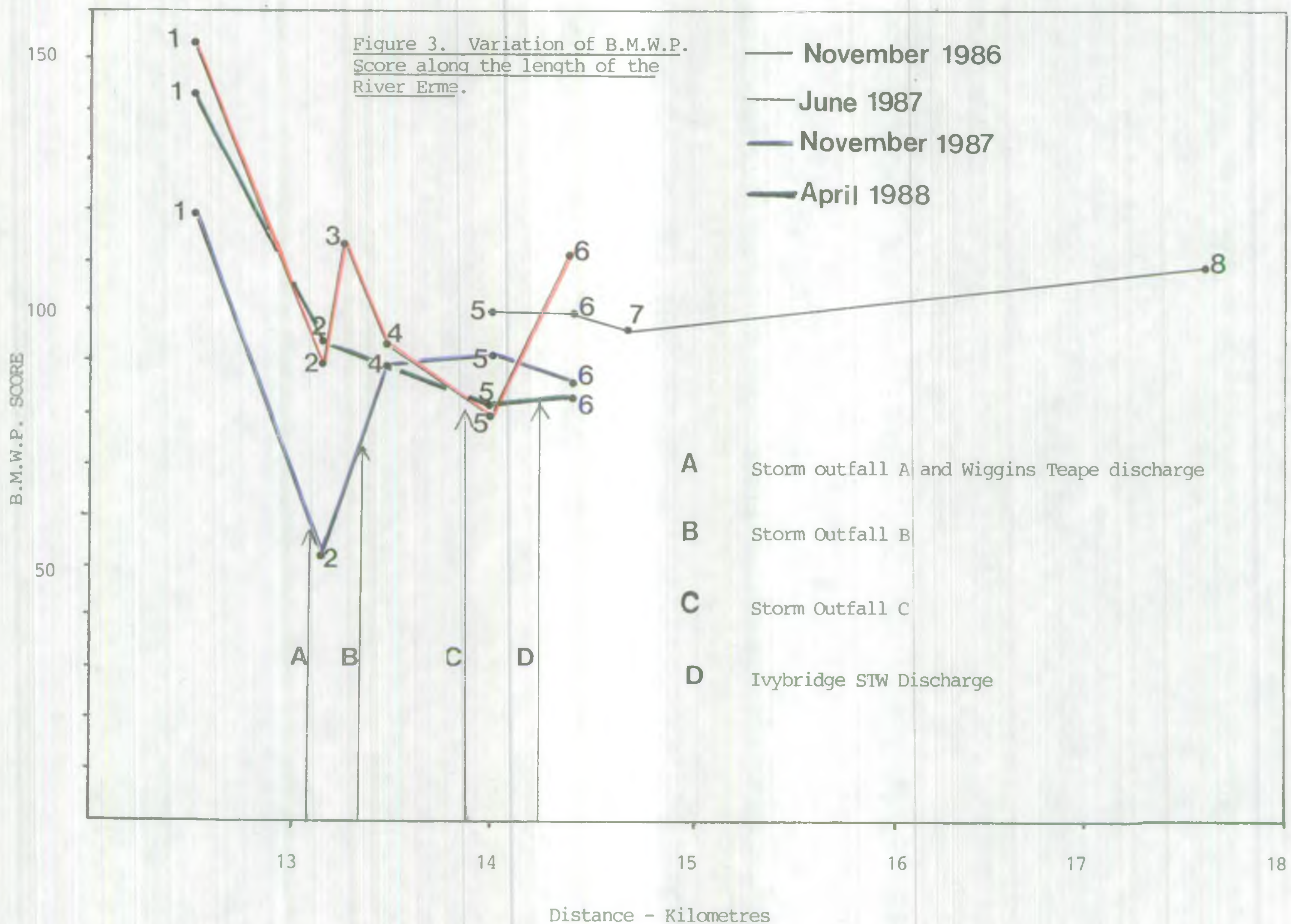


Figure 3. Variation of B.M.W.P. Score along the length of the River Erme.

