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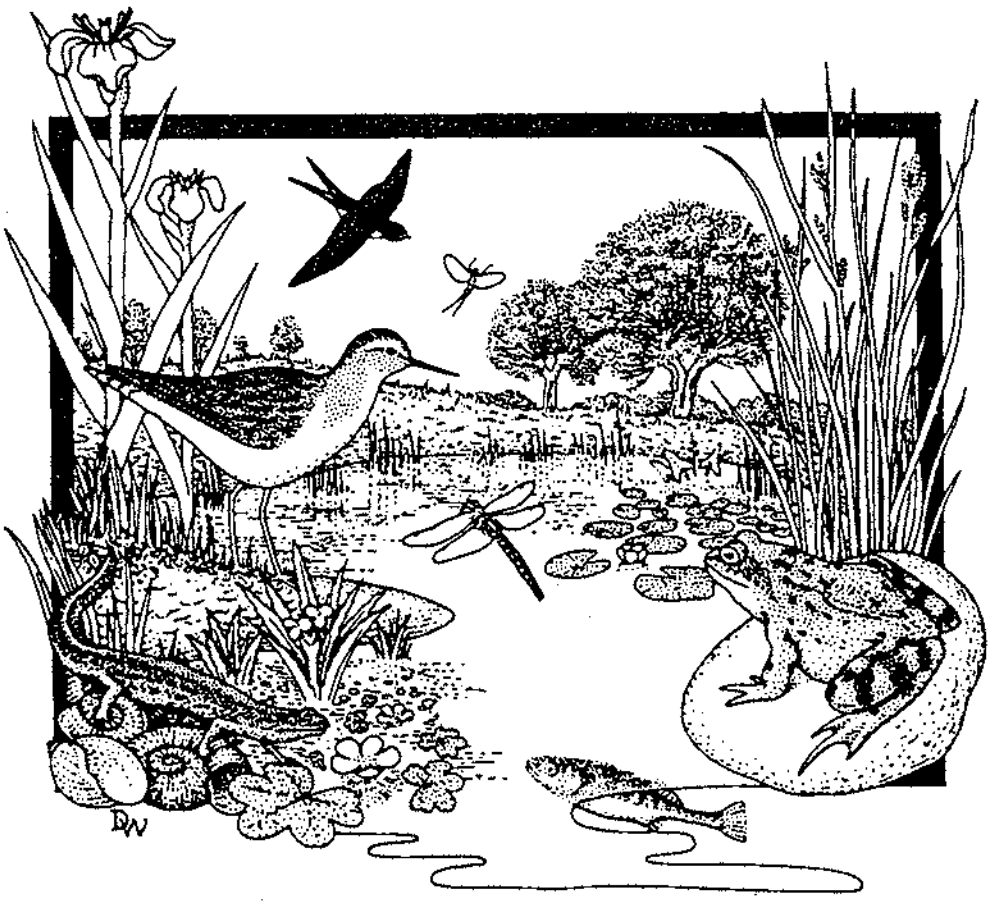
SOUTH-WEST OXFORDSHIRE RESERVOIR DEVELOPMENT STUDY (SWORDS)

Macroinvertebrate study related to Thames Water Utilities Limited (TWUL) reservoir development proposal: Phase 1 survey of the Ock and Thames catchments

A report for the National Rivers Authority

and

Thames Water Utilities Limited (TWUL)



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THE SOUTH-WEST OXFORDSHIRE RESERVOIR DEVELOPMENT STUDY (SWORDS). Macroinvertebrate study related to Thames Water Utilities Limited (TWUL) reservoir development proposal: Phase 1 survey of the Ock and Thames catchments.

EXECUTIVE SUMMARY

Background

This report describes:

(i) the results of a review of existing biological data held by NRA and Oxfordshire County Records Centre relating to the SWORDS reservoir Study Area and adjacent watercourses
(ii) macroinvertebrate survey work undertaken by Pond Action at 29 sites in the Ock and Thames catchments.

NRA biological monitoring data

NRA data on 5 sites within the reservoir Study Area indicated that water quality was good in the Childrey Brook and moderate to low in the Ginge Brook. At 28 sites outside the Study Area (up to 5km away) NRA data showed that water quality in the Sandford Brook, Marcham Brook, River Ock, River Thames and Ginge Brook was generally good.

Oxfordshire County Records Centre data

A limited amount of data relevant to the SWORDS study was located in Oxford County Records Centre. There was only one recent record of an RDB species in the area of search: a caddis fly, *Leptocerus lusitanicus* (RDB 2), which was reported from Day's Lock (near to SWORDS site T1).

Macroinvertebrate surveys: conservation value and water quality

Invertebrate community conservation value was assessed using the system developed by Pond Action. Of the 15 sites surveyed in the Ock catchment, 1 was of high conservation value (O6 on the Ock), 10 were of moderate conservation value and 4 were of low conservation value. Within the reservoir Study Area, all sites were either of moderate or low conservation value. Of the 14 sites in the Thames catchment, 4 were of high conservation value (T3, T8, T9 and T14), all other sites being of moderate conservation value.

All sites on the Ock and the Thames had good water quality. Within the reservoir Study Area, 3 sites had good water quality and 4 had moderate or low water quality.

Recommendations for further survey work

Phase 2 survey work was recommended for ditches and ponds in the reservoir Study Area, sites on the River Ock and Childrey Brook which might provide suitable habitat for crayfish, additional watercourses outside the Study Area and one site on the Ginge Brook.

