

Ecological Survey of the Bourne Stream, in the Bourne Valley SSSI, Poole, Dorset

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Summary

An ecological survey of the Bourne Stream in the Bourne Valley SSSI was carried out using biological assessment techniques (BMWP and RIVPACS) and the results compared to previous surveys. A structural assessment of features of wildlife conservation value (River Habitat Survey) was also carried out.

The biological assessment graded the Bourne Stream as High with a RIVPACS band B (Good). The environmental quality has improved over the last ten years compared with two previous surveys. Three Nationally Notable species of beetle were found in the stream.

The River Habitat Survey gave a result which is comparable to other small, lowland, riffle-dominated rivers and the Habitat Modification Score was 5 (Predominantly Unmodified). These scores are very creditable given the urban surroundings of the Bourne Valley.

Introduction

This survey was commissioned by the Bourne Stream Partnership as part of the requirement to write a Water Level Management Plan for the Bourne Stream. The remit was to resurvey the upper reaches of the stream within the Bourne Valley SSSI. Two surveys had previously been carried out on the macroinvertebrates of the stream, data from which gave a baseline against which to draw comparisons. In addition the physical structure of the stream was surveyed using River Habitat Survey techniques, which give a measure of the naturalness of the stream and hence another measure of its conservation value.

The work was carried out by Robert Aquilina during August 2005 and the report presented in October 2005.

Methods

The stream was surveyed at four points along its course within the Bourne Valley SSSI. Two of these points were chosen to match the sample points of previous surveys, so that comparative interpretation could be made. Two new sites were selected on the basis of their representativeness of the stream habitats (site 3) and a desire to include an area of the stream that had been modified in 2003 to improve throughflow in one of the online ponds (site 2).

Aquatic invertebrates were collected using a standardised, 3 minute timed method, using a hand net from the major habitats in the stream (stands of different wetland plants, distinctive substrates, tree roots etc.). Kick sampling was employed to disturb the streambed with the dislodged invertebrates being washed downstream into the net. The material collected was returned to the laboratory for sorting and identification using a binocular microscope. All major macroinvertebrate groups were recorded to species level, where life-history stage allowed, except for True Flies (Diptera), for which there is little information on species level identification and national distribution, and Worms (Oligochaeta). The invertebrate groups recorded were: Bivalvia (bivalves, excluding *Pisidium* sp.), Coleoptera (water beetles), Crustacea (slaters and shrimps), Ephemeroptera (mayflies), Gastropoda (snails), Hemiptera (water bugs), Hirudinea (leeches), Megaloptera (alderflies), Odonata (dragonflies and damselflies), Plecoptera (stoneflies), Trichoptera (caddisflies) and Tricladida (flatworms).

A range of environmental data was also recorded at each sample point of the stream.

The River Habitat Survey (RHS) was carried out on a representative 0.5 km section of the stream with assessments being made at 50 metre intervals within the section. The physical features of the stream at that point were recorded and then a sweep up was made on the return leg to ensure that no features had been missed.

Conservation assessment methodology

The evaluation of the conservation value of streams is based on the presence of macroinvertebrates. The level to which identification is made is typically to family level only, although full species lists were produced as part of this assessment in order to ensure that rare species were recognised and inventoried for the site. The BMWP (Biological Monitoring Working party) scores are then used to generate an index for the site. These scores reflect the sensitivity of the families of macroinvertebrates to oxygen depletion and thus to either organic (BOD) or chemical pollution (COD) that reduces the oxygen levels in the environment.

The BMWP score and its associated calculation of Average Score per Taxa (ASPT) can then be used to assign a quality category to the stream based on a scale from 0 – 100 where scores less than 10 indicate heavily polluted (poor) environments and scores over 100 indicate unpolluted (very good) environments.

These scores should be related to a predictive system (RIVPACS) for rivers where the score is expressed as a fraction of the predicted families for a pristine stream with that set of environmental parameters. The two previous surveys used RIVPACS for their analysis so this survey data can be set against that background (Armitage *et al.* (1995), Aquilina (2003)).

The RHS consists of a list of features of natural or artificial nature that affect the stream and its conservation value to riverine wildlife. These features are scored to give a Habitat Quality Assessment, which is a broad measure of the diversity and naturalness of the habitat and can be compared with other rivers of similar type. In addition a Habitat Modification Score can be derived to categorise the severity and extent of structural modification of the stream channel (Environment Agency, 1998).

Sample sites

The sites selected for the stream macroinvertebrate surveys and the dates of the surveys are presented below in Table 1.

