BIOLOGICAL SURVEY REPORT

PYMMES BROOK AND SALMON BROOK CATCHMENT

JUNE 1992

COMPILED BY DAVE LEEMING AND JUDY ENGLAND,

NRA BIOLOGY, WALTHAM CROSS

Summary

This report presents the results of a detailed biological survey of the Pymmes Brook, Salmon Brook and their tributaries. 71 km of watercourse are contained in this catchment, including a mix of rural, green belt locations and more extensive urbanised areas of North London. 28 sites were visited for single season macroinvertebrate sampling during mid-late June 1992.

Biological quality was varied. Sections of watercourse in most of the urban areas contained highly restricted assemblages of pollution-tolerant macroinvertebrates. The upper reaches and headwaters located in green belt areas supported a greater richness of macroinvertebrate families. Overall, a respectable total of 39 scoring families were found in this area. These included a wide spread of low-mid scoring taxa relatively intolerant of pollution, although only two top scoring (most sensitive) families were recorded (found at two sites only).

25% of the watercourse length in this catchment fell into Biotic Class E (Very Poor, BMWP scores <20), 15% Class D (Poor, scores from 20-50), 18% Class C (Fair, scores 51-100) and 4% Class B (Good biological quality, scores 101-150). No sites in this catchment achieved Biotic Class A (Very Good, BMWP >150). A further 34% of watercourse length is culverted and 3% dry which are not attributed any biotic class.

In the urbanised areas, culverted sections and artificial concrete channels reduced the biological potential of 24 and 14 km of watercourse respectively. However the over-riding influence of poor water quality was apparent.

On the Pymmes Brook the deterioration in biological quality on entering the urban area was very marked and sudden. In less than 0.5 km BMWP scores fell from 104 (Class B) to 41 (Class D) before falling into Biotic Class E (BMWP <20) for the remaining 14 km of this river. Submerged and emergent plants were also absent throughout this section which may be indicative of toxic conditions.

In contrast, the Salmon Brook maintained fair-good biological quality throughout most of its headwaters and main river length. Between the Leeging Beech Gutter and the Hounsden Mead tributaries, the Salmon Brook contained relatively good aquatic habitats with both submerged and emergent plants present. This section also produced BMWP scores of 103 and 89 (biotic classes B and C), the best on this river. Downstream, the Hounsden Mead (a tributary of very poor biological quality) and urban run-off produce a deterioration in the Salmon Brook through the areas of Bush Hill Park and above Lower Edmonton. However, fair biological quality is maintained on this river until a lengthy culverted section and multiplicity of SWO's in the Lower Edmonton area.

Deephams STW (Thames Water Utilities) discharges to the Salmon Brook about 1.3 km above it's confluence with the Pymmes Brook. Below this discharge both watercourses contain a more productive (high biomass) macroinvertebrate fauna than upstream, comprising tolerant families in densities characteristic of organic pollution. However, there is no difference in the BMWP score or ASPT compared to sites above the discharge since the taxa lists are very similar and the fauna is already affected by chronic urban run-off pollution upstream.

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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) 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.

(3) 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

The headwaters of the Pymmes and Salmon Brooks are situated in green belt open areas where agriculture (both grazing and arable), wooded parkland and private open space (especially golf courses) predominate. There is little previous biological information for the brooks and their tributaries in this area.

The middle and lower parts of each system are highly urbanised (residential suburbs, commercial centres and some industrial uses) and exhibit chronic water quality problems mainly associated with episodic urban run-of. Deephams STW (Thames Water Utilities consented discharge = 200,000 M^3 /day) discharges to the lower reaches of the Salmon Brook, representing over 99% of the usual flow at this point. The Salmon Brook joins the Pymmes Brook 1.3 km downstream.

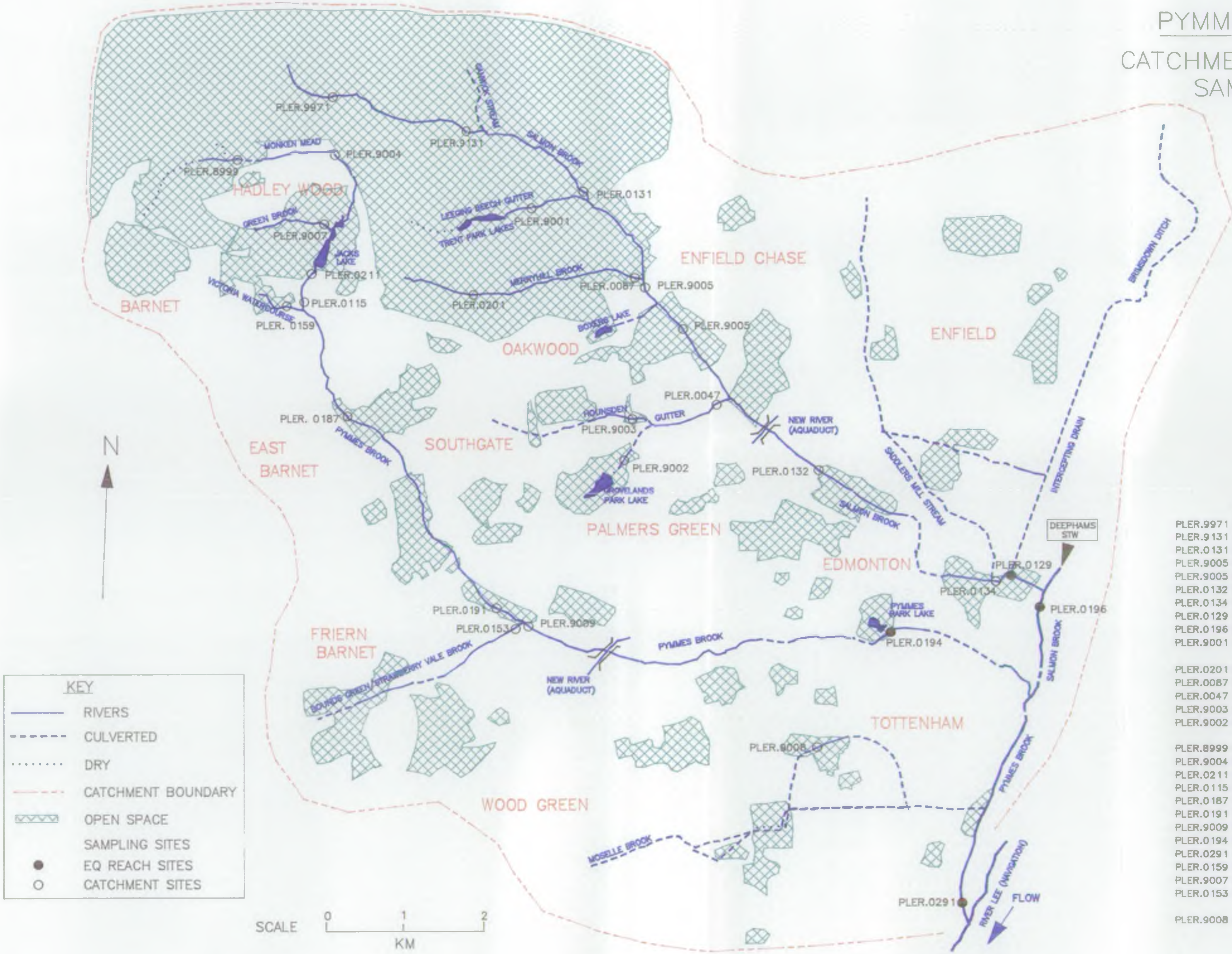
There are five EQ designated reaches for the Pymmes and Salmon Brook system, four of which are sampled in this survey. On the Salmon Brook there are two reaches; Source-Deephams STW and Deephams STW-Pymmes Brook. On the Pymmes Brook there are three reaches; Green Brook-Salmon Brook, Salmon Brook-Lee (Left Channel) and Salmon Brook-Lee (Right Channel). The last two reaches occupy a concrete channel which is divided along its centre. Only the right bank is accessible and sampled in this survey.