TECHNICAL SUMMARY

Background

This report describes the results of:

(i) a review of existing biological data held by NRA and Oxfordshire County Records Centre relating to the SWORDS reservoir Study Area and adjacent watercourses.

(ii) macroinvertebrate survey work undertaken by Pond Action at 29 sites in the Ock and Thames catchments.

NRA biological monitoring data

Biological water quality data was available from the NRA for 5 sites within the reservoir Study Area (Childrey Brook: 1 site, Ginge Brook: 4 sites) and 28 sites on adjacent watercourses.

Within the reservoir Study Area, NRA data indicated that water quality was good in the Childrey Brook and moderate to low in the Ginge Brook. Outside the Study Area (up to 5km away) NRA data showed that sites with good water quality occurred on the Sandford Brook, Marcham Brook, River Ock, River Thames and Ginge Brook. All watercourses within 5km of the reservoir Study Area also included at least one site with moderate to poor water quality **except** the River Ock and Childrey Brook.

Oxfordshire County Records Centre data

A limited amount of data relevant to the SWORDS study was located in Oxford County Records Centre. Distribution data for 17 rare or local macroinvertebrate species were found but none of these referred specifically to the reservoir Study Area. Outside the Study Area, the most significant record was of the Red Data Book caddis fly *Leptocerus lusitanicus* (RDB 2) which was reported from Day's Lock (close to SWORDS site T1).

Macroinvertebrate surveys: sites

Macroinvertebrate communities were surveyed at 29 sites in the Ock and Thames catchments to provide macroinvertebrate conservation data and additional biological water quality data for the Study Area and adjacent watercourses.

Macroinvertebrate communities: conservation value

In the Ock catchment, 1 site was of high conservation value (O6 on the Ock), 10 were of moderate conservation value and 4 sites were of low conservation value. Within the reservoir Study Area all sites (on the Nor Brook, Childrey Brook, Letcombe Brook and Cow Common Brook) were either of moderate or low conservation values.

Regional conservation scores for the Ock catchment were very similar to the national scores so that all sites had identical national and regional conservation bandings.
On the Thames, 4 sites were of high nature conservation value on a national scale (T3

Clifton Bridge, T8 Abingdon Backwaters South, T9 Abingdon Backwaters North and T14 Sandford Lock). All other sites on the Thames were of moderate conservation value. Empty shells of the RDB2 water snail *Gyraulus acronicus* were found at two sites but have not been included in the calculation of conservation scores.

Regional conservation scores were generally similar to National scores. The two main exceptions were T3 and T9 which both had high national conservation scores but only moderate regional scores.

Water quality

All sites on the Ock had good water quality and the Ock also had the second highest BMWP score recorded during the survey (224 at Ock Bridge, Lyford). Within the reservoir Study Area, sites C1 and C2 (Childrey Brook) and CC1 (Cow Common Brook) had good water quality. Sites N1 (Nor Brook), L1 (Letcombe Brook), CC2 and CC3 had moderate or low water quality.

All sites on the Thames had good water quality. The highest BMWP score in the study was recorded on the Thames (230 at Abingdon Weir).

Recommendations for further survey work

Four categories of site were recommended for further survey work.

(i) Ditches and ponds **in the reservoir Study Area,** which preliminary reconnaissance had suggested could be important macroinvertebrate habitats. 7 sites were recommended as high priority for survey.

(ii) Sites on the River Ock and Childrey Brook chosen to provide more information about the distribution of crayfish (*Austropotamobius pallipes*). The sites were **predominantly within the reservoir study area**. 6 sites were recommended as high priority for further survey work. The initial selection of Ock and Childrey sites for Phase 2 survey was also based on the possible occurrence of the rare mayfly *Ephemera lineata* at Site O6 but this identification was not confirmed (see Section 4.2.1).

(iii) Additional watercourses **outside the Study area** which were not included in the initial sampling programme but which could be affected by the reservoir development. 6 sites were recommended as high priority for further survey work.

(iv) One site on the Ginge Brook (**outside the study area**) where the BMWP score from this study was less than that recorded during NRA routine sampling.

THE SOUTH-WEST OXFORDSHIRE RESERVOIR DEVELOPMENT STUDY (SWORDS). Macroinvertebrate study related to Thames Water Utilities Limited (TWUL) reservoir development proposal: Phase 1 survey of the Ock and Thames catchments.

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1. INTRODUCTION

This report describes the results of data reviewing and survey work undertaken for Phase 1 of the SWORDS macroinvertebrate study.

1.1 Objectives of the Study

The objectives of Phase 1 of the study were:

(i) to describe river and stream water quality, as indicated by biological sampling, in the reservoir Study Area and adjacent watercourses using information derived from existing NRA data and from new survey work.

(ii) to assess the nature conservation value of macroinvertebrate communities in the reservoir Study Area and adjacent watercourses using information derived from existing biological data held in the Oxfordshire County Records Centre and from new survey work.

1.2 Structure of the report

The report has two main sections:

(i) A review of biological data relating to the reservoir Study Area and adjacent watercourses. Data for this was available from two sources: biological monitoring carried out by NRA Thames Region staff (the majority of the information) and records of aquatic invertebrates held in the Oxfordshire County Records Centre (See Section 3).