TABLE 1 ENVIRONMENTAL IMPACT ASSESSMENT OF IVYBRIDGE SEWAGE TREATMENT WORKS
SITE DETAILS AND BIOTIC INDICES

SITE	B.M.W.P. SCORE				NUMBER OF FAMILIES				AVERAGE SCORE PER TAXON			
	12.11.86	22.6.87	4.11.87	13.4.88	12.11.86	22.6.87	4.11.87	13.4.88	12.11.86	22.6.87	4.11.87	13.4.88
1. River Erme, upstream of railway bridge NGR SX 638 571	-	154	121	144	-	22	18	21	-	7.00	6.72	6.86
2. River Erme, downstream of Wiggins Teape and storm sewage outfall A. NGR SX 636 566	-	90	52	94	-	13	9	13	-	6.92	5.77	7.23
3. River Erme, downstream of storm sewage outfall A and downstream of road drain NGR SX 635 566	-	115	-	-	-	17	-	-	-	6.77	-	-
4. River Erme, downstream of storm sewage outfall B NGR SX 637 562	-	94	89*	-	-	15	14*	-	-	6.27	6.36*	-
5. River Erme, upstream of Ivybridge STW, downstream of storm sewage outfall at A38 bridge NGR SX 633 557	100	80	92	82	17	13	14	13	5.88	6.15	6.57	6.31

TABLE 1 continued

SITE	B.M.W.P. SCORE				NUMBER OF FAMILIES				AVERAGE SCORE PER TAXON			
	12.11.86	22.6.87	4.11.87	13.4.88	12.11.86	22.6.87	4.11.87	13.4.88	12.11.86	22.6.87	4.11.87	13.4.88
6. River Erme, 150m downstream Ivybridge STW final effluent discharge NGR SX 632 554	100	113	86	83	18	20	16	14	5.56	5.65	5.38	5.93
7. River Erme, Cleeve Bridge NGR SX 6335 5520	97	-	-	-	17	-	-	-	5.71	-	-	-
8. River Erme Fauns Bridge, Ermington NGR SX 6405 5305	109	-	-	-	20	-	-	-	5.45	-	-	-
9. Woodland Stream, 20m upstream of confluence with River Erme NGR SX 6320 5555	-	68	36	-	-	15	10	-	-	4.53	3.6	-

* This site sampled on 6.11.87 not 4.11.87.

TABLE 2A

INVERTEBRATE FAMILIES OBSERVED AT SITES 5-8 RIVER ERME SURVEY 12.11.86

INVERTEBRATE FAMILY	SITE 5	SITE 6	SITE 7	SITE 8
PLECOPTERA				
Perlidae	–	–	–	–
Chloroperlidae	–	–	–	–
Leuctridae				
Taeniopterygidae	–	–	–	–
Perlodidae	R/O	–	–	–
Nemouridae	C	O/C	C	O
EPHEMEROPTERA				
Heptageniidae	O	O	O	O
Ephemerellidae	–	–	–	–
Caenidae	R	–	–	–
Baetidae	O/C	O	O	O
TRICHOPTERA				
Leptoceridae	–	–	–	R
Goeridae	–	–	R	–
Lepidostomatidae	–	–	–	–
Sericostomatidae	R	O	O	–
Philopotamidae	–	–	–	–
Rhyacophilidae	O	O/C	O	O/C
Polycentropidae	–	–	–	–
Limnephilidae	–	R	–	–
Hydropsychidae	R/O	O	O	R O
ODONATA				
Cordulegasteridae	–	–	–	–
COLEOPTERA				
Dytiscidae	–	–	–	–
Gyrinidae	–	R	–	O
Hydrophilidae	–	R	R	–
Elminthidae	O	O	O	R
DIPTERA				
Tipulidae	–	–	–	R
Simuliidae	O	R	–	O
Chironomidae	O	O	O/C	O
CRUSTACEA				
Gammaridae	–	–	R	O
Asellidae	–	–	R	–

