NRA + B10

BIOLOGICAL SURVEY REPORT

CHESS CATCHMENT

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NRA BIOLOGY, WALTHAM CROSS

Summary

This report presents the results of a detailed biological survey of the River Chess catchment. The Chess valley is an attractive rural landscape and the chalk streams it contains are highly valued for the biological resources they support. There are 22.5 km of watercourse in this catchment.

14 sampling sites were visited over two seasons (summer and autumn) during 1992. Results are presented on maps of the catchment with watercourses colour-coded in relation to Biotic Classes for both BMWP and ASPT. These maps enable general spatial comparisons to be made.

Around 90% of watercourse length for which information is available is of a Good (mean BMWP scores 101-150) or Very Good (mean BMWP scores >150) biological quality. The lower part of the River Chess from Sarratt Bottom to it's confluence with the River Colne achieves particularly high BMWP scores and ASPTs.

The upper reach of the River Chess from source to Chesham STW shows a rapid improvement in biological quality with increasing distance from the urban surroundings of Chesham near its source. The headwaters of the Chess above Chesham were dry in 1991-2. Below Chesham STW there is a clear loss of pollution-sensitive macroinvertebrate families which causes a marked fall in both BMWP scores and ASPT compared to sites upstream. However, with distance from the STW, biological quality recovers steadily such that a clean water fauna is re-established in the vicinity of Chenies Bottom and Valley Farm Ford. These patterns are examined using both BMWP and ASPT scores.

The section of river from Chesham STW to Valley Farm Ford has exhibited improved biological quality in recent years following remedial works to Chesham STW. Historic trends in biological results since 1982 are identified for strategic sites on the River Chess through analysis of past data.

The biological resource of the catchment includes several macroinvertebrate families which are not found elsewhere in the North East Area. These are Heptagenid mayflies (*Heptagenia sulphurea*) and Lepidostomatid caddis (*Lepidostoma hirsutum*) which are both indicative of clean water quality. The Lepidostomatid caddis were found at a site on the River Chess below Loudwater in this survey. Heptagenid mayflies occur throughout the lower reaches of this river. The endangered native crayfish (*Austropotamobius pallipes*) were found in the river above Chesham STW. Overall, a total of 53 scoring families have been recorded in the catchment since 1990 (48 in this survey) representing a catchment-wide aggregate BMWP score of 301. These figures underline the high biological diversity and nature conservation interest of the Chess catchment. A list of the macroinvertebrate taxa recorded is provided.

Aquatic habitats were generally of a high quality apart from a short section below Chesham STW. It is possible that effluent toxicity (perhaps associated with the discharge of Cadmium) inhibits plant growth in this area. Further downstream, the abundance of filamentous algae (trailing *Cladophera* or blanket weed) increases. This is most apparent between Latimer and Valley Farm Ford and is attributable to nutrient enrichment. Nutrients may be derived either from the effluents of Chesham STW or, possibly, from smaller discharges in the vicinity of Latimer. Filamentous algae was very scarce in the river above Chesham STW (including the Chalk Stream) and in the lower parts of the river below Loudwater. Lists of aquatic plants recorded at each site and estimates of area cover by plant type are provided.

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1 INTRODUCTION

1.1 AIMS

The broad aims of the catchment survey described in this report are listed below:-

(1) Identify polluting influences and spatial changes in water-quality.

(2) Review past changes in biological status.

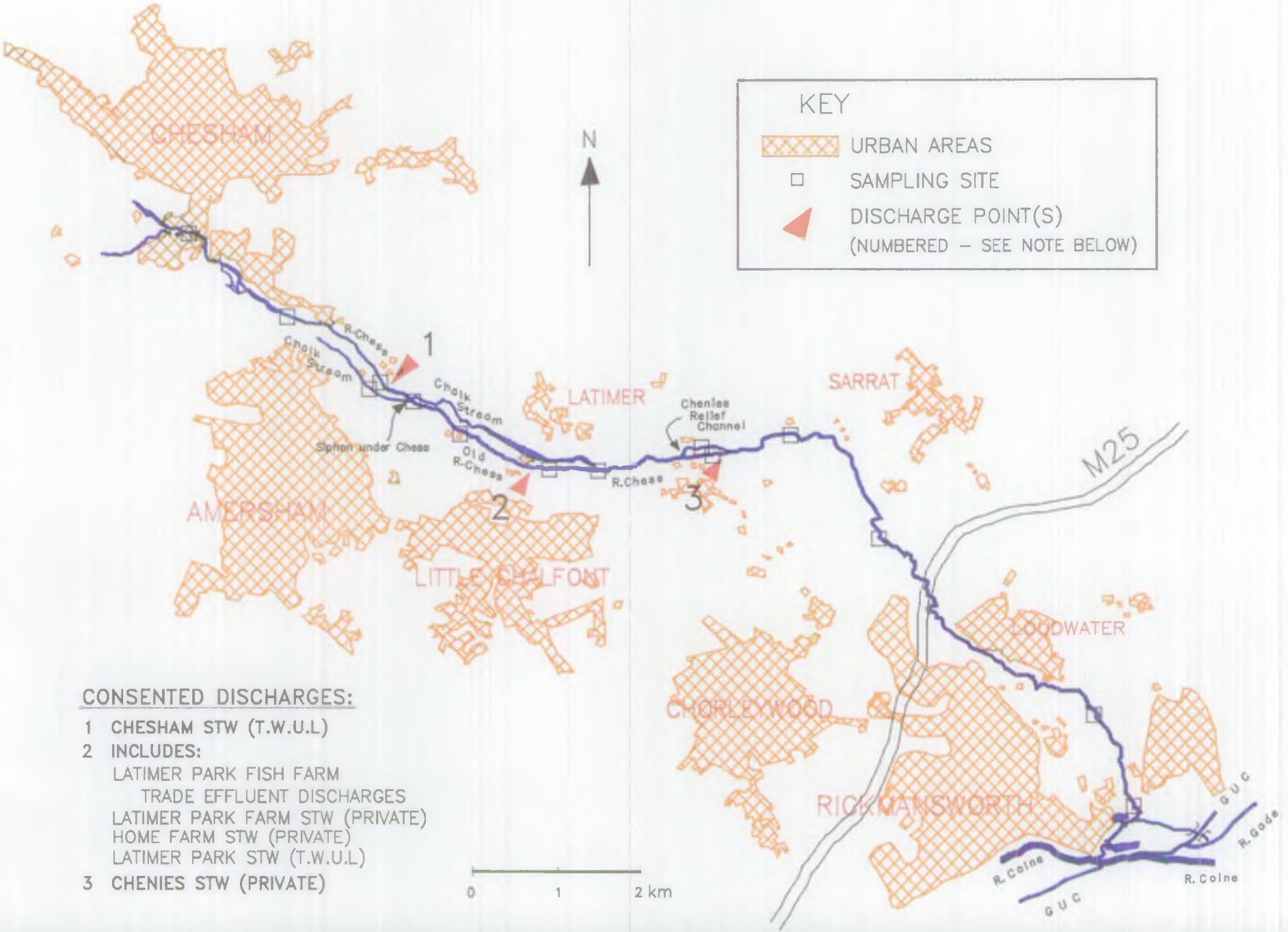
(3) Provide a baseline of biological information for the catchment. This information can be used to assess any future changes in water quality or ecosystem status, either for the purposes of routine monitoring or for special surveys in connection with pollution incidents or other environmental problems.

(4) Assess the quality of habitat and channel features. Identify sections of watercourse with importance for nature conservation, or requiring enhancement/reinstatement. Identify locations of any outstanding macroinvertebrate assemblages for consideration as special ecosystems.

1.2 BACKGROUND

A map of the Chess catchment showing the locations of all sampling sites is given in Fig. 1.

The source of the River Chess lies near Chesham, Buckinghamshire, on the eastern side of the Chiltern hills. The River Chess is bounded by the catchments of the River Bulbourne to the north and River Misbourne to the south. Beyond the Chilterns watershed, more remote from the Chess, is the Thame catchment. The chalk geology of the Chilterns escarpment affects the hydrology and water chemistry of all the rivers which flow from it.



CONSENTED DISCHARGES:

1 CHESHAM STW (T.W.U.L)

2 INCLUDES:
- LATIMER PARK FISH FARM TRADE EFFLUENT DISCHARGES
- LATIMER PARK FARM STW (PRIVATE)
- HOME FARM STW (PRIVATE)
- LATIMER PARK STW (T.W.U.L)

3 CHENIES STW (PRIVATE)

FIG. 1 CHESS CATCHMENT MAP

Chalk streams have a characteristically rich and diverse flora and fauna as a result of the calcareous water supply and the stable discharge and temperature regime of groundwater-fed river flows. Such catchments are, however, highly sensitive to the abstraction of groundwater by man. Abstraction from the River Chess is controlled by the NRA. In the case of other rivers in the Chilterns area, most notably the River Misbourne and the River Ver, the combined effects of groundwater abstraction and recent drought have caused major environmental problems.

The River Chess is a particularly attractive chalk stream, occupying a valley of high landscape and conservation value. The valley bottom contains large, open tracts of grazing pasture (which grades to wet meadow and marsh in some areas) and pockets of deciduous woodland, notably beech, as at Mount Wood near Sarratt Mill. The conservation value of the valley is reflected by the designation of two Sites of Special Scientific Interest (SSSI) at Frogmore Meadow and Sarratt Bottom. Both sites contain unimproved neutral grasslands and wet meadows.

The channel and margins of the River Chess are generally of a high quality, with low semi-natural banks and river profiles not affected by dredging or straightening. These sections are characterised by fast flowing waters, clean gravelly substrates and river margins supporting luxurient stands of emergent plants (particularly watercresses). However, there are several lengths which have been ponded behind mills and dredged or widened into broadwaters. These sections contain deeper slow flowing water and silty substrates, yet serve to enhance the overall range of habitats and wildlife supported in the river.

Locally, the Chess supports macroinvertebrate communities with a high diversity and conservation value. The river also supports a quality fishery which is notable for it's self-sustaining trout and Grayling populations which are now rare in this area. The middle reaches of the river (Sarratt-Loudwater) were selected by Thames Water Authority for Salmon Parr stocking in the late 1980s. In common with other rivers in Hertfordshire, the Chess is also under consideration as a potential

river for restocking otters (extinct in the county for many decades). The river contains lengthy remote sections of high potential, although a shortage of bankside cover and, locally, an impassable river corridor in the Rickmansworth area (which limits the potential for otter movements to the Colne valley), could preclude the river's selection (Findlay, 1992).

There are several influences on the water quality of the river Chess. Where the river flows through urban areas, as is the case through Chesham town, surface water run-off from road surfaces and surrounding urban areas, particularly after heavy rains, can be a significant polluting influence. In addition, misconnected foul water sewers and careless waste disposal to surface water drains remains a potential hazard in urbanised areas. For this reason the Chess is fortunate in maintaining a largely undeveloped river corridor below Chesham.

The potential point sources of pollution which have consents to discharge into the Chess issued by the NRA are shown in Fig.1. The largest and most influential discharge to the river is Chesham Sewage Treatment Works (STW). This works serves the urban areas of Amersham and Chesham and is managed by Thames Water Utilities Limited. Chesham STW has a consent to discharge up to 14450 cubic metres of effluent a day, and a condition that Cadmium concentrations in the effluent should not exceed 0.005 mgL^{-1} (5 Parts Per Billion) or 70 g by weight over a 24 hour period. In the past, this sewage works has had a major deleterious effect on the water quality and biological quality of the River Chess and Old River Chess for several miles downstream of the point of discharge. However, following remedial construction works completed in 1990 which addressed problems of overloading and flooding by groundwater, the biological quality of the river below the outfall has improved markedly and the zone of impact has diminished.

There are also a small number of minor discharges to the Old River Chess and River Chess in the vicinity of Latimer and at Chenies Bottom. These include small sewage works (with consents to discharge less than 100 cubic metres of effluent a day) and trade effluents from a fish

farm. No persistent biological impacts attributable to these minor discharges have been observed.

Since 1990 there have been five Environmental Quality (EQ) reaches on the River Chess and one for the Old River Chess. These are monitored annually both chemically and biologically at a site usually near the downstream limit of the reach. The EQ reach limits and biology sampling sites in this catchment are listed below:

Reach	Biology Site
River Chess	
Souce-Chesham STW	PCNR.0012 Above Chesham STW
Chesham STW-Bois Mill	PCNR.0014 At Bois Mill
Bois Mill-Chenies	PCNR.0019 Latimer Bridge
Chenies-Chenies STW	PCNR.0148 Above Chenies STW
Chenies STW-Colne	PCNR.0013 Above Colne
Old River Chess	
Chess-Chess	PCNR.0207 Latimer Park Farm

2 METHODS

2.1 MACROINVERTEBRATE SURVEY

2.1.1 Sample collection

The standard NRA macroinvertebrate sampling protocol was used at all sites. This involves three minutes of active kick and sweep sampling with a standard benthos net (mesh size 1.0mm) on 1.5 metre pole. Sampling was conducted across all the habitats present (with the time spent in each kept broadly in proportion to their extent at the site). Important habitat types include patches of different substrates or flow velocity, emergent plants, tree roots and submerged aquatic or terrestrial plants. Sites were primarily selected to provide wadable, riffle habitat. Kick sampling was supplemented by a one minute hand search of boulders or other removable solid objects.