(ii) The results of macroinvertebrate survey work undertaken by Pond Action at 29/6 sites in the Ock and Thames/Ginge catchments (see Section 4).

Recommendations for further invertebrate survey work are given in Section 5.

2. METHODS

2.1. NRA Biological monitoring data

2.1.1 Data included in the review

Biological monitoring data gathered by biologists in NRA Thames Region was reviewed for the rivers and streams inside, or within 5km of, the reservoir Study Area. River Thames monitoring sites in the vicinity of the Study Area were also included (Days Reach to Sandford Reach).

Data from each of these sites was included in the review if it referred to rivers surveyed in 1988 or later, when RIVPACS (River Invertebrates Prediction and Classification System) predictions became generally available in NRA Thames Region.

Biological monitoring data was available from a total of 5 sites inside the reservoir Study Area and from 28 sites on streams or rivers adjacent to the Study Area (see Table 2 and Appendix 1).

2.1.2 Analysis and description of NRA data

In the analysis, all Biological Monitoring Working Party (BMWP) scores and Average Scores per Taxon (ASPT's) were rounded to 1 decimal place. Ecological Quality Indices (see below) were calculated to 2 decimal places.

In the descriptions of water quality data from each site, invertebrate taxa which are awarded either 10 or 8 points in the BMWP system have been described as "pollution sensitive" (ie intolerant of organic pollution). Taxa scoring between 1 and 7 points have been described as relatively tolerant of organic pollution.

The Ecological Quality Index (EQI) based on ASPT's has been used to give a simple impression of the extent of pollution of watercourses. The following terms have been applied to summarise water quality:

(i)	"good":	ASPT Ecological Quality Index is in Class A.
(ii)	"moderate":	ASPT Ecological Quality Index is in Class B.
(iii)	"low":	ASPT Ecological Quality Index is in Class C.
(iv)	"poor":	ASPT Ecological Quality Index is in Class D.

The Ecological Quality Index based on the ASPT is the ratio between measured ASPT and the ASPT predicted by RIVPACS. Ratios close to 1.0 indicate that the measured ASPT is close to the ASPT and that the stream is therefore relatively unpolluted. A brief description of the use of the RIVPACS programme is given in section 2.5.

The following values are used for the Ecological Quality Indices:

CLASS	ASPT EQI RANGE	BMWP EQI RANGE	TAXA EQI RANGE
A	>0.89	>0.75	>0.79
B	0.77-0.88	0.5-0.74	0.58-0.78
C	0.66-0.76	0.25-0.49	0.37-0.57
D	<0.66	<0.25	<0.37

2.2 Biological survey data held at the Oxfordshire County Records Centre

Information on the distribution of rare or uncommon freshwater macro-invertebrate species, held at the Oxfordshire County Records Centre, was reviewed. The search covered all parts of the reservoir Study Area, water courses up to 5km upstream of the Study Area and the reaches of the R.Thames surveyed for this report.

2.3 Selection of survey sites and reconnaissance of further sites for Phase 2 of the study

Two days were spent in the field visiting river, stream, ditch and pond sites, with most effort concentrated within the reservoir Study Area. On the Thames, the towpath was cycled from Days Reach to Sandford to select sites. Sites were selected for their potential to support a wide range of invertebrate habitats (in contrast, standard RIVPACS related survey work is based on sites typical of river reaches).

All 1x1km squares in the reservoir Study Area were visited in order to make a systematic selection of ditch sites for Phase 2 survey. Ditches were generally viewed where they crossed or ran alongside public rights of way. Most pond and other still water sites shown within the reservoir Study Area on the OS 1:25,000 scale map were also visited.

2.4 Macroinvertebrate survey methods

2.4.1 Survey methods

Macroinvertebrates were collected from 35 sites between 9 July 1992 and 4 August 1992 (see Table 1 and Map 1).

Sites were chosen on the basis of their potential to support rich invertebrate communities. Sites were not *primarily* chosen to be typical. Survey methods followed those used by NRA Thames Region for RIVPACS work. At some sites on the Thames where access was difficult, collecting was only carried out on one bank. Three-minute hand-net samples, with a 1 minute search, were collected at each site. These samples were used to calculate BMWP scores and ASPT's.

In addition, at each site, up to 30 minutes was also spent searching for taxa which were not likely to have been collected in the main sample. These additional taxa were included in the calculation of conservation scores.

Samples were sorted for approximately 2hrs in the laboratory. Macroinvertebrate taxa were identified to family level for BMWP scores, and to species level for the following macroinvertebrate groups: flatworms, water snails, bivalves (excluding pea mussels), leeches, shrimps and slaters, stoneflies, mayflies, dragonflies, water bugs, alderflies, caddisflies and water beetles.

2.4.2 Environmental data

Standard RIVPACS environmental data was collected in the field. On the Thames, channel width was measured at bridging points and estimated at other sites from map and field evidence. Except where measureable (Sites T8 and T9) channel depth in the Thames was assumed to be greater than 1.5m. Sediment composition in the Thames was estimated at the channel edge where most collecting was undertaken. RIVPACS map data was extracted by NRA staff and run at the NRA Fobney Mead laboratory. Environmental data used is presented in Appendix 2.

2.5 Data analysis

2.5.1 Water quality data

BMWP scores and ASPT's were calculated for each of the survey sites. Predicted BMWP's and ASPT's were obtained as output from the RIVPACS programme.