MOLLUSCA				
Ancylidae	C	C	C	C
Sphaeriidae	–	–	–	–
Hydrobiidae	O	O	R	O
Lymnaeidae	–	–	–	–
TRICLADIDA				
Planariidae	R	R	–	R/O
HIRUDINEA				
Glossiphoniidae	–	–	–	R
Erpobdellidae	R	R	O	R
OLIGOCHAETA				
Oligochaeta	O	O	O	O

TABLE 2B

INVERTEBRATE FAMILIES OBSERVED AT SITES 1-6&9 RIVER ERME SURVEY 22.06.87

INVERTEBRATE FAMILY	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6	SITE 9
PLECOPTERA							
Perlidae	R	-	-	-	-	-	-
Chloroperlidae	O	O/C	O	R/O	R	R	-
Leuctridae	C	O/C	O/C	O/C	O	O	-
Taeniopterygidae	-	-	-	-	-	-	-
Perlodidae	O	R	R	-	-	-	-
Nemouridae	C	R	O/C	O	-	R	-
EPHEMEROPTERA							
Heptageniidae	R	-	-	-	-	-	-
Ephemerellidae	O/C	R/O	O	O	R	O	A
Caenidae	-	-	-	-	-	R	-
Baetidae	O/C	O	O/C	O	O	C	C/A
TRICHOPTERA							
Leptoceridae	-	-	-	-	-	-	-
Goeridae	-	-	-	-	-	-	-
Lepidostomatidae	R/O	R	R	-	-	-	-
Sericostomatidae	O	-	O	R	O	O	-
Philopotamidae	O/C	-	-	-	-	-	-
Rhyacophilidae	R	R	R	R	R	O/C	R
Polycentropidae	R	R	R	-	-	-	-
Limnephilidae	O	R	O	R	R	O	O
Hydropsychidae	O/C	-	O	R	R	O/C	-
ODONATA							
Cordulegasteridae	-	-	-	-	-	-	-
COLEOPTERA							
Dytiscidae	-	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-	-
Hydrophilidae	O	-	-	R	-	R	-
Elminthidae	O/C	-	R	R	-	O	-
DIPTERA							
Tipulidae	-	-	R	-	-	-	O
Simuliidae	O	R/O	O	R	R	R	-
Chironomidae	O	O	O	O	O	O	C
CRUSTACEA							
Gammaridae	-	-	-	-	-	-	O
Asellidae	-	-	-	-	-	-	C

MOLLUSCA							
Ancylidae	R	–	–	R	R	R	O
Sphaeriidae	–	–	–	–	–	R	R
Hydrobiidae	–	–	–	–	–	O	VA
Lymnaeidae	–	–	–	–	–	–	O
TRICLADIDA							
Planariidae	O/C	–	–	–	–	–	O
HIRUDINEA							
Glossiphoniidae	–	–	–	–	–	R	O
Erpobdellidae	–	–	–	–	O	R	O
OLIGOCHAETA							
Oligochaeta	O	O/C	O	C	C/A	O	O