2.1.2 Examination

Samples were returned to the laboratory for sorting within 24 hours of collection. Macroinvertebrates were identified to BMWP family level and the abundance of each family in the sample was estimated. The categories of abundance recorded are given in Appendix 2. This estimate also took into account numbers seen in the field but not necessarily retained in the sample (eg rock clinging families found during boulder searches). Once all families had been identified and recorded, Biological Monitoring Working Party (BMWP) scores were calculated for all samples. The BMWP system is explained further in section 2.3.

2.2 ENVIRONMENTAL SURVEY

A range of information has been collated for each site, the bulk of which is concerned with field observations about the sampling site. The information falls into four categories:

(a) Location - National Grid Reference (NGR), distance from source and altitude are listed;

(b) Physical descriptions of sites - width, depth, substrate type, flow velocity;

(c) Habitat descriptions - includes lists of aquatic plants (species or genera) present and notes on their abundance at each site;

(d) Channel Quality - assessment of the river channel and banks using categories of naturalness/artificiality and potential habitat diversity.

Details of the environmental survey methods are given in Appendix 1. Results are given in Appendix 2.

2.3 ANALYTICAL TECHNIQUES

2.3.1 Water Quality

Water quality is assessed using the BMWP score system for freshwater macroinvertebrates. This is the established method of communicating biological quality throughout all regions of the NRA.

The BMWP system aims to summarise the quality of macroinvertebrate assemblages as defined by their richness - the number of scoring families; and composition - in terms of

pollution-tolerant (low scoring) or pollution-sensitive (high scoring) taxa.

For the BMWP score system, eighty five macroinvertebrate families or taxa are listed and each is given a score from 1-10 reflecting it's perceived tolerance to organic pollution and oxygen depletion. High scoring families (7-10pts) are considered sensitive to pollution and are characteristic of relatively clean, unpolluted and well oxygenated waters. Mid-scoring groups (4-6pts) include a range of relatively tolerant taxa, many adapted to stillwater conditions and naturally low oxygen levels. These animals are excluded by poor water quality. Low scoring taxa (1-3pts) are most tolerant and include families which can withstand poor water quality.

The sum of the scores allocated to each family present in a sample gives the BMWP score for the site. The Average Score Per Taxa (ASPT) is calculated by dividing the BMWP score by the number of scoring families present. Results can be compared with target values obtained from the Riverine InVertebrate Prediction And Classification System (RIVPACS) developed by the Institute of Freshwater Ecology (I.F.E) for the NRA.

The total BMWP score achieved by a site is essentially a measure of the richness of families present that is strongly weighted by their sensitivities to pollution. Therefore, both richness and composition are rewarded by the score. ASPT reflects the composition of families found at a site. The disadvantage of this measure is that richness is not taken into account. A depauperate assemblage may not be distinguished from a rich assemblage containing a wider variety of macroinvertebrates. The importance of ASPT is that it can identify how biased an assemblage is towards either pollution-tolerant or sensitive families.

In general, it is useful to check for changes in ASPT to implicate changes in water quality as the cause. For example, if there is a difference in BMWP score between sites but no change

in ASPT, then the higher BMWP score is not reflecting a shift towards more sensitive families and therefore improvements in habitat provision rather than water quality are a likely cause.

2.3.2 Biological Potential

It is essential to consider the environmental conditions and habitat quality of a site when interpretating biological data. Several key environmental measurements are used to predict the clean-water characteristics of macroinvertebrate assemblages using RIVPACS. However, biological potential also reflects the quality and diversity of aquatic habitats present. Habitats are influenced by the nature and severity of pollution (water quality) and the range of physical conditions (in terms of depth, flow, substrates etc) provided by the channel.

Therefore, it is necessary to identify channel quality - as defined by the naturalness of the channel and the range of conditions provided - since this will affect the potential habitat and macroinvertebrate diversity of a site. Once these factors are considered it is possible to clearly identify the effects of water quality on macroinvertebrate assemblages. RIVPACS does not account for physical degradation to a channel or any subsequent loss of habitat variety. In Greater London, river corridors and flood plains are highly urbanized and the physical impacts to river channels and habitats are great.

Channel quality is assessed using categories which are intended to reflect different levels of biological potential. These are defined in Appendix 1.

2.3.3 Biological Resources

This section summarises the biological status of the catchment with reference to (a) macroinvertebrate family occurrences and

(b) the quality of aquatic habitats and flora. Summary statistics for the biological resource of this catchment provide a baseline for future surveys and can be compared with results for other catchments. Sections of watercourse of high conservation value are highlighted.

2.3.4 Low Flows

Any marked effects of low flows upon riverine habitats or macroinvertebrate assemblages are highlighted. The identification of low flow conditions involved a subjective appraisal of water level/flow characteristics and evidence of ecological change - for example, invasion of a channel by emergent aquatic plants (particularly narrow leaved species), riparian terrestrial plants and/or a shortage (or absence) of flowing water macroinvertebrate families (this can be shown most easily if past data is available).

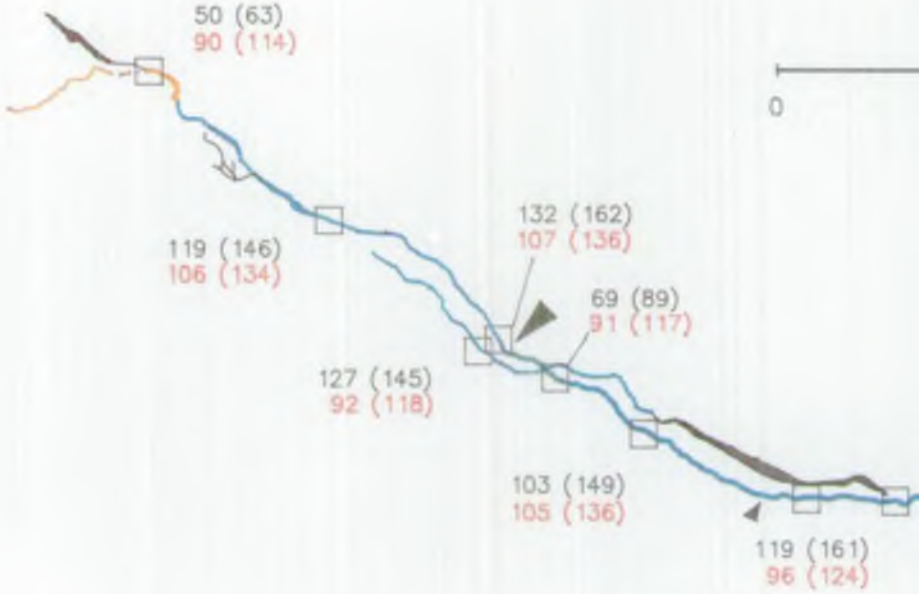
3.1 WATER QUALITY

Spatial changes in biological quality within this catchment are identified in Figs 2 and 3, for BMWP and ASPT respectively. In each case, the mean observed value from the two seasons (Summer and Autumn) is shown with the aggregate score (obtained by combining both samples) given in brackets. Sections of watercourse have been colour-coded using categories of Biotic Class for average single season BMWP score and ASPT. The trends in BMWP score and ASPT on the River Chess are also highlighted in Figs.4 and 5 which plot the results obtained (together with predicted scores) at sites against distance from source. These graphs are particularly useful for assessing the direction and scale of changes in biological quality on the river.

A full list of all macroinvertebrate taxa recorded at sites in this catchment is provided in Appendix 3. The occurrence of families is considered further in section 3.3.

3.1.1 BMWP Scores

The results for BMWP score (Fig.2) confirm that most of the catchment is either of a very high quality (mean BMWP score > 150) or of a good biological quality (mean BMWP scores 101-150). These two classes account for about 90% of the watercourse length for which information is available. BMWP scores were particularly high in the lower reaches of the River Chess, from the site PCNR.0145 at Valley Farm Ford to the final site PCNR.0013 Above Colne. At the four sites in this vicinity, single season BMWP scores were consistently in excess of 150 (Class A) and the combined two season aggregate scores were over 200. These scores are greater than the predicted scores provided by RIVPACS (above the Upper Confidence Limit in each case) and they approach the results obtained at some of the richest riverine sites in the Thames region.



KEY

DISCHARGES (see Fig 1)

NOT SAMPLED

CULVERTED

SAMPLING SITE

SINGLE SEASON BMWP CLASSES:

A VERY GOOD (>150)

B GOOD (101–150)

C FAIR (51–100)

D POOR (20–50)

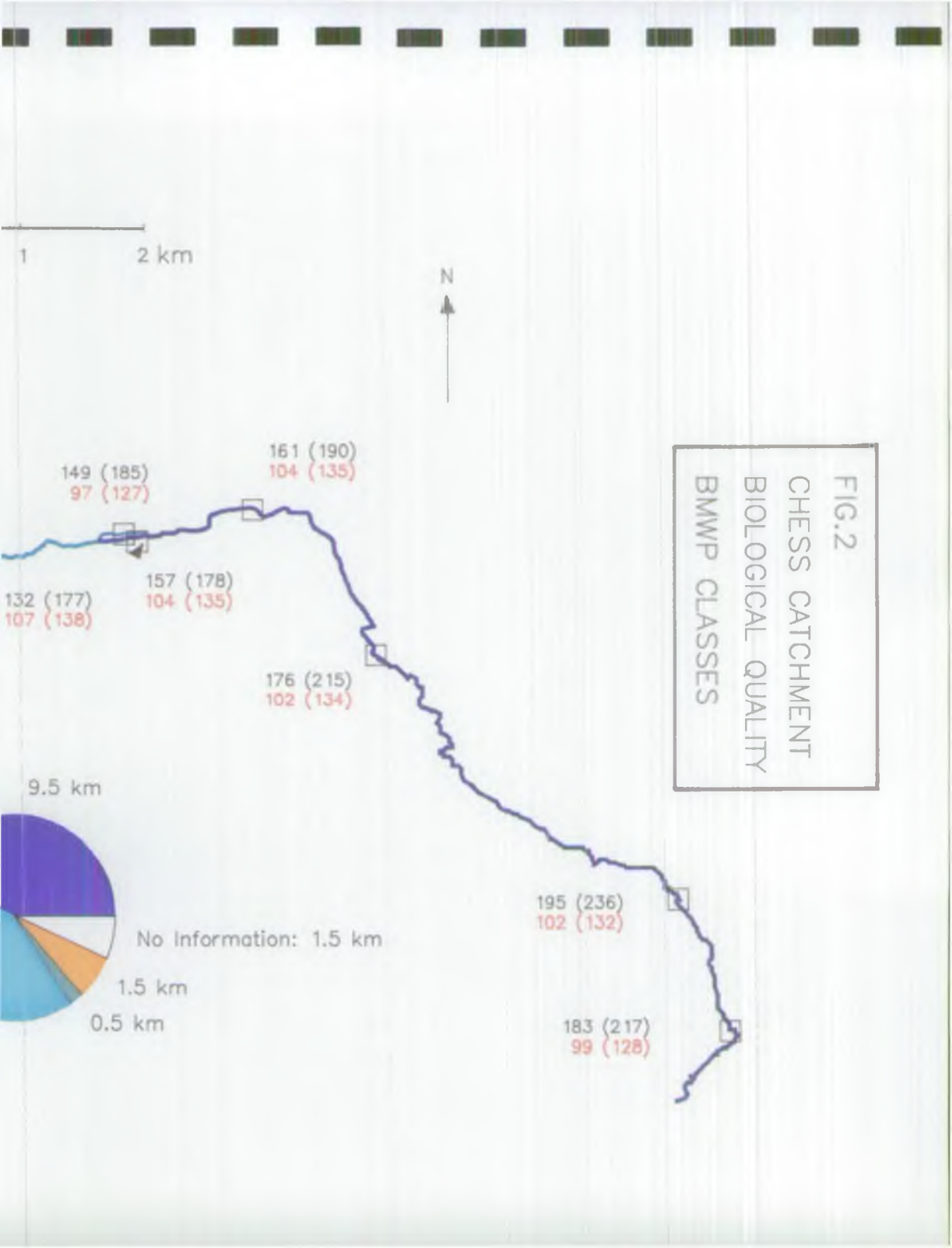
E VERY POOR (0–19)