2.5.2 River Invertebrates Prediction and Classification System (RIVPACS)

RIVPACS is based on a database derived from surveys of the macroinvertebrates and physical parameters of 268 sites with known good water-quality in 41 catchments in Great Britain. The programme uses the environmental data from an unknown site to predict the likely occurrence of macroinvertebrate taxa at that site (Moss,D et al 1987). From these predictions the BMWP and ASPT can be derived. These predicted BMWP's and ASPT's are for sites with the same physical characteristics as the unknown site but with known good water quality. The predicted BMWP and ASPT can, therefore, be used as a reference against which to estimate the water quality of the unknown site. For further information see Appendix 3.

2.5.3 Comparison of NRA survey data and results from this study

Nine sites of the sites surveyed were chosen to coincide with NRA routine monitoring sites in order to allow comparisons to be drawn between NRA results and the results of this study.

2.5.4 Conservation assessments

The conservation value of macroinvertebrate communities was assessed using the National Conservation Index (NCI) and National Conservation Score (NCS) system developed by Pond Action (for a full explanantion of the calculation of the scores, see Section 2.5.5). This system is used to identify freshwater invertebrate communities which are of high conservation value.

For the SWORDS study most emphasis has been placed on the NCI since this allows sites of different sizes and community types to be compared. The NCI is largely independent of the number of species recorded, and so corrects for biases that would otherwise be introduced by comparing sites supporting different numbers of species.

The NCI/NCS system gives a relatively objective comparison of the conservation value of sites but should only be regarded as an aid to assessing conservation value and not as an absolute measure of conservation value. It should be used in conjunction with all available information.

Pond Action's conservation assessment system is similar to other methods applied to the assessment of invertebrate community conservation value (see Appendix 4 which gives the minutes of a meeting between Pond Action, English Nature (EN) and the Joint Nature Conservation Committee (JNCC) to review the use of a scores and indices in assessing the conservation value of macroinvertebrate communities).

Dr Stuart Ball of JNCC produced the following statement concerning the use of conservation scores and indices, with particular reference to the PA

conservation assessment system and its use in the SWORDS survey.

'The Nature Conservation Review (Ratcliffe, 1977) established a set of criteria for the evaluation of conservation sites which have been widely followed. Of the 10 criteria many relate to the site as a whole (e.g. size, recorded history), whilst a few relate to the species which occur on that site (e.g. diversity, rarity) and can be quantified in relation to lists of species derived from surveys. NCI and NCS represent the best means available at the moment to quantify rarity. Like any of these criteria, they should not be used uncritically or in isolation and it is perfectly possible that a site which is not noted for rarities may be valued highly using other criteria.

'The NCI provides a robust and sensitive way of ranking sites according to the rarity of their fauna relative to other sites sampled in the same way. It is sensitive to differences in sampling, but in this study, samples have been taken in a systematic way according to a standard method, so this problem does not arise. Within such a study it is reasonable to evaluate the rarity of the fauna using the NCI and to establish a set of criteria (such as those used in the SWORDS report) to evaluate the quality of sites based on this. If a new site in the same geographical area and habitat formation was sampled in future in the same way, it would be reasonable to evaluate it using these criteria. It would not, however, be reasonable to suppose that these criteria in any way establish an absolute standard and that, for example, an NCI of ">1.5" would represent a site of "Very high conservation value" in studies of other areas or habitats or using other sampling methods.'

2.5.5 Calculation of the National Conservation Index (NCI) and National Conservation Score (NCS)

The NCI and NCS are calculated in the following way (more detailed information about the derivation is given in Sections (a), (b) and (c)):

i) All species present are given a numerical value depending on their national distribution pattern (see section (a) below).

ii) The values of all the species present are added together to give a National Conservation Score (NCS) (see section (b) below).

iii) The NCS is divided by the number of species present to give the National Conservation Index (NCI) (see Section (c) below).

(a) All species present are given a numerical value depending on their national distribution patterns

Common species are given the value of 1, local species the value of 2 and so on, culminating with the most endangered species (RDB 1) which are given a value of 64. See below for a full list.

Common species	=	1
Local species	=	2
Nationally Notable B	=	4
Nationally Notable A	=	8
Red Data Book 3 (rare)	=	16
Red Data Book 2 (vulnerable)	=	32
Red Data Book 1 (endangered)	=	64

Scores given to individual species are derived mainly from JNCC invertebrate species reviews and Red Data Books.Within this system, a level of discretion is required when interpreting the literature on species distribution. For example, The Atlantic Stream Crayfish (*Austropotamobius pallipes*) is, technically, a local species. However, the species is currently under threat due to a number of factors (see notes on the species in Appendix 7) and is therefore upgraded (for the purposes of calculating NCS and NCI) to Nationally Notable B.

(b) The values of all the species present are totalled to give a National Conservation Score (NCS)

If the communities being compared are of the same type (eg all are on a large lowland river) and individual sites are of the same size (and therefore expected to support similar numbers of species), it would be valid to use the NCS to assess the relative conservation value of the sites.

However, different types of site often differ in the number of species they

support: ditches, ponds and large lowland rivers are all likely have different types of macroinvertebrate community and therefore to support different numbers of species. To make comparisons, therefore, an index must be used which corrects for differences in species numbers.