Site number	Access point	Grid Reference	Date visited
1*	St Brelades Avenue	SZ050945	19/8/05
2	South Park Road	SZ061937	19/8/05
3	Winston Avenue	SZ065934	29/8/05
4*	Talbot Heath	SZ068928	28/8/05

*Table 1 Macroinvertebrate sample sites. The sites for which previous survey data is available are denoted by **

The sites selected for the RHS were from the first sample point at SZ050945 downstream for 0.5 km at approximately 50 metre intervals, the final point being at SZ 055940, just south of the pond at Scott Road. This section of the stream was felt to be most representative as it consistently ran through heath with a strip of woodland bordering the stream and there was only one online pond in the stretch. The pond is

not included in the survey. Grid references of the selected sites are presented together with the data in Appendix 2.

Site results

Sample point 1 (SZ050945) was surveyed on 19th August 2005 and had previously been surveyed on 18th August 2003 (Aquilina, 2003) and 8th August 1994 (Armitage *et al.*, 1995). The site was below the confluence of the stream and the outflow from the SUDS lagoons in a field grazed by two ponies. The site itself was open, well-vegetated and poached with some bare mud. The stream cut a deeper channel in the centre with shallow margins either side. Maximum depth was 45 cms with a depth of 10 cms in the shallows. The width was 2.8 m. Field measurements gave pH as 7.5 and conductivity as 385 μSm^{-1} , both values slightly lower than previously recorded.

The macroinvertebrates recorded at this site totalled 30 species (see Appendix 1), including three Nationally Notable beetles, *Gyrinus urinator*, *Rhantus suteralis* and *Hydaticus seminiger* (Foster, 2000). Two of these beetles have not been recorded before from the Bourne Stream although both *Rhantus* and *Hydaticus* larvae were recorded at this site during the 2003 survey, but larval identification beyond genus is usually impossible as there are no established keys. The BMWP score was 91 and the ASPT was 4.33, indicating a high level of biodiversity, reflecting good water quality.

Sample point 2 (SZ061937) was surveyed on 19th August 2005 and had not previously been surveyed. This site was modified in October 2003 to improve the throughflow of the pond into which it drains. Thus the course of the original stream has been altered to take in a new meander. This sample point stretched from the new meander upstream to an original, unaltered section of the stream. The site was open, although more shaded by trees upstream, with a deep channel and in-stream vegetation along the banks. The channel was 2 metres wide at this point and the depths at a quarter, half and three-quarters across were 32, 32 and 23 cms respectively.

Field measurements gave pH as 7.2 and conductivity as 287 μSm^{-1} .

The macroinvertebrates recorded at this site totalled 23 species (see Appendix 2), which was the lowest of the four sites. This is reflected in the BMWP score of 83 but this is probably due to the presence of fish in this section of the stream. This is the only section where fish were noted and they have probably come up from the pond downstream. Although they were not identified, they were a Cyprinid, probably Roach (*Rutilus rutilus*) or Rudd (*Scardinius erthrophthalmus*) as both species are known to be present in the pond. Their presence is likely to depress macroinvertebrate abundance through their predation activities, although the ASPT score of 4.61 shows that the taxa found were on average higher scoring (more pollution sensitive) than at site 1.

Sample point 3 (SZ065934) was sampled on 29th August 2005 and had not been previously surveyed. This section was selected to represent the wooded element of the stream with relatively dense shade and little in-stream vegetation, although the section was rich in features of conservation value such as riffles, exposed gravel, debris dams and tree roots. The width of the stream at the sample point was 1.9 m and the depths

at a quarter, half and three-quarters across were 2, 6 and 6 cms respectively. Field measurements gave pH as 7.5 and conductivity as 262 μSm^{-1} .

The macroinvertebrates recorded at this site totalled 30 species (see Appendix 3), with a BMWP score of 119 and ASPT score of 4.76. This site was notable for the presence of larvae of the Beautiful Demoiselle (*Calypteryx virgo*), a damselfly which requires shaded wooded streams and for a Sponge fly (*Sisyra fuscata*) which, although not uncommon, lives on freshwater sponges which themselves are sensitive to pollution and therefore indicators of clean water.

Sample point 4 (SZ068928) was sampled on 28th August 2005 and had previously been surveyed on 11th August 2003 (Aquilina, 2003) and 8th August 1994 (Armitage *et al.*, 1995). The site was below the outfall from the large pond on Talbot Heath and was an open, gravel-dominated riffle zone with in-stream vegetation along the edges and the banks topped by typical heathland scrub. The width of the stream was 4m and the depths at a quarter, half and three-quarters across were 3, 0 and 7 cms respectively. Field measurements gave pH as 7.5 and conductivity as 291 μSm^{-1} .

The macroinvertebrates recorded at this site totalled 42 species (see Appendix 4). The BMWP score was the highest of the four sites at 154, as was the ASPT score at 4.97. This is likely to be influenced by the proximity of the pond which inevitably leads to some washout of invertebrates and hence a slightly elevated score.