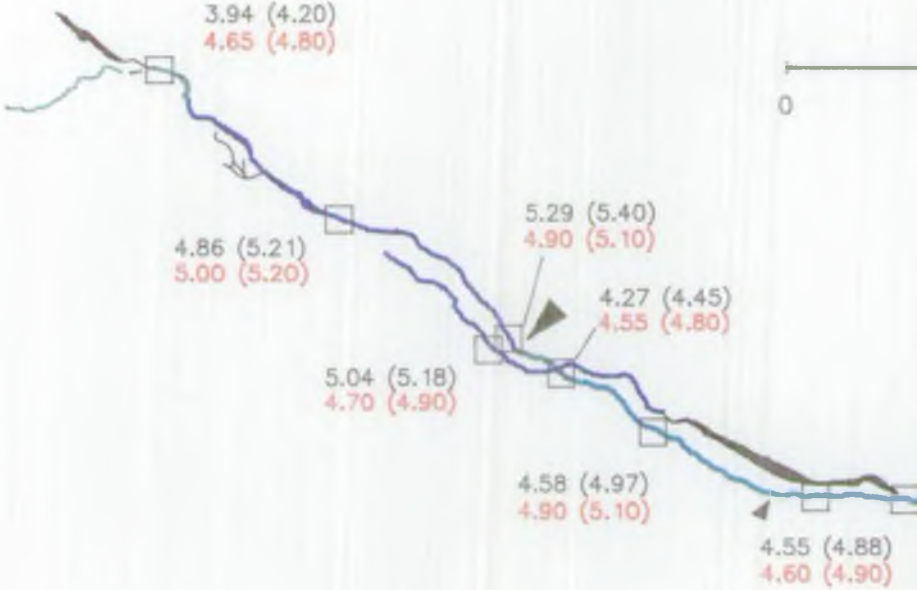
9.5 km

195 (236)
102 (132)

OBSERVED BMWP SCORE:
MEAN SINGLE SEASON (TWO SEASON AGGREGATE)

PREDICTED BMWP SCORE
MEAN SINGLE SEASON (TWO SEASON AGGREGATE)


1
2 km
N
149 (185)
97 (127)
161 (190)
104 (135)
157 (178)
104 (135)
132 (177)
107 (138)
176 (215)
102 (134)
195 (236)
102 (132)
183 (217)
99 (128)
9.5 km
No Information: 1.5 km
1.5 km
0.5 km
FIG.2
CHESS CATCHMENT
BIOLOGICAL QUALITY
BMWP CLASSES



KEY

DISCHARGES (see Fig 1)
NOT SAMPLED
CULVERTED
SAMPLING SITE

SINGLE SEASON ASPT CLASSES:

AA EXCEPTIONAL (>5.4)
A VERY GOOD (4.81–5.4)
B GOOD (4.21–4.80)
C FAIR (3.61–4.20)
D POOR (3.01–3.6)
E VERY POOR (≤3.00)

6.5 km

5.81 (5.76)
4.70 (5.00)

OBSERVED ASPT SCORE:
MEAN SINGLE SEASON (TWO SEASON AGGREGATE)

PREDICTED ASPT SCORE
MEAN SINGLE SEASON (TWO SEASON AGGREGATE)

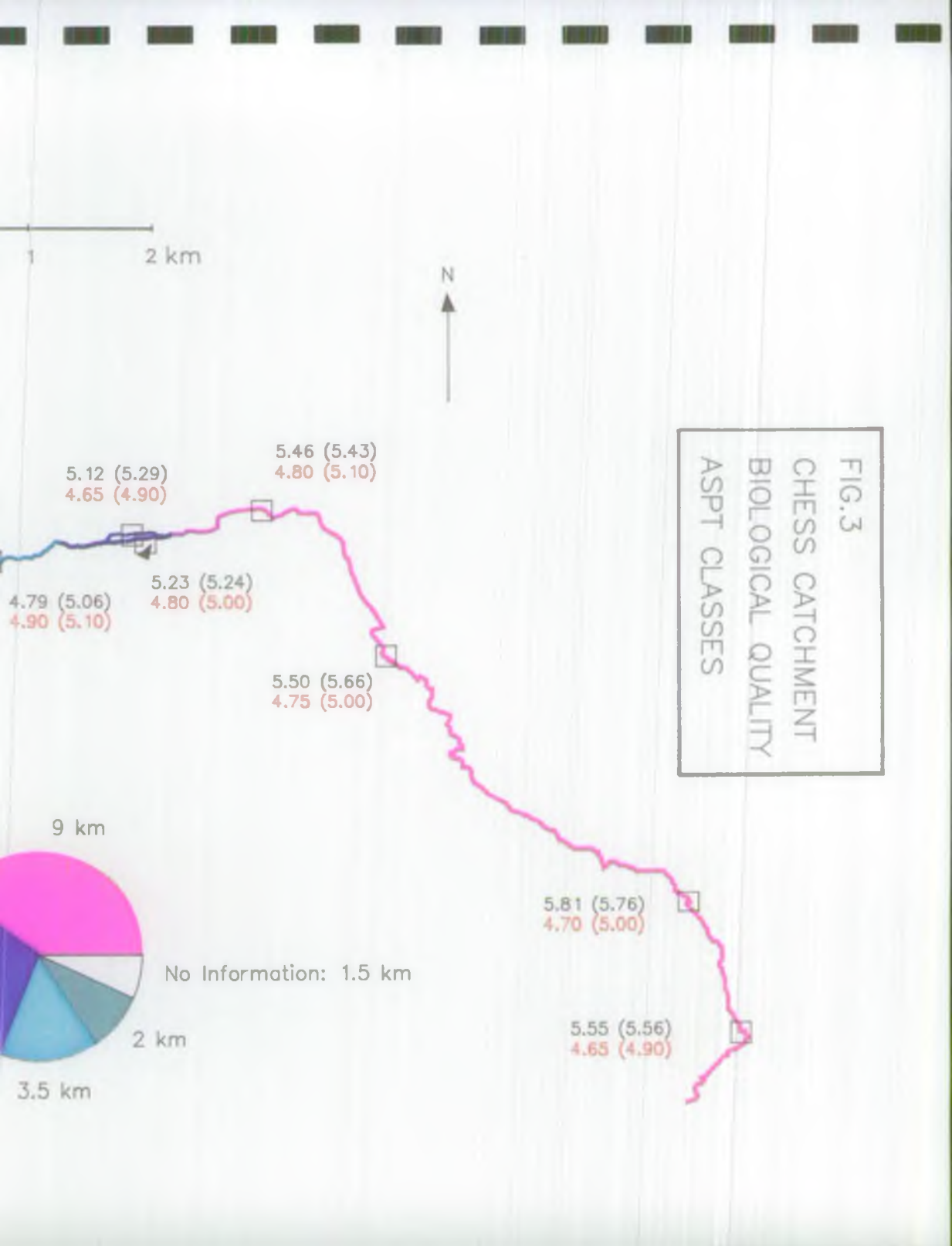


FIG.3
CHESS CATCHMENT
BIOLOGICAL QUALITY
ASPT CLASSES

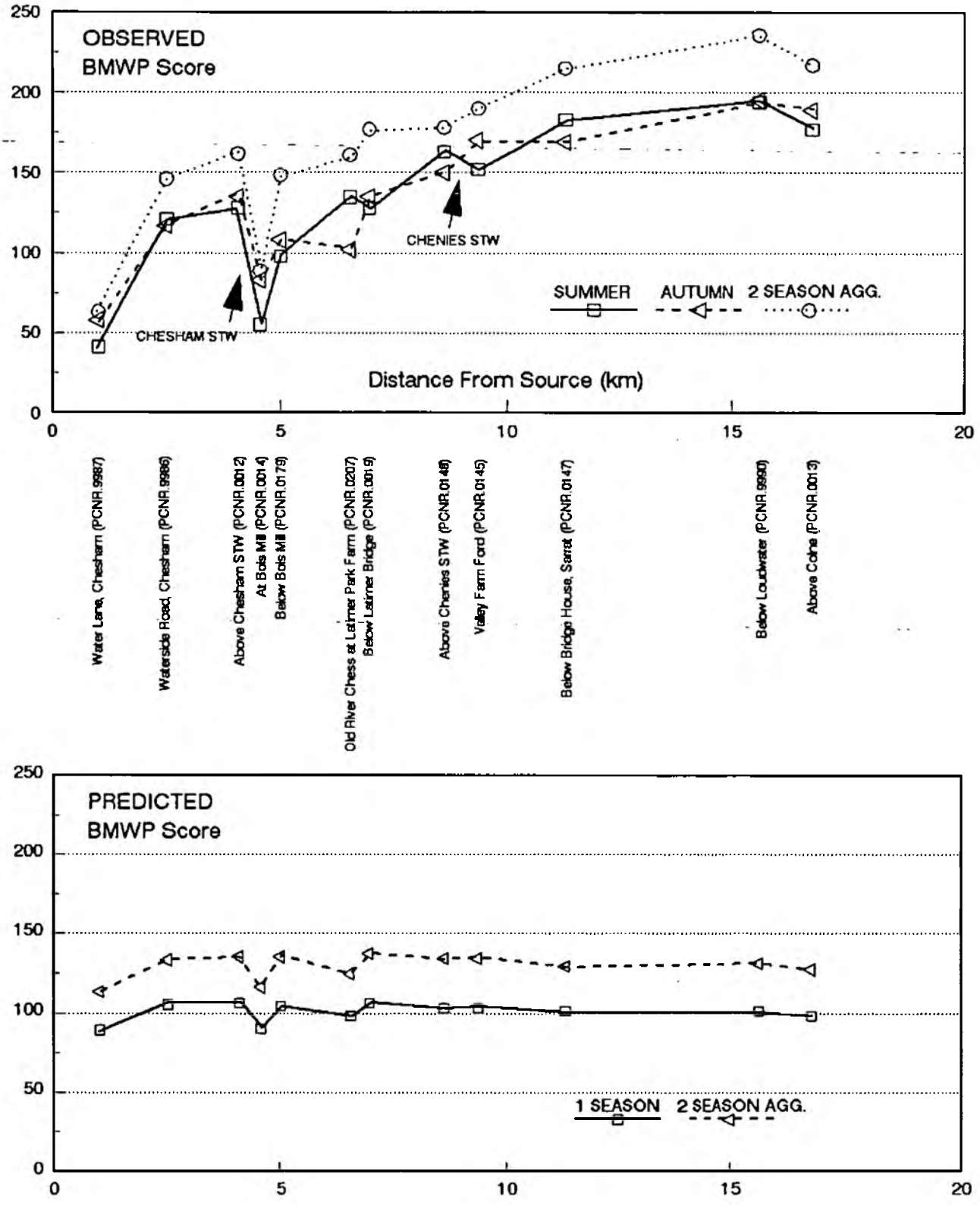
Only around 7% of the surveyed watercourse length was of a poor quality (mean BMWP 20-50). This occurred in the top section the River Chess within the town of Chesham and reflected very low flows during the summer of 1992.

A short section of the Chess below Chesham STW was found to be of fair quality (BMWP 51-100), with a marked change in fauna compared to the site situated immediately above the works. However, the conditions at the downstream site, Bois Mill, are atypical with a uniform, slow flowing channel and silted habitat due to ponding above the mill. The potential BMWP and ASPT score of such sites is lower than for faster flowing waters since they attract a fauna characteristic of stillwater conditions which comprises fewer high scoring families. The lower predicted scores for the Bois Mill site reflect this situation. At all other sites sampled, riffle habitats were sampled so BMWP and ASPT scores are more directly comparable. For a discussion of biological potential in relation to channel quality see section 3.2.

Downstream changes in BMWP scores on the River Chess are highlighted in Fig.4. This graph shows the results at sites for each season (summer, autumn) and the combined two-season aggregate BMWP score. It should be emphasised that producing a curve of BMWP score against distance in this way is simplistic since the scores reflect site specific habitat conditions which may not be comparable at intermediate points between sites. Thus, for example, a deep and slow flowing section of the river above Loudwater could not be expected to produce the BMWP scores obtained at typical riffles in this area.

The curves for BMWP score in each of the two seasons are similar, although several differences are notable. The most marked difference in BMWP scores between the two seasons was found at Latimer Park Farm on the (Old) River Chess. Here the score fell from 135 in spring to 102 in autumn, although the change in ASPT (from 4.66 to 4.43) was not great. The change at this site

FIG.4 Downstream changes in biological quality of the river Chess as shown by BMWP score.