(c) The NCS is divided by the number of species present to give the NCI

The NCI gives a good comparison between sites of any type. It should also be relatively independent of sampling effort. The NCI is, in effect, a measure of the 'average rarity' of the species recorded.

In sites with low numbers of species the presence of one or two local or notable species can have a large effect on the NCI. For this reason, it is particularly important to be cautious in the interpretation of NCI's of small sites (particularly those with less than 16 species).

NCI's are grouped in the following bands to allow sites to be broadly grouped into one of four categories on a national scale:

CONSERVATION VALUE OF MACROINVERTEBRATE COMMUNITY	**NATIONAL CONSERVATION INDEX**
Very high	>1.5
High	1.20-1.49
Moderate	1.01-1.19
Low	1.00

TABLE 1. SITES SURVEYED BY POND ACTION FOR PHASE 1 OF THE SWORDS MACROINVERTEBRATE STUDY: OCK AND THAMES CATCHMENT

SITE	RIVER	SITE NAME	GRID REF.	DATE SAMPLED
O1	Ock	Ock Bridge, Abingdon	SU487968	9/7/92
O2	Ock	New Cut Mill	SU477962	4/8/92
O3	**Ock**	**Marcham Mill Rd**	**SU456953**	**20/7/92**
O4	Ock	Noah's Ark	SU437962	3/8/92
O5	**Ock**	**Nr College Fm**	**SU420957**	**9/7/92**
O6*	Ock	Ock bridge, road to W. Hanney	SU400956	20/7/92
N1	**Nor**	**Common Barn Rd**	**SU437953**	**22/7/92**
C1*	**Childrey Brook**	**At Mill Rd, Marcham**	**SU456953**	**20/7/92**
C2	**Childrey Brook**	**Common Barn Rd**	**SU437950**	**22/7/92**
C3	Childrey Brook	Gallows bridge	SU408940	22/7/92
L1	**Letcombe Brook**	**At end of track**	**SU424943**	**9/7/92**
L2*	Letcombe Brook	Weir Farm, East Hanney	SU412923	22/7/92
CC1	**Cow Common (ditch).**	**Nr Marcham Mill**	**SU461949**	**3/8/92**
CC2	**Cow Common Brook.**	**Steventon Road**	**SU437931**	**9/7/92**
CC3	**Cow Common Brook.**	**Hutchins copse**	**SU437917**	**9/7/92**
T1*	Thames	Day's Lock	SU569937	3/8/92
T2	Thames	Day's Reach	SU566955	28/7/92
T3	Thames	Clifton Bridge	SU547954	3/8/92
T4	Thames	Long Wittenham	SU540937	3/8/92
T5	Thames	Clifton Reach	SU526942	28/7/92
T6	Thames	Sutton Pools	SU503945	3/8/92
T7	Thames	Culham Reach	SU500955	20/7/92
T8	Thames	Backwaters South	SU502961	20/7/92
T9	Thames	Backwaters North	SU509965	28/7/92
T10*	Thames	Abingdon Weir	SU504972	28/7/92
T11	Thames	Near Lock Wood, Nuneham	SU526970	28/7/92
T12	Thames	Radley	SU538990	20/7/92
T13	Thames	Sandford Reach	SP533003	28/7/92
T14*	Thames	Sandford Lock Cut	SP527022	9/7/92

Key: * Site with NRA data reviewed in Section 3 of this report.
Bold Sites in the SWORDS Study Area.

3. REVIEW OF EXISTING DATA

3.1 NRA Thames Region biological monitoring data: introduction

NRA biological monitoring data was available from 5 sites inside the SWORDS Study Area and was gathered from 28 sites outside the Study Area. These sites are listed in Table 2.

3.2 Sites inside the reservoir Study Area

3.2.1 Introduction

Five sites within the reservoir Study Area have been surveyed once or more by NRA biologists (see Table 2). Only one of these sites (the Childrey Brook at Mill Road, Marcham) is a routine monitoring site. The four others all lie on the Ginge Brook and have been surveyed only once or twice.

3.2.2 Childrey Brook

Description of water quality in the Childrey Brook in the reservoir Study Area

(i) At Mill Rd, Marcham (NRA site POCR.0001)

Water quality data with predictions were available for 9 dates between December 1988 and April 1992. BMWP scores varied between 138 and 206 (average 165.7). Predicted BMWP's varied between 141 and 160 (average 152.2). ASPT's varied between 5.04 and 5.47 (average 5.3) with predicted ASPT's of about 5.3 (average).

Measured BMWP's and ASPT's were close to the predicted values throughout the survey period. The average ASPT EQI was 0.99, indicating that water quality was good at this site.

3.2.2 Ginge Brook

A limited amount of survey data is available about the Ginge Brook in the Study Area with five samples collected between October 1989 and July 1991.

Description of water quality in the Ginge Brook at the sites in the reservoir Study Area

(i) Below Hill Farm, Steventon (NRA site PTHR.9991)

Water quality data with predictions were available only for May 1991, when

the BMWP score was 22 and the predicted BMWP was 98. The ASPT was 3.14, with a predicted ASPT of 4.6.

The BMWP was below one quarter of the predicted value, with the ASPT 32% below the predicted value. No pollution-sensitive taxa were recorded at this site. The average ASPT EQI was 0.68, indicating that water quality was low at this site.