Macroinvertebrate Conservation Assessment

The results presented above can be interpreted on their own merits with the mean BMWP being 112 and the mean ASPT being 4.67. These are high scores for a small stream and reflect High conservation value and implies good water quality. The pH and conductivity measurements are reasonably consistent and demonstrate near neutral water with moderate solute content, again implying good water quality.

The opportunity presented here to compare the data with past surveys undertaken with a standardised consistent approach and, in one case, by the same operator is rarely offered and therefore is of particular interest.

The previous surveys were undertaken over a number of seasons as is usual with stream invertebrate sampling. The 1995 surveys being over three seasons (Spring, Summer and Autumn) whilst the 2003 survey was over two (Spring and Summer). The sample data from each season are amalgamated to give a single species list and to generate a single BMWP score for the site. The previous results are summarised below in Table 2.

Site and parameter	1995 results (spring, summer + autumn)	2003 results (spring + summer)	2003 results (summer only)	2005 results (summer only)
Site 1 BMWP	87	110	87	91
Site 1 # taxa	18	25	21	21
Site 1 ASPT	4.83	4.40	4.14	4.33
Site 4 BMWP	153	125	96	154
Site 4 # taxa	31	26	21	31
Site 4 ASPT	4.94	4.81	4.59	4.97

Table 2. Biotic Indices for previously surveyed sites.

The results for BMWP and number of taxa at site 1 agree closely between the 2003 and 2005 summer only samples and the 1995 3-season sample with the 2003 2-season sample showing a greater score for both. The ASPT for the 1995 3-season combined is greater than the other years ASPT scores.

The results for the BMWP, number of taxa and ASPT compare favourably at site 4 between the 2005 summer only sample and all the other samples.

It would be expected that a multi-season sample would provide greater scores than a single visit, and usually by a reasonable amount as shown by the differences between the 2003 combined and 2003 summer only sample scores. It is therefore worth considering what conclusion can be drawn from these results. As all the factors were held as constant as possible (i.e. site selection, methodology, operator (partly)) with only time varying, it is reasonable to conclude that the Bourne Stream has improved in its macroinvertebrate biodiversity between 1995 and 2005.

A cross check of this proposition can be made by feeding the current results into the RIVPACS predictions from 2003 and recalculating the rating category generated. This does assume that the environmental parameters that are used to generate the predicted rating in RIVPACS have not changed between 2003 and now. This is a reasonable assumption as the majority of parameters are invariant such as longitude, latitude, altitude, and distance from source. The results are presented in Table 3 below.

Parameter	Site	Predicted	Observed	Index	Band
BMWP	1	151.7	91	0.60	C
	4	201.3	154	0.77	B
# taxa	1	26.3	21	0.80	B
	4	33.6	31	0.92	A
ASPT	1	5.7	4.33	0.76	B
	4	6.0	4.97	0.83	B

Table 3. Recalculated RIVPACS classification bands for 2005.

The lower of the banding scores for # taxa and ASPT is used to calculate the overall band, therefore this study gives an overall band of B for both sites 1 and 4. This is compared with previous bands in Table 4 below.

Site	1995	2003	2005
1	C	B	B
4	C	C	B

Table 4. Overall RIVPACS classification bands for the Bourne Stream

A band of B equates to a Good grade of water quality. Thus it would appear that there has been a consistent improvement in the water quality of the Bourne Stream over the last ten years, based on these measurements. It should be borne in mind that this assessment (2005) is based on a single season sample whereas the previous assessments were based on two (2003) or three (1995) seasons. A complete survey will ideally be carried out over three seasons as a greater proportion of the total macroinvertebrates are captured. So, in interpreting these results it can be confidently argued that the scores would be higher if a return visit in another season were to be made. It seems highly likely that the band would also be uplifted, at least in the case of site 4, as it scored an A with respect to number of taxa even in this single season. Therefore, the Bourne Stream is rated as Good in this survey with the expectation that Very Good might be achieved with more data from further surveys.

River Habitat Survey

In order to complement the assessment of environmental quality based on macroinvertebrates, a River Habitat Survey was undertaken with the intention of identifying those physical features of the environment that had wildlife conservation value. It is hoped that the data provided here will be useful, not only as a current catalogue but as a list of desirable features to encourage elsewhere.

River Habitat Survey (RHS) is a system for assessing the character and quality of rivers based on their physical structure. It has four components, which are a standard field survey methodology, a database of sites against which comparisons can be made, a scoring system for assessing habitat quality and a method for assessing the extent of artificial channel modification.

A number of caveats are applicable to this particular instance of RHS. Whilst this consultant was trained in RHS as part of an MSc course run between Bournemouth University and the Centre for Ecology and Hydrology (CEH), this was not part of the formal accreditation course; therefore access to the database of comparative sites is not available. A limited comparison is, however, possible with published data.