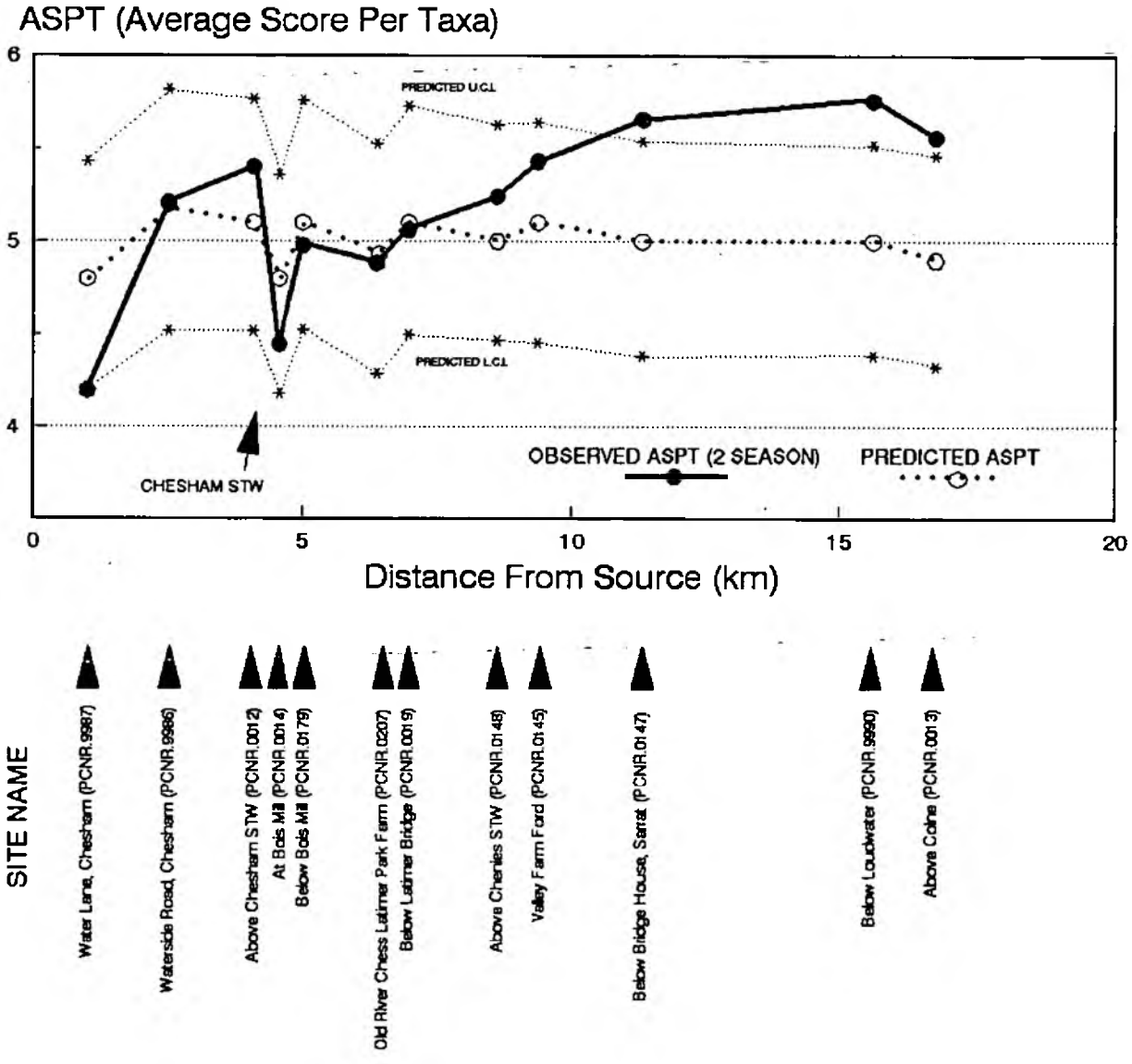
probably reflects natural variability. The higher result in Autumn at WaterLane, Chesham (58 compared to 41) reflected the return of flowing conditions and the appearance of several additional families. The ASPT also improved slightly (3.73 to 4.14). There was a marked increase in BMWP score at the Bois Mill site in the autumn season (83) compared to summer (55), which was accompanied by a marked increase in ASPT (3.93 to 4.61). This could reflect improved dilution of the STW effluent as the baseflow increased. In general, however, the differences between the two seasons were less marked than the scale of spatial differences in biological quality. These are best represented by the two-season aggregate BMWP score, which gives the most exhaustive picture of biological quality after combining the taxa lists of both samples. An assessment of historic changes in BMWP scores at five key sites is provided in section 3.1.4.

3.1.2 ASPT results

Spatial comparisons of ASPT results were provided in Fig.3. These results are useful for considering water quality further since ASPT focuses upon the composition of macroinvertebrate assemblages in terms of the proportion of sensitive or tolerant families present at a site. The results broadly reflect those for BMWP, with 74% of the watercourse length classed as either very good or exceptional, the latter class being confined to the lower reaches below Valley Farm Ford. ASPT results show a marked deterioration immediately below Chesham STW, although the ASPT of the Bois Mill site is also reduced to some extent by habitat factors. Thereafter ASPT remains relatively low for several kilometres before recovering (to a level comparable to sites above the works) in the vicinity of Chenies Bottom.

These trends are highlighted in Fig. 5 which plots the two-season aggregate ASPT results at sites on the River Chess against distance from source. The predicted two-season aggregate ASPT, obtained using RIVPACS is shown with the upper and lower

FIG.5 Downstream changes in observed and predicted ASPT (Two Season Aggregate) for the River Chess.



confidence limits about this figure. It is notable that all sites except Water Lane, Chesham (PCNR.9987), achieved the lower confidence limit of their respective predicted ASPTs. However, it is clear that ASPT improves steadily with distance from source, deteriorates sharply below Chesham STW and subsequently recovers. The exceptional fauna of the river's lower reaches is clearly identified in this graph.

3.1.3 Recent changes in the biological quality of the river Chess

Historic data is available for all watercourses visited in the catchment except the Chalk Stream, whch was sampled for the first time in this survey. Several sites on the River Chess and Old River Chess covered in this survey were visited previously as early as 1982. Others were first sampled in the mid-late 1980's, introduced for the 1990 National River Quality Survey, or visited for the first time in this survey (as with sites on the R.Chess below Loudwater and at Water Lane, Chesham). Other sites not visited in this survey have been sampled on occasions, in connection with non-routine surveys after pollution or siltation incidents.

It would be impractical to review all past data in this report, so five "key sites" on the river Chess are considered. These sites represent the length of the river and provide the most extensive records available in the part of the river in which they are situated. Information dating from 1982, with sampling on an annual basis, is available for three sites; PCNR.0013 (Chess Above Colne), PCNR.0145 (Valley Farm Ford) and PCNR.0019 (Below Latimer Bridge). In addition to these sites, data from two further sites - which are located at strategic positions above and below Chesham STW but have not been monitored as regularly - is considered. These sites are PCNR.0012 (Above Chesham STW) which has been monitored since 1982, and PCNR.0179 (Below Bois Mill) monitored since 1986. All five sites provide similar conditions (gravelly, faster flowing waters) which enable direct

comparisons between sites and the impact of water quality to be assessed most clearly.

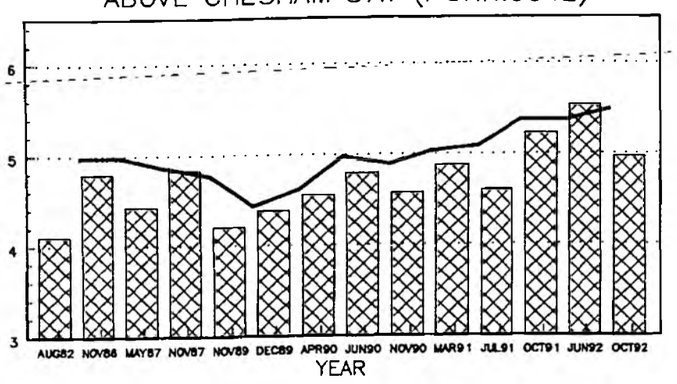
Results obtained from all samples collected at these five sites is presented in Fig.6(a) for ASPT and Fig.6(b) for BMWP score. The temporal trends in biological quality at individual sites can be compared between the different points on the river, though it is important to note that sites were not always sampled at directly comparable intervals. Since 1989 there has also been a change in sampling methodology. The new methodology is more effective due to the inclusion of boulder searches and net sweeps through all available habitats. Collections are thus more thorough, which tends to increase the Number Of Taxa and the BMWP score of samples. For this reason, ASPT is a more reliable measure in time comparisons, because it is less sensitive to such changes in sampling effort.

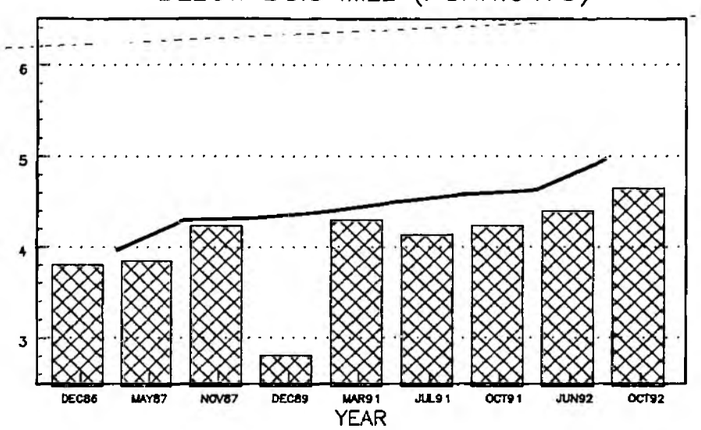
In addition to the bars showing individual sample results, lines have been drawn which represent the aggregate BMWP or ASPT of two successive samples. These lines are particularly useful for assessing trends. Short term fluctuations (following minor pollution events or spates for example) will not affect the trend unless two successive samples are affected. Furthermore, because the trend is based on the result of two combined samples, the combined taxa list represents a more exhaustive account of biological quality with improved powers of discrimination and reliability.

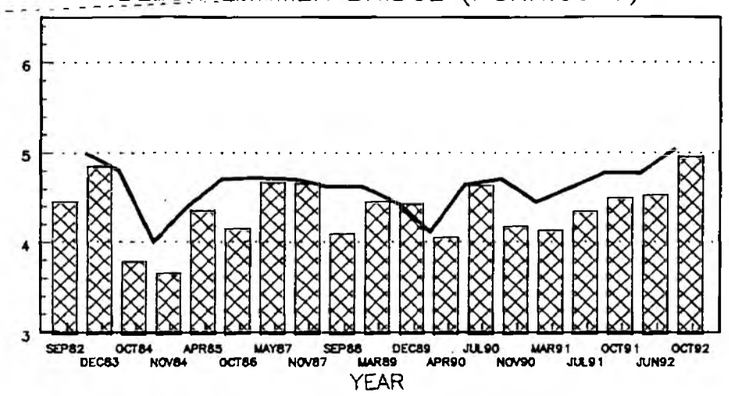
The results show that the spatial differences in biological quality identified in this survey (sections 3.1.1 and 3.1.2) have been apparent in previous years. Below Chesham STW, successive sites steadily improve in biological quality. The sites at Valley Farm Ford and Latimer Bridge, which are some distance below the STW show the greatest temporal variability in biological quality. BMWP scores and ASPT fluctuated widely during the 1980s at these sites. This reflects variations in water quality in that decade,

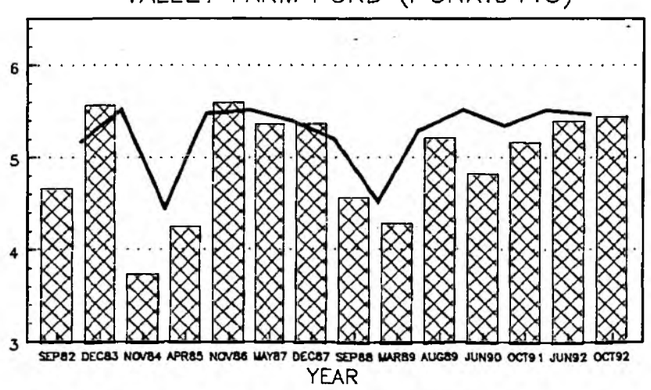
Fig:6(a) Past data (1982–92) for ASPT scores at five key sites on the R.Chess.