A map of this catchment showing the locations of all sampling sites is given in Fig.1. Of the 71km of river identified in the map, 24km (34%) are culverted.

FIG. 1

PYMMES CATCHMENT

CATCHMENT MAP SHOWING SAMPLING SITES



SITES:

PLER.9971 Salmon Brook, Below Spoilbank Wood
PLER.9131 Salmon Brook, Roundhedge Hill
PLER.0131 Salmon Brook, Hadley Road
PLER.9005 Salmon Brook, Above Enfield Road
PLER.9005 Salmon Brook, Enfield Golf Course
PLER.0132 Salmon Brook, Little Bury Street
PLER.0134 Salmon Brook Above Montague Road
PLER.0129 Salmon Brook Above Deephams STW
PLER.0196 Salmon Brook Below Deephams STW
PLER.9001 Leeging Beach Gutter
250m Below Trent Park Lake
PLER.0201 Merryhills Brook, Snake Lane
PLER.0087 Merryhills Brook Above Salmon Brook
PLER.0047 Hounsden Gutter At Deepdene Court
PLER.9003 Hounsden Gutter Above Hounsden Road
PLER.9002 Hounsden Gutter Tributary
Below Grovelands Park Lake
PLER.8999 Monken Mead, Bartrams Lane
PLER.9004 Monken Mead, Kingswell Road
PLER.0211 Pymmes Brook Below Jacks Lake
PLER.0115 Pymmes Brook Park Street
PLER.0187 Pymmes Brook At Oakhill Park
PLER.0191 Pymmes Brook At Arnos Park
PLER.9009 Pymmes Brook Below Bounds Green Brook
PLER.0194 Pymmes Brook At Pymmes Park
PLER.0291 Pymmes Brook At Tottenham Hale
PLER.0159 Victoria Watercourse At Recreation Ground
PLER.9007 Green Brook Above Pymmes Brook
PLER.0153 Bounds Green/Strawberry Hill Brook
At Seafield Road
PLER.9008 Moselle Brook, Tottenham Cemetery

2 METHODS

2.1 MACROINVERTEBRATE SURVEY

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. This 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. Kick sampling is supplemented by a one minute hand search of boulders or other removable solid objects.

Examination

Samples were returned to the laboratory for sorting within 24 hrs 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

In the field, a range of information was recorded about the sampling site. This information falls into three categories: (a) physical descriptions of sites; (b) descriptions of the habitats present at a sampling site, including lists of aquatic plants (species or genera) present and; (c) an 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.

2.3 ANALYTICAL TECHNIQUES

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.

As with other Biotic Indices, the BMWP score 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 its general 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, where BMWP scores vary between sites 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.

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 (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 determine 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.

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 providing assemblages of plants or macroinvertebrates of high conservation value are highlighted.

On-Line Lakes

On-line lakes in the catchment were not sampled directly for macroinvertebrates but inferences on water quality and biological status were made for several lakes from observations of the aquatic habitats present.

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 or terrestrial plants and/or loss of flowing water macroinvertebrate families (which can be shown if past data is available).

3 RESULTS

3.1 WATER QUALITY

Spatial changes in biological quality are identified in Figs 2 and 3, for BMWP and ASPT respectively. Sections of watercourse have been colour coded using Biotic Class categories of BMWP score and ASPT. No value has been attributed to the culverted sections of watercourses since these were not sampled directly. A full list of all macroinvertebrate taxa recorded at sites in this catchment is provided in Appendix 2. The occurrence of families is considered further in section 3.3.

The results for BMWP score show the very marked differences in water quality across this catchment. Only two sites, representing less than than 4% of watercourse length, achieved biotic class B (Good). There were larger sections of class C (Fair), D (Poor) and E (Very Poor). In general these BMWP classes are confirmed by the results for ASPT, with around 25% of the watercourse length falling into class E (very poor) using either measure. It is notable that a further 34% of watercourse length is culverted. Several sections which achieved only fair (biotic class C) BMWP scores had more respectable ASPTs. This occurred at sites on the top sections of both the Salmon Brook and Pymmes Brook (Monken Mead) which produced relatively few taxa but included a high proportion of mid-high scoring taxa and fewer low scoring snails than expected. Clearly the water quality of these sections is better than the BMWP score indicates, but other factors like sparse habitat provision and spatiness may limit the numbers of families present.

The pattern of change in biological quality in the two main rivers as they entered the urban area was different. On the Pymmes Brook there was a deterioration after the Monken Mead went into culvert in Hadley Wood and poor water quality affected the first lake on Hadley Wood Golf Course. As the water passes through the three lakes a progressive improvement in water quality is apparent and this is shown by the good biological quality achieved on the Pymmes Brook below Jacks Lake outfall (BMWP = 104, ASPT = 4.33). However, this watercourse then enters more urbanised surroundings and the next site, only 0.5 km downstream, exhibits a marked deterioration and poor biological quality

FIG.2

PYMMES CATCHMENT

BIOLOGICAL QUALITY BMWP CLASSES

FIG.3

PYMMES CATCHMENT

BIOLOGICAL QUALITY ASPT CLASSES

(BMWP = 41, ASPT = 3.42). Very poor biological quality (biotic class E) features at all remaining sites on this brook or the tributaries downstream of this point, with the single exception of the Pymmes Brook at Pymmes Park (class D) where there is only a slight improvement in BMWP and ASPT, aided by a varied channel.

In contrast, the Salmon Brook maintains a fair biological quality well into its lower reaches near Edmonton. The upper sections of this river and its tributaries above the Hounsden Gutter are of fair or good biological quality. This section benefits from a largely undeveloped, green belt location but agricultural pollutions have occurred on the Salmon Brook in this area as recently as February 1992 (a cattle slurry pollution which entered via the Ganwick Stream). The lower section of the Salmon Brook in this area, from the Leeging Beech Gutter to the Hounsden Gutter, supports a greater variety of macroinvertebrates than anywhere else on this river, although no taxa scoring above 7 pts was found. The Hounsden Gutter, which drains the urban areas of Winchmore Hill (where it is under culvert) is of very poor water quality and adversely affects the Salmon Brook below it. After a culverted section at Edmonton, the Salmon Brook receives a multitude of surface water outfalls and deteriorates to poor (class D) biological quality. Deephams STW has no effect on the BMWP score or ASPT of the Salmon Brook at this point, but a marked switch to a more productive fauna characteristic of organic pollution is apparent. This fauna is also maintained on the Pymmes Brook below the Salmon Brook.