This assessment is only of the Bourne Stream in that portion of its valley that is part of the Bourne Valley SSSI. Beyond this section, the stream becomes increasingly artificially modified and divergent from this assessment.

Comparison with other sites is only valid if they are of the same river type. In the case of the Bourne Stream, this is the small, lowland, riffle-dominated river. This is

defined as being between 20 and 200m above sea level, with a height of source below 200m, banktop width between 2m and 15m, a bedslope greater than 5m per km, and not on chalk geology. The Bourne Stream rises at 45 m asl, has a bedslope of 10m/km and runs through acid heath sands and gravels, and therefore meets all these requirements, except that the banktop width at 1.9m is just below the target range.

Whilst these caveats make this RHS indicative rather than definitive, it is felt that this approach is still valid and a useful adjunct to the biological assessment.

The raw data collected during this RHS is presented in Appendix 5 with the scoring calculations for the Habitat Quality Assessment and Habitat Modification Score being presented in Appendices 6 and 7 respectively. Only the applicable raw data is reported so sections that were left blank on the field sheets are not included. The scores are built up so that every feature that contributes is listed in order that the significance of each is apparent.

Habitat Quality Assessment

A section of the Bourne Stream between SZ049945 (access at St Brelades Avenue) and SZ055940 (access at Scott Road) was surveyed on 28th August 2005. The section was selected to be representative of the Bourne Stream in that portion of Bourne Valley which is SSSI. The landscape is a shallow vee-shaped valley with wet and dry heathland and a semi-continuous line of scrub and trees alongside the stream. At the lowest end of the section, the stream is ponded and controlled by a weir. Upstream of the pond, a more extensive area of wetland vegetation exists. The uppermost end of the section begins below the confluence of the stream and the outflow from the SUDS lagoons. The stream is crossed by two footbridges in this section, but is generally unregulated and access along the stream is mostly difficult. A one metre transect of the stream was recorded at approximately 50 m intervals with a sweep up of any features missing from the individual transects being recorded on the return leg. At each transect details of the bank and channel structure and vegetation were recorded (see Appendix 5).

The features that contribute to the quality of the habitat are evaluated in Appendix 6. Two flow types are present – rippled and smooth. The more variety of flow types the greater the score, so this is not very varied in this case.

A range of channel substrate sizes occurs from cobbles down to silt/mud. Again, the more the variety, the greater the score, but in this case is more varied.

There are no channel or bank features present that contribute to the score. This is partly due to the size of the stream, which is too small to generate the power necessary to produce the erosional/depositional features of value. The closest that is achieved is the presence of vertical earth cliffs but these are too small to be counted (must be greater than 50 cms). Similarly side and point bars are missing this high up the stream.

Bankside vegetation structure scores highly with both bankface and banktop having 2-3 vegetation types (defined as bryophytes, short herbs/creeping grasses, tall herbs/grasses, scrub/bramble, and saplings and trees).

In-stream channel vegetation scores much less highly with only 4 of 6 categories being present and none extensively. This is a reflection of the shaded nature of the stream (both bed and banks) and to some extent its size.

Land use within 50 m scores highly with all classes being present (broadleaf woodland, wetland, and moorland/heath).

The presence of trees in a semi-continuous line also adds value. The numerous features associated with trees count highly as well with all possible features being present – overhanging boughs, exposed bankside roots, underwater tree roots, coarse woody debris, and fallen trees.

A number of special features also contribute to the score although the presence of more than one does not increase the score. Those present are debris dams, carr and bog although none are extensive.

Overall the score is 56, which matches the average HQA for small, lowland, riffle-dominated rivers.

Habitat Modification Score

The level of structural modification to the channel of a river is assessed by adding the total of the components as laid out in Appendix 7. In addition to the engineering modifications, there are also management modifications that are taken into account such as poaching by livestock and vegetation management such as bank mowing or in-stream weed cutting.

In the case of the Bourne Stream, the only modifications that score are bank reinforcement associated with a footbridge and a weir, which has resulted in flow control below the pond at Scott Road. Summing the scores for these features gives an overall rating of 5, which is Predominantly Unmodified (score 3-8). Approximately 25 % of this river type is rated as predominantly unmodified, with approximately 30 % being rated higher as pristine or semi-natural.

This is clearly a satisfactory rating for a stream in an SSSI, especially given the urban surroundings, however, as noted above, the Bourne Stream is extensively modified further downstream.