Bars show individual sample results.
Lines combine two successive samples









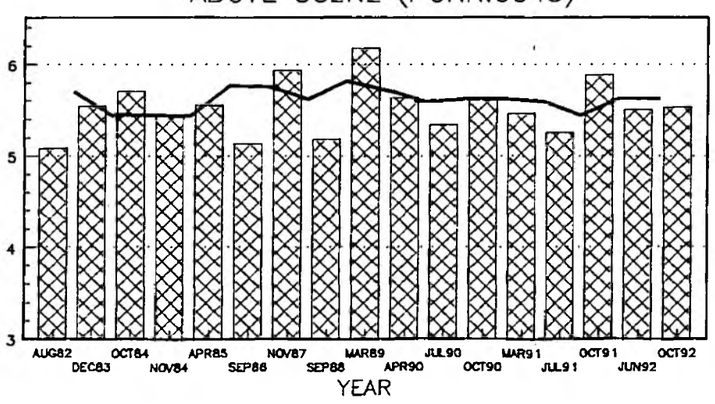
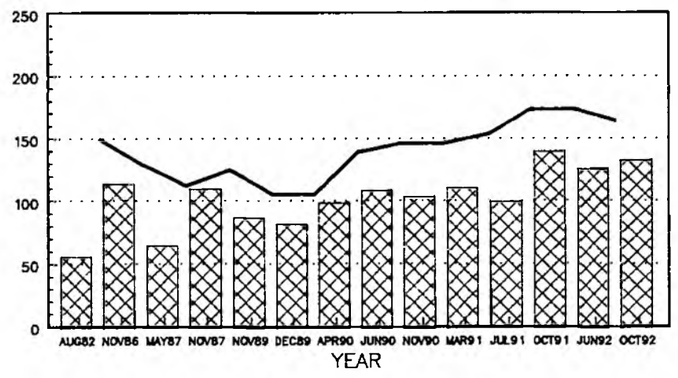
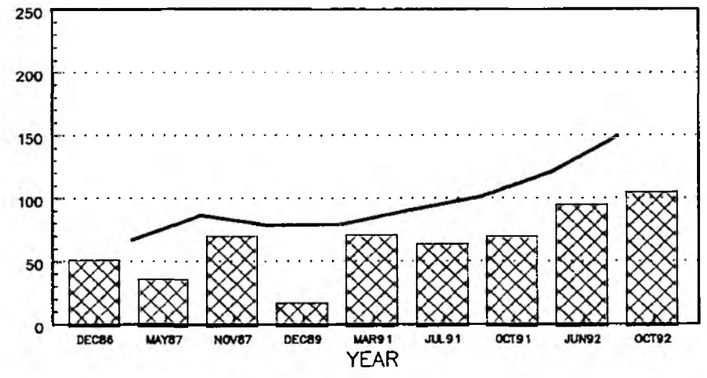
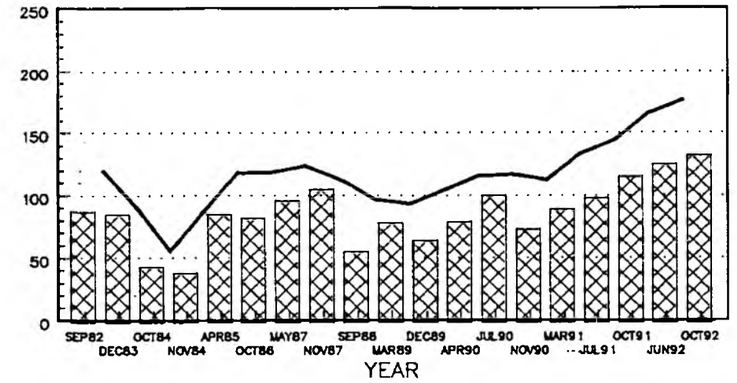


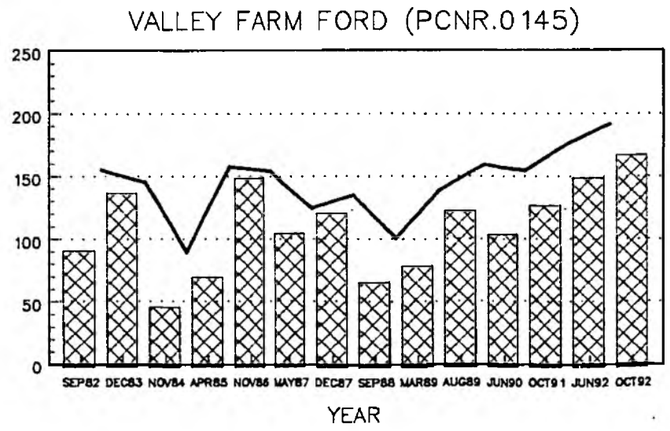
Fig.6(b) Past data (1982–92) for BMWP scores at five key sites on the R.Chess.

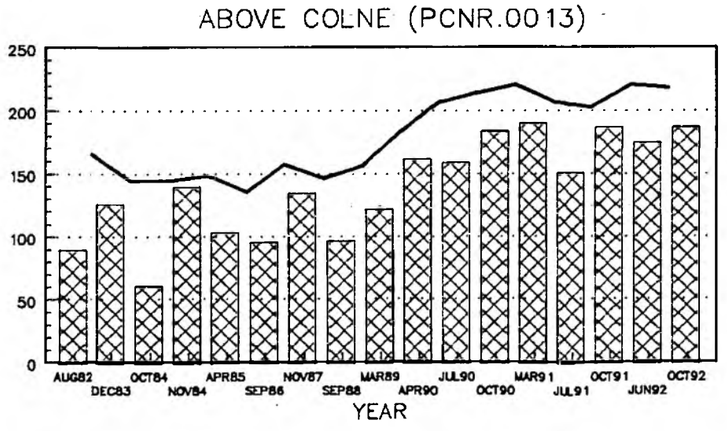
Bars show individual sample results. Lines combine two successive samples











with faunas characteristic of cleanwater periodically giving way to more restricted assemblages (particularly at Valley Farm Ford). Troughs are particularly marked in ASPT results for the period 1984-85 and, to lesser extent, for the period 1988-89.

The trough in 1984 followed a chemical pollution incident which involved the spillage of a small quantity of dilute pesticide near Latimer Farm. The product "Ambush-C" contained Cypermethrin (a synthetic pyrethoid) which is acutely toxic to most macroinvertebrates. Following the spillage, populations of many taxa, particularly shrimps, were decimated. Within months, recolonisation from unnaffected areas led to re-establishment of most families, though several taxa (notably Heptagenid mayflies) were not recorded at the affected sites until quite recently.

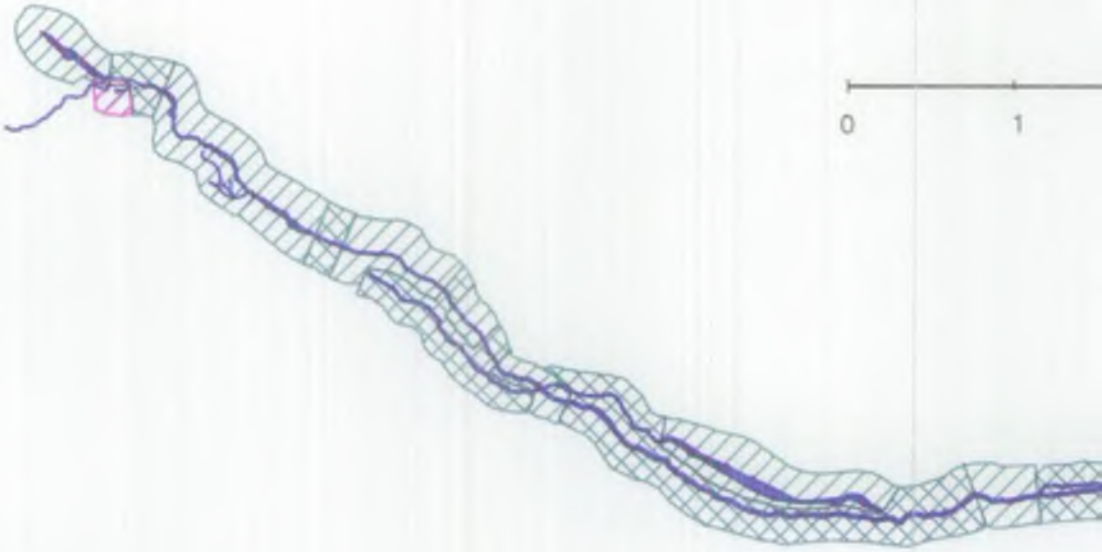
Further "dips" in biological quality at sites below Chesham STW occurred during the period 1988-89. These may be attributable to deteriorating STW effluent quality during this period. Since 1990 remedial works have greatly improved this situation. Improving biological quality at the Below Bois Mill and Latimer Bridge sites has been particularly evident since 1990. Not only has the BMWP score increased at these sites (a feature shared by most sites aided by more rigorous sampling method) but the ASPT of both single samples and two combined samples has also climbed markedly. A variety of pollution sensitive macroinvertebrate families have now been recorded further up the river towards the Chesham STW outfall than previously (see also section 3.3.1). At the sites above Chesham STW and Above Colne, BMWP scores have improved steadily over recent years, although ASPT has remained more constant, particularly at the site Above Colne (no change since 1982 infact).

3.2 BIOLOGICAL POTENTIAL

The channel quality within the Chess catchment is shown in Figure 7. As outlined earlier, the majority of watercourse length in this catchment is of a high aesthetic and conservation value, free of the channel alterations which characterise more regulated systems. "Semi-natural" conditions for aquatic flora and fauna account for about 95% of watercourse length. A fair proportion of this category is of reduced biological potential however, since it includes sections which are ponded above mills and provide a more uniform environment than might be expected. These locations do not provide the same range of environmental conditions (eg fast and slow flowing water, gravelly and silty areas) as non-uniform sections. As a result the potential macroinvertebrate fauna is more limited. Several of these lengths have also been widened and deepened through dredging (in order to provide fishing lakes at Latimer), yet since they generally retain low banks and good margins they have been classed as providing semi-natural conditions.

Within Chesham, there are short sections which have modified banks to reduce flood risk and one of the two significant lengths of culverted river are in this vicinity.

Overall, the river is remarkably free of the more artificial channel forms and the particular limitations upon flora and fauna which they impose, for example unnatural scouring, lack of substrates, vegetation or cover. There are several sections where some deepening is apparent yet effects upon channel quality are barely identifiable. For example, in the early 1980s the Chenies Relief Channel underwent dredging and re-profiling to prevent flooding of adjoining grazing lands. Though this change resulted in some loss of traditional wet meadow, the carefully designed channel works promoted a particularly varied channel morphology with a mix of riffle, run and pool habitats. Throughout the length of the Chess there are sections of river which still retain exceptionally low, natural banks with a varied channel morphology.



KEY

1: NON-UNIFORM BED AND/OR FLOW
(eg. RIFFLE-POOL SYSTEMS)

A — SEMI-NATURAL CHANNEL AND BANK

B — DEEPENED OR STRAIGHTENED

C — PILED, CONCRETED OR TOE BOARDED BANKS

2: UNIFORM BED OR FLOW
(eg. NATURALLY SLACK/SLOW RIVERS)

a — SEMI-NATURAL CHANNEL AND BANK

b — DEEPENED OR STRAIGHTENED

c — PILED, CONCRETED OR TOE BOARDED BANKS

3: CONDUITS

D — CONCRETE BED

X — CULVERTED

NO DATA

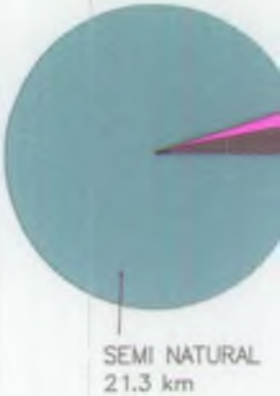


FIG.7
CHESS CATCHMENT
CHANNEL QUALITY

3.3 BIOLOGICAL RESOURCES

3.3.1 Macroinvertebrates

Of the 85 scoring families which are listed for the BMWP system, 48 were recorded in this catchment survey. This gives a catchment wide aggregate BMWP score of 271 and an ASPT of 5.65. A further five families have also been recorded by the NRA within this catchment, all since 1990. This takes the biological resource of the catchment up to 53 scoring families with an aggregate BMWP score of 301 and an ASPT of 5.68. These figures are compared with the results of other catchment surveys in table 1. A full list of all macroinvertebrate taxa recorded at each site in this survey is provided in Appendix 2. The relative abundance of each family at a site is also indicated in the appendix.