3.2 BIOLOGICAL POTENTIAL

The channel quality within the Pymmes Brook catchment is shown in Figure 4.

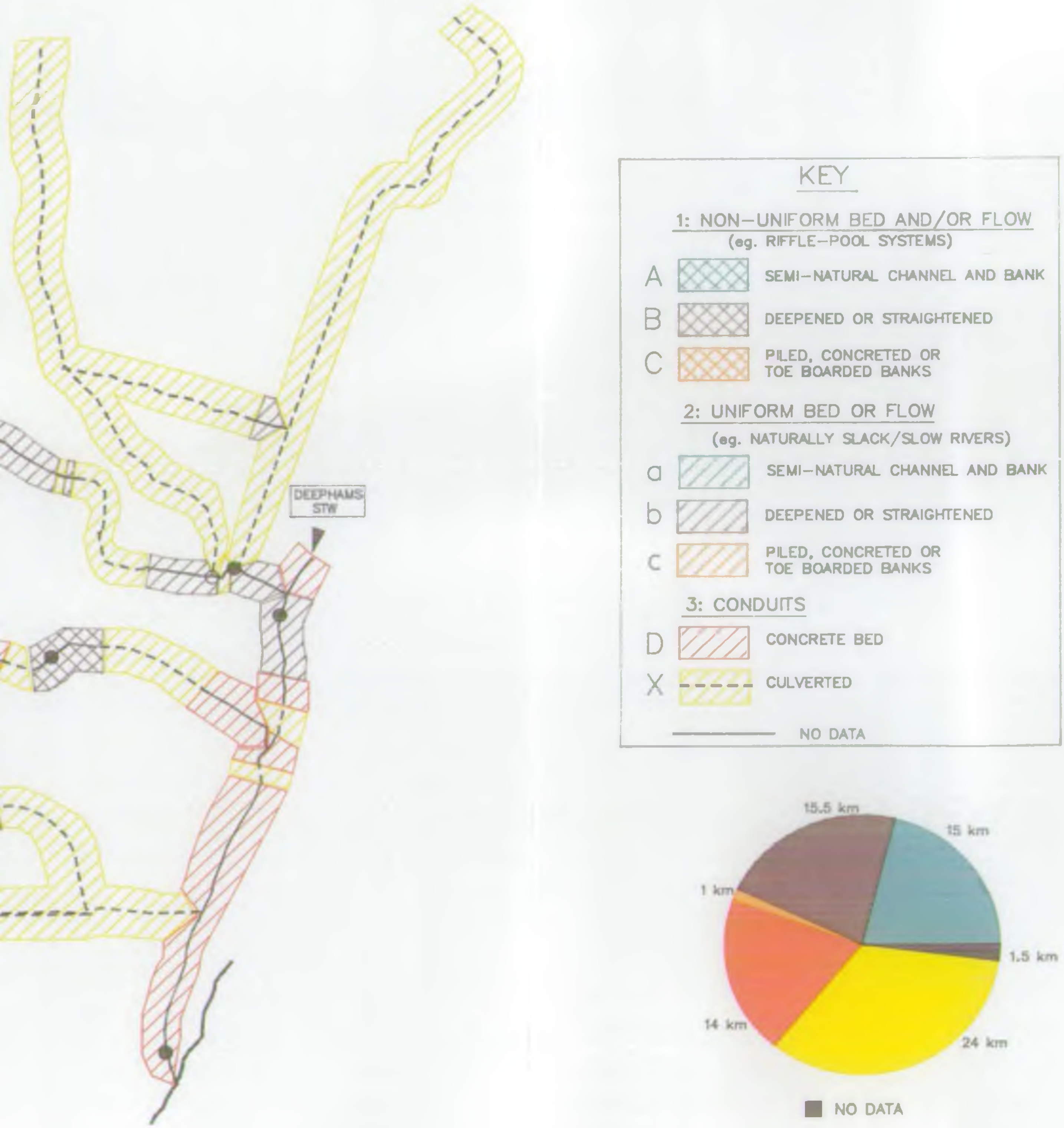
Large areas of this catchment have a restricted biological potential as a result of physical degradation. 34% of watercourse length is culverted and a further 19% comprises concrete channel and banks. However, a number of sections, particularly the upper reaches of the Salmon Brook and its tributaries, provide semi-natural channel features. The nature of aquatic habitats at sites tended to reflect channel quality quite closely, although an overriding influence of poor


N
SCALE
0
1
2
KM

FIG.4

PYMMES CATCHMENT

CHANNEL QUALITY



water quality was apparent on sections of the Pymmes Brook in particular. This watercourse lacked aquatic plants throughout most of its course despite sections of fair-good channel quality. The distribution of aquatic plants is discussed in section 3.3.

3.3 BIOLOGICAL RESOURCES

Macroinvertebrates

Of the 85 scoring families which are listed for the BMWP system, 39 were recorded in this catchment survey. This gives a catchment wide aggregate BMWP score of 193 and ASPT of 4.95. These figures are compared with the preliminary results of other catchment surveys in table 1. A full list of all macroinvertebrate taxa and fish recorded in this survey is provided in Appendix 4. This shows the abundance of all families recorded at each site and summarises the frequency of occurrence for each taxa within this catchment.

Whilst the total richness of this catchment is respectable, there is a striking disparity between the moderate faunal richness of several headwaters or mainriver sections and very poor faunas associated with most of the urbanized reaches. These spatial changes in biological quality were identified and highlighted in Figs 2 and 3 earlier.

Table 1: Aggregate Biological Quality for Catchments

CATCHMENT (No.Sites)	SEASON/YEAR	Number Of Taxa	BMWP Score	ASPT
Pymmes Brook (28)	Summer 1992	39	193	4.95
Turkey Brook (11)	Summer 1992	29	132	4.55
River Ver (13)	Spring 1992	38	195	5.13
River Ver (14)	Summer 1992	41	233	5.68
River Chess (14)	Summer 1992	45	253	5.62

(NB for the eastern area overall, 66 families were recorded over 1990-91, producing an aggregate BMWP of 390 and ASPT of 5.90.)

The typical biological quality and consistency of the catchment can be summarised by statistics for the average taxa richness and BMWP scores of the sites sampled in this catchment. These figures are provided in

Table 2 with data for several other catchments, also surveyed in summer 1992, for comparison. These figures show that the average BMWP score for a site in this catchment is low, at 44 (Biotic Class D), with a high degree of variability (63%) about this figure. Since large sections of this catchment are culverted (not sampled) and the distance between sites generally increased in the lower (poor quality) sections of the catchment, this average biological quality will tend to be an overestimate.