(ii) At Hill Farm (NRA site PTHR.9996)

Water quality data with predictions were available for October 1989 and May 1991. The BMWP scores varied between 26 and 32 (average 29). The predicted BMWP's were 98 and 121 (average 109.5). The ASPT's were 3.25 and 3.56 (average 3.4), with a predicted ASPT of 4.28 (average).

The BMWP's were less than one third of the predicted values, with ASPT's 20% below the predicted values. No pollution-sensitive taxa were recorded. The ASPT EQI was 0.81, indicating that water quality was moderate at this site.

(iii) Above Hill Farm (NRA site PHTR.9995)

Water quality data with predictions were available for June 1991. The BMWP score was 61, with a predicted BMWP of 111. The ASPT was 4.4, with a predicted ASPT of 5.

The BMWP score was about half the predicted value, with an ASPT 13% below the predicted value. One pollution-sensitive taxon was recorded from the site. The ASPT EQI was 0.87, indicating that water quality was good at this site.

(iv) At Woods Farm (NRA site PTHR.9988)

Water quality data with predictions were available for July 1991. The BMWP score was 56 with a predicted BMWP was 113. The ASPT was 4.0, with a predicted ASPT of 5.1.

The BMWP was less than half the predicted value, with an ASPT figure 22% below the predicted value. One pollution-sensitive taxon was recorded. The ASPT EQI was 0.78, indicating that water quality was moderate at this site.

3.3 Sites outside the reservoir Study Area

3.3.1 Introduction

Most sites for which NRA Thames Region has biological survey data lie outside the reservoir Study Area. Data is available from eleven named watercourses (see Table 2).

3.3.2 Sandford Brook

Most of the Sandford Brook lies within 5km of the reservoir Study Area and NRA data was available for seven sites in this area. Note that data from several sites was collected during a student project.

Detailed descriptions of individual sites

(i) Sandford Brook at A415, Marcham (NRA site POCR.0018)

Water quality data with predictions were available for 10 dates between April 1990 and April 1992. BMWP scores varied between 33 and 70 (average 54.3). Predicted BMWP's varied between 124 and 140 (average 133.1). ASPT's varied between 3.3 and 4.25 (average 3.9) with a predicted ASPT of about 5 (average 4.9).

BMWP's were always less than half the predicted value, with ASPT's up to 35% below the predicted value. No pollution-sensitive taxa were recorded at this site. The average ASPT EQI was 0.78, indicating that water quality was moderate at this site.

(ii) Sandford Brook at Shippon Road (NRA site POCR.9995)

Water quality data with predictions were available for 3 dates between August 1990 and February 1992. BMWP scores varied between 37 and 52 (average 43). Predicted BMWP's were all 134. ASPT's varied between 3.7 and 4 (average 3.8) with a predicted ASPT about 5.0.

BMWP's were consistently less than half the predicted value, with ASPT's up to 26% below the predicted value. No pollution-sensitive taxa were recorded at this site. The average ASPT EQI was 0.76, indicating that water quality was low at this site.

(iii) Sandford Brook at Gozzards Ford (NRA site POCR.0039).

Water quality data with predictions were available for 4 dates between April 1990 and February 1992. BMWP scores varied between 28-54 (average 41.3). Predicted BMWP's varied between 127 and 136 (average 133.7). ASPT's varied between 3.1 and 3.89 (average 3.6) with a predicted

ASPT of about 5 (average 5.0).

BMWP's were always less than half the predicted value, with ASPT's up to 38% below the predicted value.One pollution-sensitive taxon was recorded at this site. The average ASPT EQI was 0.72, indicating that water quality was low at this site.

(iv) Sandford Brook above Gozzards Ford (NRA site POCR.9996)

Water quality data with predictions were available for 4 dates between August 1990 and February 1991. BMWP scores varied between 48 and 92 (average 71.6). Predicted BMWP's were all 130. ASPT's varied between 4.4 and 5.8 (average 5.0) with a predicted ASPT of exactly 5.0.

BMWP's were about half the predicted value, with ASPT's close to the predicted value. Several pollution-sensitive taxa were recorded at the site. The average ASPT EQI was 1.01, indicating that water quality was good at this site.

(v) Sandford Brook at Cothill Bridge (NRA site POCR.0040)

Water quality data with predictions were available for 4 dates between April 1990 and February 1991. BMWP scores varied between 51 and 120 (average 80.5). Predicted BMWP's varied between 128 and 142 (average 134). ASPT's varied between 5.1 and 5.5 (average 5.2) with a predicted ASPT of about 5 (average 5.1).

BMWP's were generally a little over half the predicted BMWP (although on one date the measured BMWP equalled the predicted value). ASPT's were close to the predicted values. A range of pollution-sensitive taxa was recorded at the site. The average ASPT EQI was 1.02, indicating that water quality was good at this site.

(vi) Sandford Brook at Dry Sandford (NRA site POCR.9997)

Water quality data with predictions were available for dates between August 1990 and February 1991. BMWP scores varied between 57 and 73 (average 63). Predicted BMWP's were all 143. ASPT's varied between 4.8 and 5.4 (average 5.1) with a predicted ASPT of 5.3.

BMWP's were always less than half the predicted value, but ASPT's within 10% of the predicted values. Some pollution-sensitive taxa were present at the site. The average ASPT EQI was 0.96, indicating that water quality was good at this site.