TABLE 2C
INVERTEBRATE FAMILIES OBSERVED AT SELECTED SITES RIVER ERME SURVEY
04.11.87

INVERTEBRATE FAMILY	SITE 1	SITE 2	SITE 4	SITE 5	SITE 6	SITE 9
PLECOPTERA						
Perlidae	-	-	-	-	-	-
Chloroperlidae	-	-	-	-	-	-
Leuctridae	R/O	O	R	-	-	-
Taeniopterygidae	-	-	-	-	-	-
Perlodidae	O	-	-	-	-	-
Nemouridae	C	O	R	O	O	-
EPHEMEROPTERA						
Heptageniidae	C	O	O	O	O	-
Ephemerellidae	-	-	-	-	-	-
Caenidae	-	-	-	-	R	-
Baetidae	O	O/C	O	O	O/C	O
TRICHOPTERA						
Leptoceridae	R	-	-	O/C	-	-
Goeridae	R	-	R	R	-	-
Lepidostomatidae	-	-	-	-	-	-
Sericostomatidae	C	-	R/O	C	O/C	-
Philopotamidae	-	-	-	-	-	-
Rhyacophilidae	O	R	R/O	O	R	-
Polycentropidae	R	-	R	R	-	-
Limnephilidae	R	-	-	-	-	-
Hydropsychidae	O	-	R	O	O	-
ODONATA						
Cordulegasteridae	-	-	-	-	R	-
COLEOPTERA						
Dytiscidae	-	-	-	-	-	-
Gyrinidae	-	-	-	-	-	-
Hydrophilidae	R	-	-	-	-	-
Elminthidae	R	-	R	O	O	-
DIPTERA						
Tipulidae	R	-	-	-	-	R
Simuliidae	-	O	R/O	-	O	-
Chironomidae	R	O	O	O	O	O/C
CRUSTACEA						
Gammaridae	-	-	-	-	-	O

Asellidae	–	–	–	–	R	O/C
MOLLUSCA						
Ancylidae	C	R	R	C	C	O/C
Sphaeriidae	–	–	–	–	–	–
Hydrobiidae	–	–	–	–	O	C/A
Lymnaeidae	–	–	–	–	R	R
TRICLADIDA						
Planariidae	–	–	–	–	–	–
HIRUDINEA						
Glossiphoniidae	–	–	–	–	–	C
Erpobdellidae	–	–	–	–	–	–
OLIGOCHAETA						
Oligochaeta	O	C	C/A	A	C	O

TABLE 2D

INVERTEBRATE FAMILIES OBSERVED AT SELECTED SITES RIVER ERME SURVEY 13.04.88

INVERTEBRATE FAMILY	SITE 1	SITE 2	SITE 5	SITE 6
PLECOPTERA				
.rlidae	-	-	-	-
Chloroperlidae	O/C	O	-	R
Leuctridae	O/C	O/C	R	-
Taeniopterygidae	O	O/C	R	O
Perlodidae	O	R	R	-
Nemouridae	O	O/C	O/C	O
EPHEMEROPTERA				
Heptageniidae	O	O	R/O	R
Ephemerellidae	-	-	-	-
Caenidae	-	-	-	R
Baetidae	O	-	-	R
TRICHOPTERA				
Leptoceridae	-	-	-	-
Goeridae	O	-	-	-
Lepidostomatidae	R/O	-	-	-
Sericostomatidae	O	O	O	O
Philopotamidae	-	-	-	-
Rhyacophilidae	-	O	-	-
Polycentropidae	O	R	-	-
Limnephilidae	O	-	-	-
Hydropsychidae	O	R	O	O
ODONATA				
Cordulegasteridae	-	-	-	-
COLEOPTERA				
Dytiscidae	O	-	-	-
Gyrinidae	-	-	-	-
Hydrophilidae	R	-	-	-
Elminthidae	R	R	R	R
DIPTERA				
Tipulidae	-	-	-	-
Simuliidae	O	-	-	-
Chironomidae	R	O	O	O

CRUSTACEA				
*Gammar*idae	–	–	–	–
Asellidae	–	–	–	–
MOLLUSCA				
Ancylidae	R/O	–	O	R/O
Sphaeriidae	–	–	–	–
Hydrobiidae	–	–	R	O
Lymnaeidae	–	–	–	–
TRICLADIDA				
Planariidae	R	–	–	–
HIRUDINEA				
Glossiphoniidae	–	–	–	–
Erpobdellidae	–	–	R	C
OLIGOCHAETA				
Oligochaeta	O	C	C	C/A

R – RARE 1–2 INDIVIDUALS
O – OCCASIONAL 3–10 INDIVIDUALS
C – COMMON 11–49 INDIVIDUALS
A – ABUNDANT 50–100 INDIVIDUALS
VA – VERY ABUNDANT 100+ INDIVIDUALS