Table 2: Mean number of scoring taxa present and BMWP scores at sites in several contrasting catchments during summer 1992.

Figures in brackets give the coefficient of variance (cv) which is 1 standard deviation expressed as % of mean value. This reflects the variability of biological quality across sites within the catchment.

CATCHMENT	MEAN NO.TAXA	MEAN BMWP SCORE	ASPT
Pymmes Brook	12 (48%)	44 (63%)	3.67
River Ver	20 (39%)	89 (53%)	4.45
Turkey Brook	14 (39%)	53 (45%)	3.79
River Chess	26 (26%)	130 (34%)	5.00

Most of the macroinvertebrate taxa recorded in this catchment are only thinly distributed across it, with large areas having very low biological interest. Only two top scoring families were found; Leptocerid cased caddis (usually widespread in Thames region) and a Leptophlebiid mayfly, *Habrophlebia fusca*, which is more local in its distribution. These families were recorded in low numbers from two separate sites in the headwaters of the Pymmes Brook. Neither family had been recorded in this catchment previously, primarily because routine sampling is confined to the lower reaches of the catchment. No top scoring taxa were found in the Salmons Brook or its tributaries.

All 28 sites lacked the full representation of higher scoring families characteristic of true cleanwater systems. Nevertheless, the better sites on the Salmon Brook and its headwaters and sites at the very top of the Pymmes Brook and Monken Mead the did produce a wider spread of taxa, with several higher scoring families. These sections are of significant local conservation interest since they represent a pool of species that is available for dispersion to other areas within this catchment if environmental conditions or water quality improves.

Aquatic Habitats

The abundance of submerged and emergent plants at all 28 sampling sites is described in Appendix 3 with notes on other habitat features present and a physical description (width, depth, substrate composition and flow variety) of each site.

Overall, aquatic habitats were particularly restricted in this catchment. On the Pymmes Brook, for example, only 2 headwater sites (on the Monken Mead) supported a mix of submerged and emergent plants. This reflected the particularly poor water quality of this river and no plants were found over most of the brook's length even when a fair quality channel (for example, category B at Pymmes Park in Fig 4) was available. Sites with relatively varied emergent and submerged aquatic plant habitats were restricted to a middle section of the Salmon Brook.

A limited variety of submerged higher plants (macrophytes) were found in this catchment, with only the more tolerant and widespread plants like *Callitiche sp* (starworts), *Elodea sp*, *Potamogeton pectinatus* and *Potamogeton crispus* (pondweeds) found. Below Deephams STW, both the Salmon Brook and the Pymmes Brook contained dense swards of Fennel leaved pondweed (*Potamogeton pectinatus*) which was not found elewhere in this catchment and is an indicator of organic enrichment.

The most widespread emergent plants were water parsnip (*Berula erecta*), fools water cress (*Apium nodiflorum*) and brooklime (*Veronica beccabunga*). These broad-leaved plants were found throughout most of the sites on the Salmon Brook, absent only where dense shading by tall banks or episodic scour effects are most acute. Other broad-leaved emergents were more local in the catchment. These included water mint (*Mentha aquatica*) and water forget me not (*Myosotis sp*). Emergent narrow-leaved plants were also scarce, with patches of sedge (*Carex sp*), yellow flag iris (*Iris pseudacorus*) and reed sweet grass (*Glyceria maxima*) found locally on the Leeging Beech Gutter and Salmon Brook. The Leeging Beech Gutter in Trent Park passes through two lakes (and a water garden) which are well stocked with a variety of emergent plants. Jacks lake, situated on the headwaters of the Pymmes Brook also provides good marginal stands of emergent plants, chiefly at its northern end, but no plants were found in the Pymmes brook below the lake outfall (southern end).

3.4 Catchment Lakes

Several on-line lakes were visited during this survey and habitat features were noted. No macroinvertebrate samples were collected.

In general, the lakes within this catchment supported a greater variety of emergent plants than the streams and brooks. Tall emergent plants including reedmace (*Typha latifolia*), reed (*Phragmites communis*) and burr-reed (*Sparganium erectum*) occurred at Boxers Lake and were joined by sedges (*Carex sp*) and Gypsywort (*Lycopus europeus*) amongst others at Trent Park Lakes and Jacks Lake but were not seen elewhere. However, all lakes featured turbid green water, indicative of high production by microscopic algae suspended in the water column (Phytoplankton). Submerged macrophytes were not seen in any of the lakes visited but plants with floating leaves, including the white water lily (*Nymphea alba*) were widespread.

The characteristic symptoms of nutrient enrichment (eutrophication) include a progressive change from clear-water which is sparsely vegetated to dense stands of rank vegetation and filamentous algae. This process frequently culminates in a switch to open, turbid water as phytoplankton replaces higher macrophyte production. Emergent plants and plants with floating leaves, which can obtain light easily after reaching the water surface are usually the last to disappear.

In the Trent Park Lakes, eutrophication may be attributable to a high faecal loading from a large population of geese. In other cases, as with Boxers Lake and Groveland Park Lake, urban run-off also enters the lakes. In these lakes, eutrophication appears more advanced and there is less capacity for uptake and removal of nutrients by higher aquatic plants, since these are largely absent. The development of an effective zooplankton community, including larger-bodied water fleas like *Daphnia* *sp* which filter and graze phytoplankton, helping to maintain clear water, is hindered if refuges from fish predation are absent (as in open waters). All lakes appeared to contain large numbers of small zooplanktivorous fish, (particularly underyearling Roach). Despite these ecological imbalances, in fisheries, conservation and amenity terms the lakes of this catchment are highly significant biological resources.

3.5 LOW FLOWS

There is no effect of groundwater abstraction in this catchment since water tables are perched on clay overlying the main aquifers used to supply water. The drought effects were therefore slight and only several short sections of watercourse were found to be dry during this survey. These included parts of the Leeging Beech Gutter and Monken Mead (shown earlier in Figs 1-3). The drying of the Monken Mead is of concern from a conservation viewpoint since the site at Bartrams Lane (50 metres below dry section) produced the local mayfly *Habrophlebia fusca* which was found at no other site in this survey and has not been recorded in the lower Lee area previously. Low flows were also apparent at the top three sites on the Salmon Brook above its confluence with the Leeging Beech Gutter. In this section the varied bed profile facilitates retention of standing water in pools which are connected by trickles where shallow riffles are normally present.

APPENDICES

Appendix 1. Field Environmental Information.

Appendix 2. Macroinvertebrate Data.

Appendix 3. Environmental/Habitat Descriptions of Sites.

APPENDIX 1 : FIELD ENVIRONMENTAL INFORMATION

This appendix provides definitions for all environmental observations recorded during this survey. These are (a) Site Physical Descriptions (b) Habitat Descriptions and (c) Channel Quality.

Results for (a) and (b) are given in Appendix 3 and discussed in section 3.3. Results for (c) are discussed in section 3.1 and presented in figure 2 (section 3.1).

(a) SITE PHYSICAL DESCRIPTION

'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

'RIVPACS' site information (together with other geographic and hydrological information) is required to predict the clean water macroinvertebrate assemblage of sites using software developed by the Institute of Freshwater Ecology (I.F.E.).