(vii) Sandford Brook at Sandleigh (NRA site POCR. 9999)

Water quality data with predictions were available for dates between August 1990 and February 1991. BMWP scores varied between 37 and 48 (average 43.3). Predicted BMWP's were all 136. ASPT's varied between 3.7 and 4.4 (average 4.1) with a predicted ASPT of 5.4.

BMWP's were always less than half the predicted value, with ASPT's up to 35% below the predicted value. Only one pollution-sensitive taxon was recorded. The average ASPT EQI was 0.75, indicating that water quality was low at this site.

3.3.3 Marcham Brook

Data was available for two sites on the Marcham Brook. Mill Road (POCR.0011) has good water quality and was one of the sites with the highest EQI's in the data set. The Fyfield site had low to poor water quality and was one of the most impoverished sites in the NRA data set.

Detailed descriptions of individual sites

(i) At Mill Rd, Marcham (NRA site POCR.0011)

Water quality data with predictions were available for 3 dates between June 1991 and April 1992 (BMWP's and ASPT's from April 1990 are also listed in Appendix 1). BMWP scores varied between 154 and 163 (average 158). Predicted BMWP's were all 139. ASPT's varied between 4.97 and 5.41 (average 5.2) with a predicted ASPT of 5.

BMWP's and ASPT's were close to the predicted values. A wide range of pollution sensitive taxa was recorded at the site. The average ASPT EQI was 1.04, indicating that water quality was good at this site.

(ii) At Fyfield (NRA site POCR.0010)

Water quality data with predictions were available only for June 1990. The BMWP score was 12, with a predicted BMWP of 129. The ASPT was 3, with a predicted ASPT of 4.9.

The BMWP was less than 10% of the predicted value, with an ASPT score 40% below the predicted value. An extremely impoverished fauna was recorded. The average ASPT EQI was 0.60, indicating that water quality was poor at this site.

3.3.4 Bagpuize Brook

(i) At Swanny Brook (NRA site POCR.0033)

Water quality data with predictions were available for only one date in April 1992. BMWP's and ASPT's were available from two other dates since May 1990. BMWP scores varied between 12 and 39 (average 29.6) with ASPT's of 2.4 to 3.8.The predicted BMWP and ASPT were 93 and 4.6 respectively.

The average BMWP was less than half the predicted value, with average ASPT 17% below the predicted value. No pollution-sensitive taxa were recorded at the site. The average ASPT EQI was 0.83, indicating that water quality was moderate at this site.

3.3.5 River Ock

The two sites on the Ock for which data was available had the highest average ASPT's of the sites reviewed. Water quality was good at both sites.

Detailed descriptions of individual sites

(i) At Abingdon Common (NRA site POCR.0014)

Water quality data with predictions were available for 9 dates between September 1988 and April 1992. BMWP scores varied between 124 and 197 (average 156.6). Predicted BMWP's varied between 106 and 178 (average 159.8). ASPT's varied between 5.3 and 5.6 (average 5.5) with a predicted ASPT between 4.8 and 5.23 (average 5.2).

Several BMWP's exceeded their predicted values, with ASPT's close to predicted values. The site supported a wide range of pollution-sensitive taxa. The average ASPT EQI was 1.04, indicating that water quality was good at this site.

(ii) At Ock Bridge, Lyford (NRA site POCR.0017)

Water quality data with predictions were available for 9 dates between September 1988 and June 1992. BMWP scores varied from 158 to 193 (average 158). Predicted BMWP's varied between 99 and 160 (average 152.5). ASPT's varied between 5.3 and 5.6 (average 5.5) with predicted ASPT's between 4.7 and 5.24 (average 5.1).

BMWP's and ASPT's mostly exceeded their predicted values.The site supported a wide range of pollution-sensitive taxa and had the highest average ASPT of the sites for which data was available. The average ASPT EQI was 1.05, indicating that water quality was good at this site.

3.3.6 Woodhill Brook

Detailed descriptions of individual sites

(i) North of E.Challow (NRA site POCR.0034)

Water quality data with predictions were available for 5 dates between February 1990 and June 1992. BMWP scores varied from 12 to 36 (average 23). Predicted BMWP's varied between 86 and 123 (average 109). ASPT's varied between 2.4 and 3.6 (average 3.1) with a predicted ASPT's between 4.5 and 4.96 (average 4.8).

This site had the lowest average BMWP and ASPT of the sites reviewed here.The BMWP's were always less than half the predicted value, with ASPT scores up to 52% below the predicted value. The absence of pollution sensitive taxa, with an average ASPT EQI of 0.64, indicates that water quality was poor at this site.

3.3.7 Letcombe Brook

Detailed descriptions of individual sites

(i) Weir Farm, East Hanney (NRA site POCR.0006)

Water quality data with predictions was available for 9 dates between October 1988 and June 1992. BMWP scores varied from 42 to 80 (average 66.1). Predicted BMWP's varied between 144 and 149 (average 147.3). ASPT's varied between 3.8 and 4.5 (average 4.1) with a predicted ASPT between 5.0 and 5.3 (average 5.2).

BMWP's were almost always less than half the predicted value, with ASPT's up to 28% below the predicted value. Pollution sensitive-taxa were occasionally recorded at this site. The average ASPT EQI was 0.78, indicating that water quality was moderate at this site.