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Appendix 1 Macroinvertebrates recorded at Site 1

Species	Common name	Family	BMWP score
<i>Lymnaea peregra</i>	Wandering snail	Lymnaeidae	3
<i>Lymnaea palustris</i>	Marsh Snail	Lymnaeidae	
<i>Potamopyrgus antipodarum</i>	Jenkins spire shell	Hydrobiidae	3
<i>Physa</i> sp.	None (snail)	Physidae	3
<i>Pisidium</i> sp.	Pea mussel	Sphaeriidae	3
<i>Polycelis tenuis</i>	None (flatworm)	Planariidae	5
<i>Dugesia polychroa</i>	None (flatworm)	Planariidae	
<i>Asellus aquaticus</i>	Water hog-louse	Asellidae	3
<i>Crangonyx pseudogracilis</i>	Freshwater shrimp	Gammaridae	6
<i>Baetis rhodani</i>	Mayfly (large dark olive)	Baetidae	4
<i>Cordulegaster boltonii</i>	Golden-ringed Dragonfly	Cordulegasteridae	8
<i>Hydrometra stagnorum</i>	Water Measurer	Hydrometridae	5
<i>Notonecta maculata</i>	Water boatman	Notonectidae	5
<i>Nepa cinerea</i>	Water scorpion	Nepidae	5
<i>Gerris lacustris</i>	Pond skater	Gerrididae	5
<i>Dytiscus marginalis</i>	The Great Diving beetle	Dytiscidae	5
<i>Rhantus suteralis</i> *	Diving beetle	Dytiscidae	
<i>Hydaticus seminiger</i> *	Diving beetle	Dytiscidae	
<i>Agabus didymus</i>	Diving beetle	Dytiscidae	
<i>Laccobius bipunctatus</i>	Scavenger beetle	Hydrophilidae	5
<i>Anacaena lutescens</i>	Scavenger beetle	Hydrophilidae	
<i>Gyrinus urinator</i> *	Whirligig beetle	Gyrinidae	5
<i>Haliphus lineatocollis</i>	Crawling water beetle	Haliplidae	5
<i>Haliphus immaculatus</i>	Crawling water beetle	Haliplidae	
<i>Hydropsyche angustipennis</i>	Caddis fly	Hydropsychidae	5
Indet.	Dance midge	Dixidae	0
Chironomid sp.	Non-biting midge	Chironomidae	2
Indet.	Mosquito	Culicidae	0
<i>Simulium</i> sp.	Black fly	Simuliidae	5
Indet.	Worm	Oligochaeta	1
Total number of species	30	BMWP score	91
Number of scoring taxa	21	ASPT score	4.33
* Notable species			

Appendix 2 Macroinvertebrates recorded at Site 2

Species	Common name	Family	BMWP score
<i>Lymnaea peregra</i>	Wandering snail	Lymnaeidae	3
<i>Lymnaea stagnalis</i>	Great Pond Snail	Lymnaeidae	
<i>Potamopyrgus antipodarum</i>	Jenkins spire shell	Hydrobiidae	3
<i>Physa</i> sp.	None (snail)	Physidae	3
<i>Pisidium</i> sp.	Pea mussel	Sphaeriidae	3
<i>Asellus aquaticus</i>	Water hog-louse	Asellidae	3
<i>Helobdella stagnalis</i>	Leech	Glossiphoniidae	3
<i>Baetis rhodani</i>	Mayfly (large dark olive)	Baetidae	4
<i>Cloeon dipterum</i>	Mayfly(Pond Olive)	Baetidae	
<i>Cordulegaster boltonii</i>	Golden-ringed Dragonfly	Cordulegasteridae	8
<i>Hydrometra stagnorum</i>	Water Measurer	Hydrometridae	5
<i>Notonecta maculata</i>	Water boatman	Notonectidae	5
<i>Notonecta marmoreal viridis</i>	Water boatman	Notonectidae	
<i>Velia caprai</i>	Water cricket	Veliidae	0
<i>Corixa punctata</i>	Lesser water boatman	Corixidae	5
<i>Gerris lacustris</i>	Pond skater	Gerrididae	5
<i>Elmis aenea</i>	Riffle beetle	Elmidae	5
<i>Hydropsyche angustipennis</i>	Caddis fly	Hydropsychidae	5
<i>Mystacides azurea</i>	Caddis fly	Leptoceridae	10
Chironomid sp.	Non-biting midge	Chironomidae	2
Indet.	Mosquito	Culicidae	0
<i>Simulium</i> sp.	Black fly	Simuliidae	5
Indet.	Worm	Oligochaeta	1
Total number of species	23 species	BMWP score	83
Number of scoring taxa	18	ASPT score	4.61