The additional information provides a fuller account of site character, including the range in width, depth and flow conditions present. These features affect the variety of habitats expected and the potential characteristics of macroinvertebrate and fish populations.
Note: the minimum depth recorded covers at least 10% of the site area.

(b) SITE HABITAT COMPOSITION

% Area cover by category:	Other features recorded:
Open Water/Bare Substrate	Tree Roots
Submerged Aquatic Plants	Coarse Detritus/Leaf Litter
Floating Leaved Rooted Plants	Overhanging Vegetation*
Free Floating Plants	(* submersed terrestrial sp)
Emergent Narrow-Leaved Plants	Man-Made Objects
Emergent Broad-Leaved Plants	Filamentous Algae Cover
	Sewage Fungus

Information concerning the habitat types present and their extent is of particular use when interpreting macroinvertebrate data from sites. The aquatic architecture provided by submerged and emergent plants, tree roots and other solid underwater surfaces are important habitat features. As with larger stones and boulders, plant habitats provide important substrates for macroinvertebrates to attach to or live under. Plant surfaces also provide food - epiphyte coverings (diatoms, algae and microorganisms) and decaying plant material is used by snails, shrimps and a great variety of insect larvae. There are many weed dwelling predators and scavengers (especially water beetles, bugs, dragonfly and caddis larvae). Emergent or submerged plants also provide slack, sheltered areas in fast flowing waters and provide egg laying or emergence sites for aerial insects. Therefore, it is neccessary to take account of habitat provision in order to isolate water quality as the sole cause of differences in biology either between sites or at a particular site over time.

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

(c) <u>CHANNEL QUALITY</u>

The three types of channel identified and further categories of modification (lettered) are defined below.

(1) <u>Non-Uniform bed/flow:</u>

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) <u>Uniform bed or flow:</u>

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 floodpains.

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) <u>Man-Made Conduits:</u>

D Artificial channel with concrete bed

X Culverted or piped

This assessment of Channel Quality considers an area equivalent to the Micro River Landscape considered by catchment planning to target environmental enhancement works. The assessment of channel quality provided in this report 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 where these natural features are absent (ie categories b and c). This could be achieved by instream flow deflectors or reinstating sinuosity to a rivers course.

Alteration of river channels by man can have important ecological consequences. For example, wherever high banks entrain the stormflow of a river then the effects of scouring are more acute. This will affect the severity of catastrophic washouts of substrates, plants and animals but these effects may be reduced in non-uniform channels where areas of substrate are sheltered by instream variations in the bed profile, or by submerged/emergent plants. Catchment geology also affects the spatiness (incidence of flash flooding) of watercourses. The increased speed of surface water run-off in urbanised catchments also promotes spatiness.

Appendix 2: Macroinvertebrate Data (n=28 sites)

NOTE: SITES ARE ARRANGED FROM L-R IN ORDER OF INCREASING TAXA RICHNESS. FOR KEY TO ABUNDANCE CODES AND SITE LABELLING SEE OVER PAGE.

SITE..	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	NO. SITES	(% OF SITES)
SCORING FAMILIES:																														
10 PTS:																														
LEPTOPHLEBIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	1	(3.6%)
LEPTOCERIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	1	(3.6%)
8 PTS:																														
AESHNIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	--	--	1	(3.6%)
7 PTS:																														
CAENIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	A1	--	A2	B3	A1	5	(17.9%)
POLYCENTROPIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	B1	--	--	--	A2	--	--	--	--	--	--	--	--	--	2	(7.1%)
LIMNEPHILIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	A1	A1	--	A1	A3	--	--	A2	--	A3	A3	A3	A2	10	(35.7%)
6 PTS:																														
ANCYLIDAE	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	(3.6%)
(ACROLOXIDAE)	--	--	--	--	--	--	A1	A1	--	--	--	--	A2	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	4	(14.3%)
GAMMARIDAE	--	--	--	--	--	--	--	--	--	--	B1	--	--	--	C2	B2	B3	B2	D1	C3	B1	B1	A2	B1	D2	C2	B2	C2	15	(53.6%)
COENAGRIIDAE	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	A1	--	3	(10.7%)
5 PTS:																														
HYDROMETRIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	A1	A2	3	(10.7%)
GERRIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A3	--	B2	--	--	A2	A2	A2	5	(17.9%)
NEPIDAE	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	A3	3	(10.7%)
NOTONECTIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	A1	A1	--	A1	4	(14.3%)
CORIXIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	A2	--	--	C3	A3	--	--	A1	A2	A2	--	7	(25.0%)
HALIPLIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	A3	B1	--	--	A2	B2	--	5	(17.9%)
DYTISCIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	A3	--	A1	A2	B2	A2	A2	A2	A1	B2	--	10	(35.7%)
GYRINIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	A1	--	--	--	2	(7.1%)
HYDROPHILIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	A1	A2	--	--	B1	C1	A2	--	--	--	B3	A1	8	(28.6%)
SCIRTIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	(3.6%)
ELMIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	B2	--	--	--	--	--	A2	--	--	2	(7.1%)
CURCULIONIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	--	--	1	(3.6%)
HYDROPSYCHIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	--	--	--	--	--	B1	--	A1	--	3	(10.7%)
TIPULIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	A1	--	--	--	A1	--	--	--	A1	A2	--	--	A3	--	6	(21.4%)
SIMULIIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	B2	--	--	A2	A2	--	A1	--	5	(17.9%)
PLANARIIDAE	--	--	--	--	--	--	--	--	--	A3	B2	--	A3	--	--	--	--	--	--	--	--	--	--	B1	--	--	A3	A2	6	(21.4%)
DENDROCOELIDAE	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	--	--	--	--	A3	--	A1	A2	A2	5	(17.9%)
4 PTS:																														
BAETIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	B1	B1	A1	C1	B3	A2	--	--	B2	B1	A3	B3	A2	11	(39.3%)
SIALIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A3	--	--	--	--	--	--	A1	A3	--	--	A2	A2	B1	6	(21.4%)
PISCICOLIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	1	(3.6%)
3 PTS:																														
HYDROBIIDAE	--	--	A3	A3	B1	--	--	--	A2	B1	--	--	--	--	B1	A2	D1	A3	A3	A3	B2	--	B1	B1	--	B2	A3	A2	17	(60.7%)
(BITHYNIIDAE)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	1	(3.6%)
LYMNAEIDAE	A1	--	A3	B2	B1	B1	--	A2	A2	--	B1	B2	A2	A3	--	A2	A2	A1	A1	A2	A2	C2	B3	B1	--	C1	C3	B2	23	(82.1%)
PHYSIDAE	--	A2	A2	--	B1	--	B1	--	B2	--	--	C2	--	A2	--	--	--	--	--	--	--	--	--	--	B1	--	--	A2	9	(32.1%)
PLANORBIDAE	--	--	--	--	--	--	--	A1	--	--	--	A1	--	--	--	A3	A1	--	--	A2	--	--	--	A3	A3	C1	C2	B2	10	(35.7%)
SPHAERIIDAE	--	--	--	--	--	--	--	--	B1	C2	A2	--	A3	--	--	A3	B1	--	--	A3	--	--	B2	B2	C2	B2	C1	B2	13	(46.4%)
GLOSSIPHONIDAE	--	--	--	--	--	A2	--	--	--	A3	A3	--	B1	A2	--	B1	--	A2	A3	A2	A2	A2	--	B1	A1	A3	A2	A3	16	(57.1%)
ERPOBDELLIDAE	--	A2	--	A1	--	B2	B2	--	B2	A2	B2	B1	B2	B3	--	B2	A1	--	A1	A1	--	--	--	B3	A1	--	--	B1	17	(60.7%)
ASELLIDAE	A2	B3	A2	A3	A3	C1	B3	B3	B3	B2	B3	B3	B3	D1	--	C2	C1	C2	A2	A3	B1	D1	A2	C2	B1	C1	C1	B3	27	(96.4%)
2 PTS:																														
CHIRONOMIDAE	B3	C1	A3	C1	B2	B3	C1	C1	B3	B2	B3	C1	B3	C2	C2	C1	B3	C2	C1	C2	B3	C3	C1	C1	D3	D1	C3	C1	28	(100)
1 PT:																														
OLIGOCHAETA	C1	C1	C2	C2	B2	C2	C1	C2	C1	C2	D1	C2	C2	C1	--	C1	C1	C2	C2	C1	D1	C2	C1	C3	C1	C3	C2	C2	27	(96.4%)
NO. SCORING TAXA	4	5	6	6	6	6	6	6	8	9	9	9	10	11	11	12	12	13	13	14	14	15	15	18	18	21	24	24		