Table 1: Catchment-Wide Aggregate Biological Quality

CATCHMENT (No. Sites)	SEASON/YEAR	No. Taxa	BMWP Score	ASPT	No. 10 pt Taxa
Pymmes Brk (28)	Summer 1992	39	193	4.95	2
Turkey Brk (11)	Summer 1992	29	132	4.55	0
Ver (13)	Spring 1992	39	198	5.08	3
Ver (14)	Summer 1992	44	233	5.30	4
Ver (14)	Summer + Autumn	46	243	5.28	4
Chess (14)	Summer 1992	46	256	5.57	7
Chess (14)	Autumn 1992	45	253	5.62	7
Chess (14)	Summer + Autumn	48	271	5.65	8

Several macroinvertebrate families recorded in this catchment are of particular interest in conservation terms due to their scarcity within the Thames region and the North East Area (which includes the major catchments of the R.Colne and R.Lee). The most familiar species in this category is the native freshwater crayfish (*Austropotamobius pallipes*) . A colony of these crayfish

survives in shallow water at the site above Chesham STW and individuals have been recorded on most visits since Spring 1990. No crayfish have been found in the remainder of the river since 1989 at which time they were recorded (once only) at Valley Farm Ford. It would appear that the population is now restricted to a short section of the river above Chesham STW. However, our sampling methods for macroinvertebrates, which are applied at selected sampling points only, are not sufficiently extensive to survey crayfish adequately - particularly so if populations are fragmented or scarce. Within the North East Area, isolated populations of native crayfish are now known only from local parts of the Rivers Misbourne, Ver and Chess (Colne area) and Mimram (Lee area). There was a progressive loss of entire river populations in the early-mid 1980s as a result of crayfish plague. A continued decline associated with further disease, habitat loss and drought in recent years has made native crayfish a nationally vulnerable species in need of protection.

The cased caddis *Lepidostoma hirsutum* (Lepidostomatidae) was recorded at the site below Loudwater in this survey. This is the first record of a Lepidostomatid caddis in the North East Area. These caddis are rather local in distribution throughout the Thames region. Another particularly notable macroinvertebrate family in the R.Chess is the Heptagenid mayflies (represented by the species *Heptagenia sulphurea*). These mayflies are also found only in this river within the North East Area. Heptagenids, which are particularly sensitive to water quality, were fairly common at the four sites in the river from Valley Farm Ford downstream. They were also recorded in 1987 in the upper reaches of the Chess at Waterside Road, Chesham. Absence from that site in this survey and no further records anywhere above Chesham STW would seem to confirm the loss of a rather isolated population in the upper reach of this river.

Following improvements to Chesham STW in 1990, Heptagenid mayflies returned in good numbers to the Valley Farm Ford site in 1992, from which they had not been found since 1983. It is

possible that if water quality improves further they may recolonise sections further upstream, notably the Chenies Relief Channel where they were last recorded in 1983. Recolonisation by other sensitive families, notably Ephemerid mayflies and Goerid caddis has been observed. Both were recorded as far upstream as Latimer Bridge for the first time in this survey.

Overall, the river supports a great diversity of macroinvertebrates with a high conservation value. The families recorded in this survey are listed below. Those listed in **bold** are BMWP scoring families. Families marked by an asterix are particularly notable (see discussion above). Families listed in *italics* have also been recorded by the NRA from this catchment since 1990. This, infact, provides a complete list of all recorded families for this catchment, since none were found before 1990 which have not been found since.

List of macroinvertebrate taxa recorded in the Chess Catchment:

INSECTA

Ephemoptera (Mayflies)

Heptageniidae*, **Leptophlebiidae**, **Ephemerellidae**, **Ephemeridae**, **Caenidae**, **Baetidae**.

Plecoptera (Stoneflies)

Nemouridae.

Trichoptera (Caddis or Sedge Flies)

Lepidostomatidae*, **Leptoceridae**, **Goeridae**, **Sericostomatidae**, **Limnephilidae**, **Glossomatidae**, **Hydroptilidae**, ***Phryganeidae*** (cased caddis) **Psychomyidae**, **Rhyacophilidae**, **Polycentropidae**, **Hydropsychidae** (caseless caddis).

Coleoptera (Beetles)

Haliplidae, Dytiscidae (diving beetles), **Gyrinidae** (whirligig beetles), **Scirtidae, Elmidae** (riffle beetles) ***Hydrophilidae*** (scavenger beetles).

Hemiptera (water bugs)

Hydrometridae (water measurers), **Gerridae** (pond skaters), **Notonectidae** (water boatmen), **Corixidae** (incl. Micronecta) (lesser waterboatmen). ***Nepidae*** (water scorpion).

Odonata (Dragonflies and Damselflies)

Calopterygidae (=Agriidae) (banded demoiselles), **Coenagriidae** (blue damselflies).

Diptera (Flies)

Tipulidae (craneflies), **Simuliidae** (blackflies), **Chironomidae** (non-biting midges), Ceratopogonidae (biting midges), Dixidae (meniscus midges), Culicidae (mosquitos and gnats), Psychodidae (owl midges), Tabanidae (horse flies), Muscidae.

Megaloptera (Alderflies)

Sialidae.

Chelicerata (Water Spiders and Mites)

Hydracarina (water mites).

CRUSTACEA

Astacidae*, **Gammaridae, Crangonyctidae, Asellidae**

MOLLUSCA

Gastropoda (Snails and Limpets)

Ancylidae (river limpets), **Acroloxidae** (lake limpets), **Valvatidae, Hydrobiidae, Bithyniidae, Lymnaeidae** (snails), **Physidae** (bladder snails), **Planorbidae** (ramshorn snails),

Bivalvia (Mussels)

Unionidae (mussels), **Sphaeridae** (pea and orb mussels)

TURBELLARIA

Tricladida (Flatworms)

Planariidae (incl. **Dugesiidae**), **Dendrocoelidae**

ANNELIDA

Hirudinea (Leeches)

Piscicolidae (fish leeches), **Glossiphonidae**, **Erpobdellidae**, **Hirudinidae** (horse leeches).

Oligochaeta (Segmented Worms)

Incl. Naididae, Lumbriculidae, Lumbricidae, Tubificidae

3.3.2 Aquatic Habitats

The diversity and relative abundance of submerged and emergent plants at all 28 sampling sites is described in Appendix 3. Notes on other habitat features present and a physical description (width, depth, substrate composition and flow velocities) of each site are also given in this appendix.

In general, the river supported a high cover of both submerged and emergent plants. A variety of submerged plants were found in the catchment, of which the starworts (*Callitriche spp*) were found at all sites. In the middle-lower reaches (from Latimer Bridge downstream) the submerged plants were dominated by water crowfoots (*Ranunculus spp*). These relatively sensitive plants favour stable, fast flowing conditions. They were scarce in the upper river above Chesham STW which may reflect reduced flows during recent years. Crowfoots were also absent for some distance below the point of discharge of Chesham STW, suggesting a local toxic effect of the STW effluent.

Since plants respond primarily to the toxicity of effluents (compared to macroinvertebrates which are affected mostly by

deoxygenation), these changes in the plant community may indicate local toxic effects of Chesham STW.

Recent chemical analysis of the sediment at the Bois Mill site (sampling undertaken by the NRA in connection with the EC Dangerous Substances Directive) has shown high Cadmium concentrations. In 1991, the Cadmium concentrations in sediments at Bois Mill were found to be 39.2 mg/kg dry weight, this increased to 76.6 mg/kg in 1992, although the difference could reflect sample variation rather than a worsening of the situation. Material derived from the STW is most likely to accumulate at this site due to ponding above Bois Mill. The extent of this problem and possible biological impact merit further investigation.

Emergent broad-leaved plants were locally highly abundant, particularly in the middle-lower reaches (Latimer Bridge-Colne) and the upper river (Water Lane-Above Chesham STW). Diversity and abundance of emergent plants was reduced below Chesham STW as was noted for submerged plants. Elsewhere, watercress (*Nasturtium officinale* group) was typically the most abundant (in terms of area cover) and Fools Water Cress (*Apium nodiflorum*), Water Mint (*Mentha aquatica*) and Water Forget-Me-Not (*Myosotis scirpoides*) were also widespread and abundant. Yellow Cress (*Rorippa amphibium*) was found at the lowest two sites on the River Chess and Gypsywort (*Lycopus europea*) at several sites throughout. Although these are generally common plants, neither occur widely in the North East Area.

As expected, emergent narrow-leaved plants were most abundant in parts of the river where flow velocities were lower and silty substrates were available. They were common and locally abundant throughout the length of the river although diversity was reduced immediately below Chesham STW (virtual monoculture of reed sweet grass *Glyceria maxima*).

Extensive Weed cutting was taking place in the river around the time of the autumn sampling. This is the time of maximum area cover for most species. Affected sections had very little emergent broadleaved cover remaining (typically reduced from around 50% cover to less than 1%). Therefore it is possible that underestimates of broadleaved species richness and abundance have occurred. It is unclear what quantifiable effect these maintenance operations have on the wider ecology of the river, but loss of fish cover, disturbance of the macroinvertebrate fauna and other wildlife associated with the river margin and loss of potential macroinvertebrate food resources could be expected.

Trailing filamentous algaes or "Blanket weeds" (chiefly *Cladophera spp*) are a symptom of nutrient enrichment (eutrophication). Blanket weed growths can smother less vigorous plants and reduce the aesthetic and wildlife value of the river. Although virtually absent throughout much of the catchment (- an indication of very good water quality), moderate growths were apparent at all sites from Latimer Bridge downstream to Valley Farm Ford on the River Chess and at Latimer Park Farm on the Old River Chess. These growths are attributable to the discharge from Chesham STW further upstream. Absence from the river immediately downstream of the discharge (eg sites at Bois Mill and Below Bois Mill) was also noted. This could reflect effluent toxicity but since *Cladophera* growths are stimulated by Ammonium and Phosphate, which is released from the decomposition of organic matter after release of STW effluents into the river, it is usual to find the most luxurient blanket weed growths some distance below a STW outfall (Hynes, 1966). It is likely that densities of Filamentous algae were reduced in some areas by active removal.

3.4 LOW FLOWS

Low flows were apparent in the uppermost parts of the river Chess during visits in June 1992. Above the site at Water Lane, Chesham, the river was dry. Below Chesham flows increased steadily, though levels were very low at a site above Chesham STW.

This site is situated below the point where water is carried from the Chess to the Chalk stream and is notable for supporting a colony of native freshwater crayfish (*Austropotamobius pallipes*), one of the last known colonies in the Colne catchment and the only recently confirmed colony on the Chess (see discussion in section 3.3.1. The sparse cover by submerged plants at this site (since 1990) may also reflect reduced flows and the particularly shallow conditions. A short distance below this site flows are supplemented by treated effluent from Chesham STW.

Throughout the period from summer 1990 to summer 1992 flows in the river were close to or below the historic minima. Above average rainfall from late summer and through autumn subsequently restored flows. The effects of drought flows upon the macroinvertebrate assemblages were confined to the headwater section of the Chess above Chesham. Effects upon water plants and aquatic habitats throughout the river cannot be reliably assessed since no past data is available.

REFERENCES

Findlay, M (1991) "The Hertfordshire Otter Habitat Project: Interim Report- Habitat Survey". Herts and Middlesex Wildlife Trust.

Hynes, H.B.N (1966) "The Biology Of Polluted Waters" Liverpool University Press.

APPENDICES

Appendix 1. Environmental Information.

Appendix 2. Environmental/Habitat Descriptions of Sites.

Appendix 3. Macroinvertebrate Data.

APPENDIX 1 : ENVIRONMENTAL INFORMATION

This appendix provides definitions for all environmental observations recorded during a survey and an explanation of the tables (Appendix 3) which summaries this information for all the sites visited in the catchment.

The environmental information collated for each site comprises four components: (a) Site Location, (b) Physical descriptions, (c) Habitat Descriptions and (d) Channel Quality. Results for (b) and (c) are discussed in section 3.3. Results for (d) are discussed in section 3.2 and presented in figure 7.

(a) SITE LOCATIONS

Sites sampled

Site Ref (U.R.N)	SITE NAME	Grid Ref (NGR)	Dist (km)	Altitude (metres)

This table lists the sites sampled on each watercourse in downstream sequence. National Grid Reference, distance (km) from source and Altitude (metres) is shown.

(b) PHYSICAL

Site Physical Descriptions

SITE REF (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE Bou Gra San Sil (Mean % area)	FLOW VELOCITIES OVER SITE

These observations give a detailed description of the sampling site - the area, usually 10-20m in length, from which the macroinvertebrate sample was obtained. The physical descriptions include observations which are routinely collected in order to use RIVPACS.

'RIVPACS' info:	+ additional info:
Mean Width (m)	Max/Min Width (m)
Mean Depth (cm)	Max/Min* Depth (cm)
% Substrate Composition (4 categories)	Flow Velocities present

The additional information provides a fuller account of site character, including the range in width, depth and flow conditions present at a site under normal conditions. These features can affect the potential nature and variety of habitats (also influenced by water quality).

The definitions and methods of assessment are described over page.