Appendix 3 Macroinvertebrates recorded at Site 3

Species	Common name	Family	BMWP score
<i>Lymnaea peregra</i>	Wandering snail	Lymnaeidae	3
<i>Lymnaea stagnalis</i>	Great Pond Snail	Lymnaeidae	
<i>Potamopyrgus antipodarum</i>	Jenkins spire shell	Hydrobiidae	3
<i>Physa</i> sp.	None (snail)	Physidae	3
<i>Anisus vortex</i>	Whirlpool ramshorn	Planorbidae	3
<i>Pisidium</i> sp.	Pea mussel	Sphaeridae	3
<i>Muscalarium lacustre</i>	Orb mussel	Sphaeridae	
<i>Polycelis tenuis</i>	None (flatworm)	Planariidae	5
<i>Helobdella stagnalis</i>	None (leech)	Glossiphoniidae	3
<i>Asellus aquaticus</i>	Water hog-louse	Asellidae	3
<i>Crangonyx pseudogracilis</i>	Freshwater shrimp	Gammaridae	6
<i>Baetis rhodani</i>	Mayfly (large dark olive)	Baetidae	4
<i>Cordulegaster boltonii</i>	Golden-ringed Dragonfly	Cordulegasteridae	8
<i>Calopteryx virgo</i>	Beautiful Demoiselle	Calopterygidae	8
<i>Hydrometra stagnorum</i>	Water Measurer	Hydrometridae	5
<i>Velia caprai</i>	Water cricket	Veliidae	0
<i>Nepa cinerea</i>	Water scorpion	Nepidae	5
<i>Sigara dorsalis</i>	Lesser water boatman	Corixidae	5
<i>Limnius volkmari</i>	Riffle beetle	Elmidae	5
<i>Elmis aenea</i>	Riffle beetle	Elmidae	
<i>Megasternum obscurum</i>	Scavenger beetle	Hydrophilidae	5
<i>Sisyra fuscata</i>	Sponge fly	Sisyridae	0
<i>Limnephilus decipiens</i>	Caddis fly	Limnephilidae	7
<i>Adicella reducta</i>	Caddis fly		10
<i>Hydropsyche angustipennis</i>	Caddis fly	Hydropsychidae	5
<i>Rhyacophila dorsalis</i>	Caddis fly	Rhyacophilidae	7
Chironomid sp.	Non-biting midge	Chironomidae	2
Indet.	Crane fly	Tipulidae	5
<i>Simulium</i> sp.	Black fly	Simuliidae	5
Indet.	Worm	Oligochaeta	1
Total number of species	30	BMWP score	119
Number of scoring taxa	25	ASPT score	4.76

Appendix 4 Macroinvertebrates recorded at Site 4

Species	Common name	Family	BMWP score
<i>Lymnaea peregra</i>	Wandering snail	Lymnaeidae	3
<i>Planorbis planorbis</i>	The ramshorn	Planorbidae	3
<i>Anisus vortex</i>	Whirlpool ramshorn	Planorbidae	
<i>Gyraulus albus</i>	White ramshorn	Planorbidae	
<i>Gyraulus crista</i>	Nautilus ramshorn	Planorbidae	
<i>Potamopyrgus antipodarum</i>	Jenkins spire shell	Hydrobiidae	3
<i>Physa</i> sp.	None (snail)	Physidae	3
<i>Pisidium</i> sp.	Pea mussel	Sphaeriidae	3
<i>Polycelis tenuis</i>	None (flatworm)	Planariidae	5
<i>Polycelis felina</i>	None (flatworm)	Planariidae	
<i>Dugesia polychroa</i>	None (flatworm)	Planariidae	
<i>Erpobdella testacea</i>	None (leech)	Erpobdellidae	3
<i>Theromyzon tessalatum</i>	None (leech)	Glossiphoniidae	3
<i>Asellus aquaticus</i>	Water hog-louse	Asellidae	3
<i>Crangonyx pseudogracilis</i>	Freshwater shrimp	Gammaridae	6
<i>Sialia lutaria</i>	Alderfly	Sialidae	4
<i>Baetis rhodani</i>	Mayfly (large dark olive)	Baetidae	4
<i>Cloeon dipterum</i>	Mayfly (Pond Olive)	Baetidae	
<i>Cordulegaster boltonii</i>	Golden-ringed Dragonfly	Cordulegasteridae	8
<i>Aeshna</i> sp.	Hawker dragonfly	Aeshnidae	8
<i>Ishnura elegans</i>	Blue-tailed damselfly	Coenagrionidae	6
<i>Hydrometra stagnorum</i>	Water Measurer	Hydrometridae	5
<i>Velia caprai</i>	Water cricket	Veliidae	0
<i>Nepa cinerea</i>	Water scorpion	Nepidae	5
<i>Ilyocoris cimicoides</i>	Saucer bug	Naucoridae	5
<i>Gerris</i> sp. nymph	Water skater	Gerridae	5
<i>Notonecta glauca</i>	Water boatman	Notonectidae	5
<i>Elmis aenea</i>	Riffle beetle	Elmidae	5
<i>Oulimnius</i> sp.	Riffle beetle	Elmidae	
Dytiscid larva	Diving beetle	Dytiscidae	5
<i>Gyrinus urinator</i> *	Whirligig beetle	Gyrinidae	5
<i>Haliphus lineatocollis</i>	Crawling water beetle	Haliplidae	5
<i>Haliphus ruficollis</i> gr.	Crawling water beetle	Haliplidae	
<i>Anacaena globulus</i>	Scavenger beetle	Hydrophilidae	5
<i>Mystacides azurea</i>	Caddis fly	Leptoceridae	10
<i>Goera pilosa</i>	Caddis fly	Goeridae	10
<i>Hydropsyche angustipennis</i>	Caddis fly	Hydropsychidae	5
<i>Rhyacophila dorsalis</i>	Caddis fly	Rhyacophilidae	7