SITE..	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
NON SCORING FAMILIES:																												
CERATOPOGONIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	B1	--	A2	--	A1	--	A2	A3	A2	--
HYDRACARINA	--	--	--	--	--	--	--	--	--	--	--	--	B1	--	A2	B1	--	--	A2	A3	--	A2	--	A2	--	B3	C2	B1
MUSCIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--
LUMBRICIDAE	--	--	--	--	--	--	--	--	--	--	--	--	B1	--	--	--	--	--	--	A1	--	--	--	A2	A2	--	--	--
LUMBRICULIDAE	--	--	--	--	--	--	--	--	--	--	--	B2	B1	--	--	--	--	--	--	--	--	--	--	A2	A2	--	A2	--
NAIDIDAE	--	--	--	--	--	--	--	--	--	--	B2	--	--	--	--	--	--	--	B2	A3	A3	B2	--	--	--	--	B2	B3
SPONGILLIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A3	A3	--	--	--
COLLEMBOLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	A2	--	--	--
NEMATODA	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--
OSTRACODA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	B2	--	--	B2	--	--	B3
VELIDAE	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	C1	--	A2	B2	B3	B3	A2	B3	--	--	A1	B2	--	B3
DIXIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--
CULICIDAE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	A2	--	--	--	--	--
HYDRA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A1
DAPHNIIDAE	--	--	--	A3	--	A3	--	--	--	--	--	A3	--	--	--	--	--	--	--	--	--	A3	--	--	--	--	A2	--
COPEPODA	--	--	--	A3	--	A3	--	--	--	A2	--	B3	--	--	--	--	--	--	--	--	--	A3	--	--	--	--	--	B1
FISH:																												
PERCH	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--
DACE	--	--	--	--	--	--	--	--	--	--	--	--	A2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
STONE LOACH	--	--	--	--	--	--	--	--	--	--	--	--	A1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
STICKLEBACK (3 SPINED)	--	--	--	--	--	--	B3	C1	--	--	B2	A3	--	--	--	A3	A3	--	A2	--	A3	B1	C1	C1	A2	B3	B2	C1

KEY TO SITE LOCATIONS

01	PLER.9009 PYMMES BROOK BELOW STRAWBERRY VALE BROOK
02	PLER.9003 HOUNSDEN GUTTER ABOVE HOUNSDEN ROAD
03	PLER.0153 BOUNDS GREEN/STRAWBERRY VALE BROOK AT SEAFIELD ROAD
04	PLER.9008 MOSELLE BROOK AT TOTTENHAM CEMETERY
05	PLER.0159 VICTORIA WATERCOURSE AT RECREATION GROUND
06	PLER.0291 PYMMES BROOK AT TOTTENHAM HALE
07	PLER.0187 PYMMES BROOK AT OAKHILL PARK
08	PLER.0191 PYMMES BROOK AT ARNOS PARK
09	PLER.0047 HOUNSDEN GUTTER AT DEEPDENE COURT
10	PLER.9002 HOUNSDEN TRIBUTARY AT GROVELANDS PARK
11	PLER.0129 SALMONS BROOK ABOVE DEEPHAMS STW
12	PLER.0194 PYMMES BROOK AT PYMMES PARK
13	PLER.0134 SALMON BROOK ABOVE MONTAGUE ROAD
14	PLER.0196 SALMON BROOK BELOW DEEPHAMS STW
15	PLER.9971 SALMON BROOK BELOW SPOILBANK WOOD
16	PLER.0115 PYMMES BROOK AT PARK ROAD
17	PLER.9004 MONKEN MEAD BROOK AT KINGWELL ROAD, HADLEY WOOD
18	PLER.0131 SALMON BROOK AT HADLEY ROAD
19	PLER.0201 MERRYHILLS BROOK AT SNAKES LANE
20	PLER.0087 MERRYHILLS BROOK ABOVE SALMON BROOK
21	PLER.9007 GREEN BROOK ABOVE PYMMES BROOK
22	PLER.9131 SALMON BROOK AT ROUNDHEDGE HILL
23	PLER.8999 MONKEN MEAD BROOK AT BARTRAMS LANE
24	PLER.0132 SALMON BROOK AT LITTLE BURY STREET
25	PLER.9001 LEEGING BEECH GUTTER 400M BELOW TRENT PARK LAKE
26	PLER.9005 SALMON BROOK ABOVE ENFIELD ROAD A110
27	PLER.9006 SALMON BROOK AT ENFIELD GOLF COURSE
28	PLER.0211 PYMMES BROOK BELOW JACKS LAKE

KEY TO ABUNDANCE CATEGORIES:

CATEGORY	NUMBER OF INDIVIDUALS
A1	1
A2	2-4
A3	5-9
B1	10-19
B2	20-49
B3	50-99
C1	100-199
C2	200-499
C3	500-999
D1	1000-1999
D2	2000-4999
D3	5000-9999
E	>10,000

APPENDIX 3: ENVIRONMENTAL/HABITAT DESCRIPTIONS OF SITES

Explanation of tables: Definitions, categories and symbols.

Sites sampled

Site Ref (U.R.N)	SITE NAME	Dist (km)

This table gives a list of the sites sampled on each watercourse, listed in downstream sequence. The distance (km) downstream from source is shown.