Mean Width and Depth

These observations are routinely assessed for each sample taken. The mean depth of several spot measurements using a net pole marked with 10 cm divisions (min 3 for depth, 1 for width) is recorded. Where a site includes riffle and pool areas the mean value is taken to reflect the riffle conditions. Where a watercourse could not be crossed (depths over 70cm flood waders !) width and depth estimates could not be corroborated by direct measurement.

Width and Depth ranges

The range of widths and depths at a site, under typical flow conditions are two simple measurements which indicate channel variety and thus have a bearing on potential habitat and faunal diversity.

The minimum width is simply the width of the watercourse at water level at its narrowest point in the vicinity of the sampling site, whilst the higher value gives the maximum width. Width ranges were usually estimated but were measured if the difference to the mean (measured) width could not be assessed easily.

The minimum depth is the greatest depth attained over the shallowest 10 % of the sample site - ie, at least 10 % of the site is shallower than this value. The maximum depth is recorded at the deepest point over the sample area or estimated if measurement is not possible.

Substrate Composition

The % composition of areas of boulder, gravel, sand or silt over the sampling site is estimated by eye. For any analysis of long term trends at a site (eg associated with modified flow regimes) a number of estimates taken at different times would be useful.

Flow velocities over site

This records the range of flows present across the sampling area, with the most characteristic flow velocities for the site listed in bold. Observations refer to typical conditions for the time of year, unless otherwise indicated. Velocities are defined below;

1: Slack (<10cm/sec)
2: Slow (10-25)
3: Moderate (25-50)
4: Fast (50-100)
5: Spate (>100)

(c) SITE HABITAT COMPOSITION

The habitat types present and their extent are an important component of the ecology of watercourses and the biological resources supported. It is necessary to monitor and assess such features in order to fully understand the nature of change to a watercourse through space or time. Since the principal habitat features of rivers are quite easily observed and recognised, their protection or enhancement should be relatively straightforward. The value of riverine habitats to both underwater life or the wildlife of the river corridor in general is great.

Information describing the habitats at a sampling-site is useful for the interpretation of macroinvertebrate data. For example, the aquatic architecture provided by submerged plants and the underwater roots or leaves of emergent plants, trees or bankside plants are important habitat features. These features play a variety of roles during the life cycles of macroinvertebrates and fish in particular, and the loss or gain of such features can be expected to produce a marked change in the fauna supported at a site. Their value includes the provision of shelter or cover and substrates for attachment to, sites for egg laying or emergence (eg winged insects), and a wide range of food resources.

Habitat features can also provide evidence of water quality and other human impacts. Dense cover by Filamentous algae is a clear indication of advanced nutrient enrichment problems. Smothering by such 'blanket weeds' can lead to the loss of less vigorous aquatic plants and the valuable habitat they provide. Though habitat features are naturally dynamic, both on a seasonal basis and following removal by stormwaters, persistent change can be shown.

Site Habitat Descriptions

SITE REF (U.R.N.)	SUBMERGED PLANTS	FLOATING LEAVED	EMERGENT NARROW	EMERGENT BROAD	SURFACE PLANTS	FIL. ALGAE	TREE ROOT	O/H VEG

In this table, the extent of each habitat type (% cover or potential significance) is estimated and indicated by asterix symbols if present (explained below). Where higher aquatic plants are present a list of species or genera is given. A key to the abbreviations used is provided at the end of this appendix.

Higher Aquatic Plants;

Includes submerged plants, floating leaved rooted plants, free floating surface plants, emergent narrow leaved and broadleaved vegetation.

•	trace fragments or individual plants recorded only
*	< 5 % area cover (scarce)
**	5-15% area cover (significant)
***	15-40% area cover (common)
****	>40% area cover (abundant)

Filamentous Algae:

Includes trailing *Cladophora* or *Spirogyra* types.

-	Trace/Insignificant (< 1% cover)
*	Significant (1-10% cover)
**	Common (10-40% cover)
***	Abundant (>40% cover)

Tree roots and O/H Veg* (*submersed terrestrial overhanging vegetation):

*	Present but insignificant habitat provision
*	Significant habitat provision
**	Abundant habitat provision

Key to Plant types

Plants recorded at sites in the catchment are listed under the category which describes their growth type. On the tables, plants are listed in order of commonest-scarcest. Where abbreviations appear in **bold** this indicates the species concerned is relatively abundant.

Submerged plants:

code	latin name	common name
Cal	Callitriche spp	- Starworts
Cer	Ceratophyllum spp	- Hornworts
Elo	Elodea spp	- Canadian pondweeds
Pon	Pontinalis spp	- Mosses
Myr	Myriophyllum spp	- Milfoils
P.c	Potamogeton crispus	- Curled pondweed
P.sp	Potamogeton (pusillis?)	- Fine leaved pondweed
Ran	Ranunculus spp	- Water crowfoots

Floating Leaved:

code	latin name	common name
Pol	Polygonum amphibium	- Amphibious bistort

Emergent narrow leaved plants:

code	latin name	common name
Car	Carex spp	- Sedges
Gly	Glyceria maxima	- Reed sweet grass
Iri	Iris pseudacorus	- Yellow flag iris
Jun	Juncus spp	- Rushes
Pha	Phalaris arundinacea	- Reed Canary Grass
Spa	Sparganium erectum	- Bur reed

Emergent Broadleaved plants:

code	latin name	common name
Api	Apium nodiflorum	- Pools water cress
Ber	Berula erecta	- Lesser water parsnip
Lyc	Lycopus europeus	- Gypsywort
Men	Mentha aquatica	- Water mint
Myo	Myosotis scorpoides	- Water forget-me-not
Pol	Polygonum amphibium	- Amphibious bistort
R.a	Rorippa amphibia	- Great Yellow Cress
Rna	Rorippa nasturtium-aquaticum	- Water cress
Ver	Veronica beccabunga	- Brooklime

Free-floating plants:

code	latin name	common name
Lem	Lemna spp (incl. L.minor)	- Duckweeds
Ent	Enteromorpha spp	- Macro algae

(d) CHANNEL QUALITY

This assessment of Channel Quality considers the river's bed and banks, an area equivalent to the "Micro River Landscape" considered by Catchment Planning to target environmental enhancement works. Three types of channel are identified (non-uniform, uniform and man-made conduits) and further categories of modification (from semi-natural to canalised) are identified. These are defined below.

(1) Non-Uniform bed/flow:

These sites, which include riffle-pool systems, offer a variety of water depths, flow velocities and (usually) substrate particle sizes, representing a good diversity of physical conditions for instream fauna and flora.

A Semi-natural with varied bank slopes as appropriate for river type. No straightening or deepening apparent.

B Deepened or straightened channels with unnaturally steep or tall banks above water level.

C Channel with piled, concrete or toe boarded banks but retains varied bed profile.

(2) Uniform bed or flow:

These sites offer a restricted variety of water depths or flow velocities. This may be a natural characteristic of larger slow flowing rivers, broadwaters or dykes with naturally low banks or a feature of modified channels, where channel quality is impaired (categories b, c).

a Semi-natural channel with relatively low banks, characteristic of slow flowing watercourses on floodplain.

b Deepened or straightened channels with unnaturally steep or tall banks above or below water level.

c Canalised channel with piled, concrete or toe boarded banks.

(3) Man-Made Conduits:

D Artificial channel with concrete bed

X Culverted or piped

This assessment can be used to highlight possible management options - from conservation (categories A and a), enhancement (B, b, C,), to reinstatement (c, D, X). The lower case categories would benefit from riffle/pool reinstatement if these are natural features for the watercourse concerned (ie categories b and c). This could be achieved by instream flow deflectors or reinstating sinuosity.

APPENDIX 2 ENVIRONMENTAL SUMMARIES FOR ALL SITES

Watercourse: CHALK STREAM

Length (km): 1.70 **Tributary of:** CHESS

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Grid Ref. N.G.R	Source Distance(km)	Altitude (m)
PCNR.0176	BELOW BLACKWELL HALL LANE	SU 980 995	1.02	88

Site Physical Descriptions

SITE REP (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE Bou Gra San Sil (Mean % area)	FLOW VELOCITIES OVER SITE
PCNR.0176	3.5	(2.8-4.0)	45	(30-65)	1 59 30 10	1,2,3,4

Site Habitat Descriptions

SITE REP (U.R.N.)	SUBMERGED PLANTS	FLOATING LEAVED	EMERGENT NARROW	EMERGENT BROAD	SURFACE PLANTS	FIL. ALGAE	TREE ROOT	O/H VEG
PCNR.0176	**** (Cal/Api/Elo /Ran/Fon)	-	* (Pha/Car)	*** (Rna/Api/Myo /Ver)	* (Lem)	-	-	*

Watercourse: CHENIES RELIEF CHANNEL

Length (km): c.0.8 **Tributary of:** CHESS

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Grid Ref. N.G.R	Source Distance (km)	Altitude (m)
PCNR.9985	ABOVE CHESS	TQ 016 988	c.0.5	71

Site Physical Descriptions

SITE REP (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE Bou Gra San Sil (Mean % area)	FLOW VELOCITIES OVER SITE
PCNR.9985	4.0	(3.0-5.0)	18	(5-60)	2 83 9 6	1,2,3,4,5

Site Habitat Descriptions

SITE REP (U.R.N.)	SUBMERGED PLANTS	FLOATING LEAVED	EMERGENT NARROW	EMERGENT BROAD	SURFACE PLANTS	FIL. ALGAE	TREE ROOT	O/H VEG
PCNR.9985	**** (Ran/Cal/Elo /Api)	-	* (Pha/Gly/Iri)	* (Rna/Api/Pol)	* (Lem)	**	-	*

Watercourse: CHESS

Length (km): 17.90 **Tributary of:** COLNE

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Grid Ref. N.G.R	Source Distance (km)	Altitude (m)
PCNR.9987	WATER LANE, CHESHAM	SP 957 014	1.00	100
PCNR.9986	BELOW WEIR, WATERSIDE ROAD, CHESHAM	SP 967 005	2.60	93
PCNR.0012	ABOVE CHESHAM STW	SU 982 996	4.07	88
PCNR.0014	AT BOIS MILL	SU 984 994	4.55	87
PCNR.0179	BELOW BOIS MILL	SU 988 992	5.00	86
PCNR.0019	BELOW LATIMER BRIDGE	TQ 005 986	6.97	79
PCNR.0148	ABOVE CHENIES STW	TQ 019 987	8.61	74
PCNR.0145	ABOVE VALLEY FARM FORD	TQ 026 990	9.37	69
PCNR.0147	BELOW BRIDGE HOUSE, SARRAT	TQ 035 978	11.29	64
PCNR.9990	BELOW LOUDWATER	TQ 062 958	15.60	52
PCNR.0013	ABOVE COLNE	TQ 067 946	16.74	49

Site Physical Descriptions

SITE REF (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE Bou Gra San Sil (Mean % area)	FLOW VELOCITIES OVER SITE
PCNR.9987	4.4	(2.0-6.8)	10	(1-25)	1 35 15 49	1,2,3
PCNR.9986	4.5	(3.5-6.5)	18	(5-40)	20 30 38 12	1,2,3,4
PCNR.0012	5.8	(4.5-6.5)	7	(1-15)	2 69 18 11	1,2,3,4
PCNR.0014	8.0	(7.5-8.5)	30	(10-45)	0 0 0 100	1,2,3
PCNR.0179	4.6	(4.0-6.5)	11	(5-20)	5 85 7 3	2,3,4,5
PCNR.0019	7.5	(7.0-9.0)	25	(15-40)	5 65 22 8	1,3,4,5
PCNR.0148	5.8	(4.5-6.5)	18	(10-45)	3 83 8 6	1,2,3,4
PCNR.0145	8.0	(6.5-10)	18	(10-25)	4 64 31 1	1,3,4,5
PCNR.0147	5.3	(5.0-7.0)	18	(6-40)	4 75 20 1	1,3,4,5
PCNR.9990	8.3	(7.0-10)	23	(10-40)	1 70 25 4	1,2,3,4
PCNR.0013	8.0	(8.0-10)	30	(15-70)	4 46 33 17	1,2,3,4

Site Habitat Descriptions

SITE REF (U.R.N.)	SUBMERGED PLANTS	FLOATING LEAVED	EMERGENT NARROW	EMERGENT BROAD	SURFACE PLANTS	FIL. ALGAE	TREE ROOT	O/H VEG
PCNR.9987	** (Ran/Cal/Pon)	-	* (Car)	*** (Men/Api/Rna /Ver)	* (Lem)	*	-	*
PCNR.9986	** (Cal/Pon/P.c)	-	* (Car/Spa/Pha)	** (Api/Rna/Myo)	* (Lem)	*	*	*
PCNR.0012	* (Cal/P.c)	-	*** (Gly)	** (Rna/Myo/Lyc /Api/Ver)	* (Lem)	*	*	*
PCNR.0014	** (Cal/Pon)	-	* (Gly/Spa)	* (Men/Myo/Ber)	* (Lem)	*	**	*
PCNR.0179	* (Cal/Pon)	-	-	* (Rna/Api)	* (Lem)	*	*	*