Chironomid sp.	Non-biting midge	Chironomidae	2
<i>Simulium</i> sp.	Black fly	Simuliidae	5
Indet.	Moth-fly	Psychodidae	0
<i>Culicoides</i> type	Biting midge	Ceratopogonidae	0
Total number of species	42	BMWP score	154
Number of scoring taxa	31	ASPT score	4.97
* Notable species			

Appendix 5 River Habitat Survey

1998 RIVER HABITAT SURVEY		
A BACKGROUND MAP-BASED INFORMATION		
Altitude (m) <i>45</i>	Slope (m/km) <i>10</i>	Navigation ? <i>No</i>
Distance from source (km) <i>0.2</i>		
B FIELD SURVEY DETAILS		
Site number: <i>1</i>	Mid-site GR <i>SZ052494</i>	River: <i>Bourne stream</i>
Date <i>28/8/05</i>	Time <i>11am</i>	Surveyor <i>Robert Aquilina</i>
Bed of river visible ?	<i>yes</i>	
Site surveyed from:	<i>Right bank</i>	
C PREDOMINANT VALLEY FORM		
shallow vee	Terraced valley floor ?	<i>No</i>
D NUMBER OF RIFFLES, POOLS AND POINT BARS (<i>indicate total number</i>)		
Riffles	Pools	

1998 RIVER HABITAT SURVEY : TEN SPOT CHECKS											
E PHYSICAL ATTRIBUTES											Spot check 1 is at upstream end
Spot checks	1	2	3	4	5	6	7	8	9	10	Ov
Grid reference (SZ)	0490594505	0515294416	0512994377	0512994330	0523194301	0526494208	0531194205	0542794165	0547094137	0557894026	
LEFT BANK EA=earth, PC(B)=poached(bare), NO=none, CC=concrete, RI=reinforced											
Material	EA	EA	EA	EA	EA	EA	EA	EA	EA	CC	
Bank modification(s)	PC	NO	NO	NO	NO	NO	NO	NO	NO	RI	
Bank features(s)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
CHANNEL NV=not visible, NO=none, SI=silt/mud, SA=sand, GP=gravel/pebble, CO=cobble, AR=artificial, RS=resectioned, DA=dam/weir, SM=smooth, RP=rippled,											
Channel substrate	NV	GP	SI	SI	GP	CO	SA	SI	SI	AR	
Flow type	SM	SM	SM	SM	RP	RP	SM	SM	SM	RP	
Channel modification(s)	NO	NO	NO	NO	NO	RS	NO	NO	NO	DA	
Channel feature(s)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
RIGHT BANK EA=earth, PC(B)=poached(bare), NO=none, CC=concrete, RI=reinforced											
Material	EA	EA	EA	EA	EA	CC	EA	EA	EA	CC	
Bank modification(s)	PC(B)	NO	NO	NO	NO	EM	NO	NO	NO	RI	
Bank features(s)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
F BANKTOP LAND USE AND VEGETATION STRUCTURE											
BL=broadleaf/mixed woodland, SC=scrub, MH=moor/heath, WL=wetland, IG=improved grassland, RP=rough pasture, TH=tall herbs, C=complex(4 or more vegetation types), S=simple(2-3 types), U=uniform(one type), B=bare											
Land use within 5m of left bank top	RP	BL	BL	BL	SC	MH	MH	MH	WL	SC	
Left bank top (structure within 1m)	S	C	C	C	S	S	S	C	S	S	
Left bank face (structure)	U	S	S	S	S	S	S	S	S	B	
Right bank face (structure)	S	S	S	S	S	U	S	S	S	B	
Right bank top (structure within 1m)	S	S	C	C	C	S	S	S	S	U	
Land use within 5m of right bank top	TH	BL	BL	BL	BL	SC	BL	SC	WL	IG	