Site Physical Descriptions

SITE REF (U.R.N)	WIDTH Mean (M) Range (site)	DEPTH Mean (cm) 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 collected). Atypical conditions, including the effects of drought or spate flows at the time of sampling, are noted. The methods/definitions used in recording each observation is described below.

1) Mean Width and Depth

These observations are routinely assessed for each sample taken and are used as predictors of invertebrate assemblages using RIVPACS. The mean of several spot measurements (min 3 for depth, 1 for width) using a net pole marked with 10 cm divisions was recorded. Where a site includes riffle and pool areas the mean value is taken to reflect the riffle-run conditions. Where a watercourse could not be crossed width and depth estimates were made.

2) 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 within 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, or, to put it another way, at least 10 % of the site is shallower than this value. The maximum depth is the depth at the deepest point over the sample area, although in larger watercourses and canals it can only be estimated. A site with a wide range in depth (eg 2-100 cm) reflects a combination of shallow riffle or margins and deep holes which indicate a highly varied channel. Consideration of substrate composition and flow velocities present provides a fuller picture.

3) Substrate Composition

Substrate composition is routinely assessed as samples are collected and is used as a predictor of invertebrate assemblages using RIVPACS. 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 would be needed at different times to assess significant, persistent changes.

4) Flow Velocities over site

This records the range of flows present across the sampling area, with the flow velocities of greatest significance listed in bold. These are defined below:-

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

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 recorded over a 40m length (including the sampling area) is provided. A key to the abbreviations used is provided over page.

1) 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)

2) Filamentous Algae:

Includes *Cladophora* or *Spirogyra* types, excludes heavy diatomaceous cover.

• Trace/Insignificant (< 5% cover)
* Significant (5-10% cover)
** Common (10-40% cover)
*** Abundant (>40% cover)

3) 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 each site 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 significant area cover (>5%) for the species concerned.

Submerged plants:

code	latin name	common name
Ber	Berula erecta	- Water parsnip (submerged growth form)
Cal	Callitriche spp	- Starworts
Cer	Ceratophyllum spp	- Hornworts
Elo	Elodea spp	- Canadian pondweeds
Pon	Fontinalis spp	- Mosses
Gly	Glyceria fluitans	- Floating sweet grass
Myr	Myriophyllum spp	- Milfoils
Oen	Oenanthe fluviatilis	- River dropwort
P.p	Potamogeton pectinatus	- Fennel leaved pondweed
P.c	Potamogeton crispus	- Curled pondweed
Ppr	Potamogeton praelongus	- Long stalked pondweed
Ran	Ranunculus spp	- Water crowfoots
Sag	Saggitaria saggittifolia	- Arrowhead (submerged growth form)
Sch	Schoenoplectus (=Scirpus)	- Club Rush (submerged growth form)
Zan	Zannichellia palustris	- Horned pondweed

Floating Leaved:

code	latin name	common name
Nuph	Nuphar lutea	- Yellow water lily (incl submerged growth form)
Ny.a	Nymphea alba	- White water lily
Ny.p	Nymphoides peltata	- Fringing water lily
Poly	Polygonum amphibium	- Amphibious bistort
P.na	Potamogeton natans	- Broad leaved pondweed (submerged growth form)

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
Phr	Phragmites communis	- Reed
Sci	Scirpus lacustris	- Bullrush or club rush
Spa	Sparganium erectum	- Bur reed
Typ	Typha latifolia	- Reedmace

Emergent Broadleaved plants:

code	latin name	common name
Ali	Alisma plantago-aquatica	- Water plantain
Api	Apium nodiflorum	- Fools water cress
Ber	Berula erecta	- Lesser water parsnip
Men	Mentha aquatica	- Water mint
Myo	Myosotis scorpoides	- Water forget-me-not
Oen	Oenanthe spp	- Water dropworts
P.a	Polygonum amphibium	- Amphibious bistort
R.a	Rorippa amphibia	- Great Yellow Cress
Rna	Rorippa nasturtium-aquaticum	- Water cress
Rum	Rumex hydrolapathum	- Water dock
Sag	Saggitaria saggitifolia	- Arrowhead
Ver	Veronica beccabunga	- Brooklime
V.a	Veronica anagalis-aquatica	- Speedwells

Free-floating plants:

code	latin name	common name
Azo	Azolla filliculoides	- Water fern
Lem	Lemna spp (incl. L.minor)	- Duckweeds
L.tr	Lemna trisulca	- Ivy leaved duckweed
L.p	Lemna polyrrhiza	- Fat duckweed
Ent	Enteromorpha spp	- Macro algae

Watercourse: BOUNDS GREEN/STRAWBERRY VALE BROOK

Length (km): 3.65 **Tributary of**: PYMMES BROOK

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.0153	AT SEAFIELD ROAD	3.60

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
PLER.0153	4.8	(4.8)	4	(1-5)	CONCRETE	2, 3

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
PLER.0153	-	-	-	-	-	-	-	-

NB Heavy diatomaceous slimes with possible sewage fungus at PLER.0153

Watercourse: GREEN BROOK

Length (km): 1.03 **Tributary of**: PYMMES BROOK

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.9007	ABOVE PYMMES BROOK	1.00

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
PLER.9007	0.7	(0.5-1.5)	5	(2-10)	1 40 40 19	1, 2, 3

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
PLER.9007	-	-	-	-	-	-	-	*

Watercourse: HOUNSDEN GUTTER

Length (km): 3.43 **Tributary of**: SALMON BROOK

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.9003	ABOVE HOUNSDEN ROAD	2.30
PLER.0047	DEEPDENE COURT	3.08

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
PLER.9003	2.5	(2.0-3.5)	8	(5-30)	6 60 20 14	1, 2, 3, 4
PLER.0047	4.0	(1.0-5.0)	10	(5-40)	5 80 10 5	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
PLER.9003	-	-	-	-	-	**	*	*
PLER.0047	-	-	-	-	-	•	*	•

NB Sewage fungus and diatomaceous slimes found at both PLER.9003 and PLER.0047.

Watercourse: HOUNSDEN TRIBUTARY

Length (km): 1.0 (EST) **Tributary of**: HOUNSDEN GUTTER

Sites sampled 1990/91

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.9002	GROVELANDS PARK	0.20

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
PLER.9002	0.5	(0.1-1.3)	3	(1-25)	0 65 10 25	1, 2

Low Flows: Discontinuous, slack water and exposed muds

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
PLER.9002	-	-	-	-	• (Lem)	-	•	•

Watercourse: LEEGING BEECH GUTTER

Length (km): 2.48 **Tributary of**: SALMON BROOK

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.9001	400M BELOW TRENT PARK LAKE	1.40

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
PLER.9001	1.2	(0.8-2.2)	4	(1-22)	4 71 7 18	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
PLER.9001	-	-	* (Iri,Gly)	* (Ber,Myo,Men, Ver)	-	-	-	**

Watercourse: MERRYHILLS BROOK

Length (km): 3.06 **Tributary of**: SALMON BROOK

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.0201	AT SNAKES LANE	0.92
PLER.0087	ABOVE SALMON BROOK	2.97