PCNR.0019	*** (Ran/Cal/Myr /P.sp/Elo)	-	* (Spa/Jun)	*** (Rna/Api/Ver)	* (Lem)	**	-	-
PCNR.0148	*** (Ran/Api/Cal/ Elo/Fon/Myr)	-	* (Iri/Spa/Gly /Pha)	* (Api/Rna/Myo)	* (Lem /Ent)	**	-	*
PCNR.0145	**** (Ran/Api/Cal /Elo/Pon)	-	* (Gly/Pha)	** (Api/Rna/Myo)	* (Lem)	**	-	*
PCNR.0147	*** (Ran/Api/Pon/ Elo/P.c/Cer)	-	* (Gly/Iri/Pha)	* (Api/Rna/Myo /Ber)	* (Lem/ Ent)	*	-	*
PCNR.9990	*** (Ran/Cal/Pon)		* (Car/Pha/Spa)	*** (Rna/Men/Api /R.a/Pol)	* (Lem)	*	-	**
PCNR.0013	*** (Ran/Cal/Pon /Myr)	-	** (Spa/Gly/Pha)	* (Rna/R.a/Myo Api/Men)	* (Lem/ Ent)	-	*	**

Watercourse: OLD RIVER CHESS

Length (km): 2.05 **Tributary of**: CHESS

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Grid Ref. N.G.R	Source Distance (km)	Altitude (m)
PCNR.0207	AT LATIMER PARK FARM	SU 999 985	1.57	85

Site Physical Descriptions

SITE REF (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE Bou Gra San Sil (Mean % area)	FLOW VELOCITIES OVER SITE
PCNR.0207	4.4	(3.5-5.3)	30	(20-50)	3 77 13 7	2.3.4

Site Habitat Descriptions

SITE REF (U.R.N.)	SUBMERGED PLANTS	FLOATING LEAVED	EMERGENT NARROW	EMERGENT BROAD	SURFACE PLANTS	FIL. ALGAE	TREE ROOT	O/H VEG
PCNR.0207	**** (Ran/Cal/P.sp /Myo/P.c)	-	-	** (Api/Rna/Myo)	* (Lem)	**	-	*

APPENDIX 3 LISTS OF MACROINVERTEBRATE TAXA RECORDED AT EACH SITE.

Sites are listed from Left-Right in downstream sequence for each sampling period. The site-names for each of the site codes are listed below. The abundance of individuals from each macroinvertebrate family in a sample is denoted by asterix symbols as outlined below.

Site names and Site Codes:

PCNR.9987 Chess At Water Lane, Chesham
PCNR.9986 Chess at Waterside Road, Chesham
PCNR.0012 Chess Above Chesham STW
PCNR.0176 Chalk Stream at Blackwell Hall Lane
PCNR.0014 Chess At Bois Mill (D/S STW)
PCNR.0179 Chess Below Bois Mill
PCNR.0207 Old River Chess Latimer Park Farm
PCNR.0019 Chess Below Latimer Bridge
PCNR.9985 Chenies Relief Channel Above Chess
PCNR.0148 Chess Above Chenies STW
PCNR.0145 Chess At Valley Farm Ford
PCNR.0147 Chess Below Bridge House, Sarratt Bottom
PCNR.9990 Chess Below Loudwater
PCNR.0013 Chess Above Colne

Key to abundance categories:

*	1-9 individuals in sample
**	10-99
***	100-999
****	1000-9999
*****	>10,000

Summer season:

Biology Area	02	02	02	02	02	02	02	02	02	02	02	02	02	02
Day	08	08	10	10	10	10	08	10	08	08	08	08	08	08
Month	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun
Year	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992
Sample Number	0101	0102	0111	0110	0112	0113	0106	0114	0104	0103	0105	0107	0108	0109
Site Code	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR
	9987	9986	0012	0176	0014	0179	0207	0019	9985	0148	0145	0147	9990	0013
HEPTAGENIIDAE											*	*	*	**
EPHEMERELLIDAE		**	**	***		**	**	**	***	***	***	***	***	**
EPHEMERIDAE									*				*	**
LEPTOCERIDAE		**	**	**	*			**	**	***	***	***	***	**
GOERIDAE			*						**	*	*	*	*	*
LEPIDOSTOMATIDAE													*	
SERICOSTOMATIDAE		*	*	**						***	*	**	**	**
ASTACIDAE			*											
CALOPTERYGIDAE							*				*	*	*	*
PSYCHOMYIIDAE			*									*	*	
CAENIDAE			*			*		*	***	**	***	***	***	***
RHYACOPHILIDAE		*					*		*	*	*	*		
POLYCENTROPIDAE												*		*
LIMNEPHILIDAE		**		**		**	*	*	**	**	**	**	**	**
ANCYLIDAE		*	*			*	*	*	*	*	*	*	*	*
HYDROPTILIDAE			*	*			**			*				
GAMMARIDAE	**	****	***	***		**	**	***	**	***	****	****	***	***
COENAGRIIDAE							*			*				
HYDROMETRIDAE								*					*	*
GERRIDAE	*					*	*	*		*	*	*	*	*
NOTONECTIDAE								*					*	
CORIXIDAE		*	**		***		**	***	*		*	*	*	**
HALIPLIDAE	*	**	*	*		*	*	*	*	*		*	*	*
DYTISCIDAE	*	*	*	*	*	*	*		*			*	*	*
GYRINIDAE							*							
ELMIDAE		*	*	*			*		*	*	*	**	**	*
HYDROPSYCHIDAE		*		*		*	*	*	**	**	**	*	*	**
TIPULIDAE	*		*	**		*		*	*	*	*	*	*	
SIMULIIDAE							*		*	*	**	**	**	*
PLANARIIDAE		**			**	**	*	***	*	***				
DENDROCOELIDAE										*		*		*
BAETIDAE		**		**		**	**	**	**	**	***	***	***	**
SIALIDAE			*					*				*		
PISCICOLIDAE		*		*		*		*		*				
VALVATIDAE		***		***	**		**	***	*	*				*
HYDROBIIDAE		***									*		**	
LYMNAEIDAE	*	***	*	*	*	**	*	**	*	*	*	*	*	**
PHYSIDAE						**	**			*	*			
PLANORBIDAE	*	**		**	***	***	**	***	**	***	**	**	**	***
SPHAERIIDAE		**	*	**	**	**	**	***	**	**	**	***	***	***
GLOSSIPHONIIDAE	**	**	**	*	*	*	*	**	**	**	*	*		*
HIRUDIDIDAE								*						
ERPOBDELLIDAE		*	**	*	*	**	***	**	*	***	*	*	*	*
ASELLIDAE	**	**	**	**	***	****	***	***	**	***	*	**	*	*
CHIRONOMIDAE	***	**	***	*	**	**	**	**	**	*	*	*	**	***
OLIGOCHAETA	*	**	**	**	**	***	***	***	**	**	*	**	**	**
ACROLOXIDAE		*		*										
BITHYNIIDAE							*	***	*	**		**	*	*
CERATOPOGONIDAE			*	*	*			*	*	*		*		**
CRANGONYCTIDAE				**	***			**		**				
GLOSSOSOMATIDAE											*		*	
HYDRACARINA	*	***	***	**				*	**	*	*	*	*	
LUMBRICULIDAE		*		*	*		**	*				*	**	
MUSCIDAE						*								*
NAIDIDAE	*		*	*						*				
OSTRACODA			**		**	***		*	**	*		**	**	**
STRATIOMYIDAE						*								
TABANIDAE												*		
VELIIDAE		*								*				
SPONGILLIDAE		*												
CULICIDAE	*		*											
DAPHNIIDAE					***									
BMWP Score	41	121	128	112	55	98	135	128	144	163	152	183	194	177
ASPT	3.73	4.84	5.57	4.87	3.93	4.45	4.66	4.57	5.14	5.09	5.43	5.55	5.88	5.53
Biotic Class	D	B	B	B	C	C	B	B	B	A	A	A	A	A

Autumn season:

Biology Area	02	02	02	02	02	02	02	02	02	02	02	02	02	02
Day	21	21	19	19	19	19	19	21	19	19	21	21	21	21
Month	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct	Oct
Year	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992	1992
Sample Number	0278	0281	0269	0277	0270	0275	0271	0272	0276	0273	0280	0279	0282	0274
Site Code	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR	PCNR
	9987	9986	0012	0176	0014	0179	0207	0019	9985	0148	0145	0147	9990	0013
HEPTAGENIIDAE											*	**	*	*
LEPTOPHLEBIIDAE													*	*
EPHEMERELLIDAE				***					**	*	*	*	*	
EPHEMERIDAE								*	**	*	*	**	***	**
LEPTOCERIDAE	*	***	***	**	**	*	**	**	**	***	**	**	***	***
GOERIDAE			**	**				*		*	*		**	**
SERICOSTOMATIDAE		*		**	*	*			*	***	**	**	*	*
ASTACIDAE			*											
CALOPTERYGIDAE											**	*	*	**
PSYCHOMYIIDAE		**	**				*		*					
CAENIDAE				**		*		**	**	*	**	**	****	***
RHYACOPHILIDAE			**	*			*	*	**	**	*	**	*	
POLYCENTROPIDAE											*	*		*
LIMNEPHILIDAE		**	**	**				*		*		*		*
ANCYLIDAE		**	*	**		*	*	**	*	*	*	**	*	**
HYDROPTILIDAE		*	**	*		*	**	*	**			**	*	*
GAMMARIDAE	***	***	****	***	**	**	**	***	**	****	***	****	****	****
COENAGRIIDAE					**			*		*			*	*
HYDROMETRIDAE					*				*			*	*	
GERRIDAE			*											*
CORIXIDAE	*	**	**	*	**		*	***	**	*	*		***	*
HALIPLIDAE	*	**	**	*	*		*		*				*	
DYTISCIDAE	*	*	*	*	*			*			*	*	*	*
GYRINIDAE														*
SCIRTIDAE													*	
ELMIDAE		*	*	**		**				*	**	**	***	**
HYDROPSYCHIDAE			*	*		**		*	**	**	**	**	*	*
TIPULIDAE	*		*	*									*	
SIMULIIDAE						**	**		**	*	**	**	*	
PLANARIIDAE		**			**	**	**	**	**	**		*	*	*
DENDROCOELIDAE						**		*	**	**	*			*
BAETIDAE	**	**	**	**	**	**	**	*	**	**	**	**	**	**
SIALIDAE		*	**	*	**		*	*	*		*	*	*	*
PISCICOLIDAE							**				*			*
VALVATIDAE		**	**	**				**	**		*	*	*	*
HYDROBIIDAE		**				**		**			*	*	***	*
LYMNAEIDAE	***	**	*	*		*	**	**	*	*	**	*		*
PHYSIDAE						*	**		*	*				
PLANORBIDAE	**	**	**	*	*	**	**	**	**	**	**	**	*	*
SPHAERIIDAE	**	*	**	**	**	**	**	***	***	***	**	**		*
GLOSSIPHONIIDAE	*	**	**	*	*	**	**	**	**	**	*	*	*	*
ERPOBDELLIDAE			**	*	**	**	**	**	**	**	*	*	*	
ASELLIDAE	**	*	**	*	***	***	**	**	**	***	**	**	**	*
CHIRONOMIDAE	***	**	***	**	**	**	**	**	***	**	**	**	*	***
OLIGOCHAETA	**	***	***	**	***	***	***	***	***	*	**	**	**	**
ACROLOXIDAE		*					*							
BITHYNIIDAE							*	**	*	*	*	**	*	*
CERATOPOGONIDAE	**		*	*						*			**	**
CRANGONYCTIDAE					**									
GLOSSOSOMATIDAE		*	*	**		*		**			*	*	**	
HYDRACARINA	**	***	*	***	**		**	*	*	**	**	**	**	**
LUMBRICULIDAE						**	**	**		*		**	*	*
NAIDIDAE				*	**	**	**			*				
OSTRACODA							**			*		**	**	
DIXIDAE			*	*									*	**
DAPHNIIDAE	**				****									
LUMBRICIDAE								*			*		**	*
BMWP Score	58	117	135	141	83	108	102	135	153	150	170	169	195	189
ASPT	4.14	4.88	5.00	5.22	4.61	4.70	4.43	5.00	5.10	5.36	5.48	5.45	5.74	5.56
Biotic Class	C	B	B	B	C	B	B	B	A	B	A	A	A	A