G CHANNEL VEGETATION TYPES											
P=present, E=extensive(>33%)											
NONE			P	P	P	P	P				
Liverworts/mosses/lichens										E	
Emergent broad-leaved herbs	P	E									
Emergent reeds/sedges/rushes								E	P		
Free-floating plants	P										
Amphibious plants	E										
Filamentous algae										P	
1998 RIVER HABITAT SURVEY : 500 m SWEEP-UP											
H LAND USE WITHIN 50m OF BANK TOP											
P=present, E=extensive(>33%)											
	L	R						L	R		
Broadleaf/mixed woodland (BL)	P	P			Tall herbs - rank vegetation (TH)			P	P		
Moor/heath (MH)	E	E			Wetland (bog, marsh, fen) (WL)			P	P		
Scrub (SC)	P	P			Suburban/urban development (SU)			E			
I BANK PROFILES											
P=present, E=extensive(>33%)											
Natural/unmodified	L	R			Artificial/modified			L	R		
Vertical/undercut	E	E			Poached			P	P		
Vertical + toe	P	P			Reinforced – whole bank			P	P		
Permanent features	Bridges at 6 + 10, Weir at 10										

J EXTENT OF TREES AND ASSOCIATED FEATURES					
P=present, E=extensive(>33%)					
TREES	L bank	R bank	ASSOCIATED FEATURES	Whole channel	
None			Shading of channel	E	
Isolated/scattered			Overhanging boughs	E	
Regularly-spaced, single			Exposed bankside roots	E	
Occasional clumps			Underwater tree roots	E	
Semi-continuous	P	P	Fallen trees	P	
Continuous			Coarse woody debris	E	
K EXTENT OF CHANNEL FEATURES					
P=present, E=extensive(>33%)					
Riffles	P		Pools	E	
Runs	P		Ponded reaches	P	
Glides	E				
L CHANNEL DIMENSIONS					
LEFT BANK		CHANNEL		RIGHT BANK	
Banktop height (m)	0.5	Bankfull width (m)	1.9	Banktop height (m)	0.5
Bankfull height (m)	0.5	Water width (m)	1.9	Bankfull height (m)	0.5
Embanked height (m)	0	Water depth (m)	0.1	Embanked height (m)	0
Bed material U= unconsolidated	U	Location of measurement	riffle		
M ARTIFICIAL FEATURES (total number)					
Feature	Major		Intermediate	Minor	
Weirs				1	
Culverts				1	
Bridges				2	
Overhead cables	1		2		

Water impounded by weir/dam ?	Yes, affecting <33% of the site	
N EVIDENCE OF RECENT MANAGEMENT		
None		
O FEATURES OF SPECIAL INTEREST (list)		
Braided/side channels	Debris dams	Leafy debris
Artificial open water	Bog	Carr
Fringing reed-bank		
P CHOKED CHANNEL		
Is 33% or more of the channel choked with vegetation ?	No	
Q NOTABLE NUISANCE PLANT SPECIES (list)		
Parrots feather (<i>Myriophyllum aquaticum</i>) in pond		
R OVERALL CHARACTERISTICS (list)		
Major impacts	Litter	
Animals	Water vole Dragonflies/damselflies	
Disturbance activities	Dogs (litter)	
S ALDERS ?		
None		

Appendix 6 Habitat Quality Assessment

Habitat Quality Assessment (HQA) Scoring			
Category	Feature	Score	Cumulative Total
Flow type	Smooth	3	3
	Rippled	2	5
Channel substrates	Cobble	1	6
	Gravel/pebble	2	8
	Sand	1	9
	Silt/mud	3	12
Channel features	none	0	12
Bank features	none	0	12
Bank vegetation structure – bankface	left	3	15
	right	3	18
Bank vegetation structure – banktop	left	3	21
	right	3	24
Point bars	none	0	24
In-stream channel vegetation	Liverworts and mosses	1	25
	Emergent broad-leaved herbs	1	26
	Emergent reeds/rushes/sedges	1	27
	Free-floating and amphibious	1	28
Land use within 50m	Left bank broadleaf woodland	1	29
	Left bank moorland/heath	2	31
	Left bank wetland	1	32
	Right bank broadleaf woodland	1	33
	Right bank moorland/heath	2	35
	Right bank wetland	1	36
Trees	Left bank semi-continuous	3	39
	Right bank semi-continuous	3	42
Associated features	Overhanging boughs	1	43
	Exposed bankside roots	2	45
	Underwater tree roots	2	47
	Coarse woody debris	3	50
	Fallen trees	1	51
Special features	Debris dams, carr, bog	5	56
Total score			56

Appendix 7 Habitat Modification Score

Habitat Modification Score (HMS)		
Component	Score	Cumulative total
Reinforcement	2	2
Dam/weir	2	4
Footbridge	0	4
Flow control	1	5
Total score		5