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
PLER.0201	1.0	(0.5-3.0)	3	(1-13)	2 88 3 7	1, 2, 3, 4
PLER.0087	0.8	(0.5-1.5)	5	(2-25)	3 90 4 3	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
PLER.0201	-	-	-	-	* (Lem)	-	*	*
PLER.0087	-	-	-	-	-	-	*	*

Watercourse: MONKEN MEAD

Length (km): 4.01 **Tributary of**: PYMMES BROOK

Sites sampled

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.8999	BARTRAMS LANE (ABOVE CULVERT)	1.60
PLER.9004	KINGWELL ROAD, HADLEY WOOD	3.00

Site Physical Descriptions

SITE REF (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE (Mean % area) Bou	Gra	San	Sil	FLOW VELOCITIES OVER SITE
PLER.8999	1.3	(1.0-1.5)	12	(10-30)	1	65	10	24	1
PLER.9004	1.5	(0.8-2.0)	4	(1-15)	7	73	15	5	1, 2, 3

V.Low Flow apparent at PLER.8999, slack ponded water and dry 50m upstream

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
PLER.8999	*** (Cal)	-	-	** (Ber,Api)	-	-	-	**
PLER.9004	-	-	-	* (Ber)	-	*	*	*

Watercourse: MOSELLE BROOK

Length (km): 7.30 **Tributary of**: PYMMES BROOK

Sites sampled 1990/91

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.9008	AT TOTTENHAM CEMETERY	4.30

Site Physical Descriptions

SITE REF (U.R.N)	WIDTH Mean (M)	WIDTH Range (site)	DEPTH Mean (cm)	DEPTH Range (site)	SUBSTRATE (Mean % area) Bou	Gra	San	Sil	FLOW VELOCITIES OVER SITE
PLER.9008	3.0	(2.5-3.5)	22	(10-30)	15	80	5	0	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
PLER.9008	-	-	-	-	-	*	-	-

Heavy diatomaceous slimes present at PLER.9008

Watercourse: PYMMES BROOK

Length (km): 15.57 **Tributary of**: RIVER LEE (NAVIGATION)

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source* Distance(km)
PLER.0211	BELOW JACKS LAKE OUTFALL	4.54
PLER.0115	AT PARK ROAD	5.04
PLER.0187	AT OAKHILL PARK	6.82
PLER.0191	AT ARNOS PARK	10.02
PLER.9009	BELOW BOUNDS GREEN/STRAWBERRY VALE BROOK	10.47
PLER.0194	AT PYMMES PARK	14.80
PLER.0291	AT TOTTENHAM HALE	19.42

*NB: Source Distance includes Monken Mead (4.01 km)

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
PLER.0211	2.5	(0.5-3.5)	5	(1-30)	6	80	10	4	1, 2, 3
PLER.0115	1.5	(0.8-2.0)	3	(1-13)	10	88	2	0	2, 3
PLER.0187	3.2	(2.8-4.5)	10	(5-50)	2	90	7	1	1, 2
PLER.0191	7.0	(6.5-7.5)	55	(30-65)	5	5	50	40	1, 2
PLER.9009	4.8	(4.8)	4	(1-5)	CONCRETE				2, 3
PLER.0194	7.0	(6.5-8.0)	23	(8-60)	2	93	4	1	1, 2, 3
PLER.0291	13.0	(13.0)	100	(80-120)	CONCRETE				3, 4

Low Flow apparent at PLER.0211: ponded behind v shallow riffle

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
PLER.0211	-	-	-	-	• (Lem)	•	*	•
PLER.0115	-	-	-	-	-	*	-	•
PLER.0187	-	-	-	-	-	*	•	•
PLER.0191	-	-	-	-	-	*	*	*
PLER.9009	-	-	-	-	-	*	-	-
PLER.0194	-	-	-	-	-	*	*	*
PLER.0291	** (P.p)	-	-	-	-	***	-	-

Sewage fungus and diatomaceous slimes present at PLER.9009

Watercourse: SALMON BROOK

Length (km): 14.00 **Tributary of:** PYMMES BROOK

Sites sampled:

Site Ref (U.R.N)	SITE NAME	Source Distance(km)
PLER.9971	BELOW SPOILBANK WOOD	0.35
PLER.9131	ROUNDHEDGE HILL	2.20
PLER.0131	HADLEY ROAD	4.49
PLER.9005	ABOVE ENFIELD ROAD (A110)	6.00
PLER.9006	ENFIELD GOLF COURSE	6.70
PLER.0132	LITTLE BURY STREET	9.00
PLER.0134	ABOVE MONTAGUE ROAD	12.30
PLER.0129	ABOVE DEEPHAMS STW	12.40
PLER.0196	BELOW DEEPHAMS STW	12.72

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
PLER.9971	0.5	(0.2-1.0)	2	(1-8)	20	40	10	30	1, 2, 3
PLER.9131	1.0	(1.3-3.3)	5	(1-60)	3	55	15	27	1, 2, 3
PLER.0131	0.8	(0.4-2.5)	5	(1-35)	2	75	10	13	1, 2, 3
PLER.9005	4.0	(4.0-4.5)	10	(2-55)	7	80	5	8	1, 2, 3
PLER.9006	1.8	(1.0-3.3)	8	(4-50)	1	69	10	20	1, 2, 3, 4
PLER.0132	5.0	(2.0-7.0)	25	(8-30)	20	65	12	3	1, 2, 3, 4
PLER.0134	2.5	(1.5-3.5)	8	(3-15)	6	40	46	8	1, 2, 3, 4
PLER.0129	3.3	(3.0-3.5)	25	(12-35)	1	5	80	14	1, 2
PLER.0196	10.0	(9-11)	80	(30-110)	8	82	8	2	1, 4, 5

Low Flow apparent at PLER.9971, 9131 and 0131. Standing water retained in intermittent pools, connecting riffles now only trickles.

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
PLER.9971	• (Fon)	-	-	-	-	-	-	*
PLER.9131	-	-	-	-	-	-	-	**
PLER.0131	• (Fon)	-	-	• (Ber)	-	•	•	*
PLER.9005	** (Elo)	-	-	** (Ber,Ver)	-	*	*	*
PLER.9006	* (Elo)	-	-	** (Ber/Api,Ver)	• (Ent)	**	-	**
PLER.0132	• (Elo)	-	-	-	-	•	*	•
PLER.0134	• (Elo,P.c)	-	-	• (Ber)	-	*	-	-
PLER.0129	* (Elo)	-	-	-	-	*	-	*
PLER.0196	**** (P.p)	-	-	-	-	***	-	•

Watercourse: VICTORIA WATERCOURSE

Length (km): 0.59 **Tributary of**: PYMMES BROOK

Sites sampled 1990/91

Site Ref (U.R.N)	SITE NAME	Source Distance (km)
PLER.0159	AT RECREATION GROUND	0.45

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
PLER.0159	1.0	(0.4-1.6)	5	(2-13)	3 77 10 10	1, 2, 3

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
PLER.0159	-	-	-	-	-	•	*	•