(ii) Above Wantage STW (NRA site POCR.0008)

Water quality data with full predictions were available for 3 dates between October 1988 and January 1991. BMWP scores varied from 58 to 86 (average 67.3). Predicted BMWP's were all 142. ASPT's varied between 4.1 and 4.3 (average 4.12) with a predicted ASPT of 5.4 .

BMWP's were usually about half the predicted value, with ASPT's up to 23% below the predicted value. One pollution-sensitive taxon was recorded at this site. The average ASPT EQI was 0.79, indicating that water quality was moderate at this site.

(iii) 50m below Dairy depot (NRA site POCR.9994)

Water quality data with predictions was available only for April 1991. The BMWP score was 48 with a predicted BMWP of 114. The ASPT was 3.7 with a predicted ASPT of 5.2.

The BMWP was less than half the predicted value, with an ASPT score 29% below the predicted value. No pollution-sensitive taxa were recorded at the site. The ASPT EQI was 0.71, indicating that water quality was low at this site.

(iv) 100m above Dairy depot (NRA site POCR.9993)

Water quality data with predictions were available only for April 1991. The BMWP score was 47 with a predicted BMWP of 111. The ASPT was 3.6 with a predicted ASPT of 5.1.

The BMWP was less than half the predicted value, with an ASPT score 29% below the predicted value. No pollution-sensitive taxa were recorded at this site. The ASPT EQI was 0.71, indicating that water quality was low at this site.

3.3.8 River Thames

Detailed descriptions of individual sites

(i) At Day's Lock (NRA site PTHR.0083)

Water quality data with predictions were available for dates in May 1989 and November 1992. BMWP scores were 145 and 180 (average 162.5). Predicted BMWP's were both 183. ASPT's 5 and 5.45 (average 5.2) with a predicted ASPT of 5.73 on both dates.

BMWP's were close to the predicted values, with ASPT's up to 18% below the predicted values. The average ASPT EQI was 0.92, indicating that water quality was good at this site.

(ii) At Abingdon Weir (NRA site PTHR.0077)

Water quality data with full predictions were available for three dates between June 1988 and June 1990. BMWP scores varied from 134 to 149 (average 141.6). Predicted BMWP's varied between 170 and 182 (average 178). ASPT's varied between 4.8 and 5.1 (average 4.9) with a predicted ASPT's between 5.6 and 5.8 (average 5.7).

BMWP's were about three quarters of the predicted values, with ASPT's up to 18% below the predicted value. The average ASPT EQI was 0.86,

indicating that water quality was moderate at this site.

(iii) At Top of Sandford Lock Cut (NRA site PTHR.0109)

Water quality data with predictions were available for 9 dates between June 1988 and May 1992. BMWP scores varied from 143 to 187 (average 168.1). Predicted BMWP's varied between 170 and 185 (average 179.9). ASPT's varied between 5 and 5.52 (average 5.19) with predicted ASPT's between 5.4 and 5.8 (average 5.6).

This site had the highest average BMWP score of the NRA sites. BMWP's were close to the predicted values, although ASPT's were always slightly below the predicted value. The average ASPT EQI was 0.93, indicating that water quality was good at this site.

3.3.9 Ginge Brook

Detailed descriptions of individual sites

(i) At B4016 Sutton Courtenay (NRA site PTHR.0029)

Water quality data with predictions were available for 9 dates between July 1988 and May 1992. BMWP scores varied from 51 to 134 (average 95.2). Predicted BMWP's varied between 99 and 138 (average 133). ASPT's varied between 4 and 5.6 (average 5.0) with predicted ASPT's between 4.7 and 5.1 (average 5.0).

BMWP's were about three quarters of the predicted values, with ASPT's up to 27% below the predicted value. The average ASPT EQI was 0.92, indicating that water quality was good at this site.

(ii) Below Drayton Waste Disposal Site (NRA site PHTR.0106)

Water quality data with predictions were available only for October 1989. The BMWP score was 93 with a predicted BMWP of 137. The ASPT was 4.9, with a predicted ASPT of 5.0.

The BMWP was about three quarters of the predicted value, but the ASPT was close to the the predicted value. Pollution sensitive taxa were recorded at the site. The average ASPT EQI was 0.97, indicating that water quality was good at this site.

(iii) Meadow Brook Farm, Steventon (PTHR.9990)

Water quality data with predictions were available for June 1991. The BMWP score was 37 with a predicted BMWP of 108. The ASPT was 3.4, with a predicted ASPT of 4.0.

The BMWP was below half of the predicted value, with the ASPT figure 31% below the predicted value. No pollution-sensitive taxa were recorded at the site. The ASPT EQI was 0.69, indicating that water quality was low at this site at the time of survey.

(iv) 100m below Clearwater Fish Farm (PTHR.0027)

Water quality data with predictions were available for July 1991. The BMWP score was 37 with a predicted BMWP of 104. The ASPT was 3.4, with a predicted ASPT of 4.9.

The BMWP was less than half the predicted value, with the ASPT 31% below the predicted value. No pollution-sensitive taxa were recorded at this site. The ASPT EQI was 0.69, indicating that water quality was low at this site at the time of survey.

(v) At Ludbridge on A417 East Hendred (PTHR.0031)

Water quality data with predictions were available for July 1991. The BMWP score was 120 with a predicted BMWP of 105. The ASPT was 4.6, with a predicted ASPT of 4.9.

The BMWP score was above the predicted value, with the ASPT close to the predicted value. Pollution-sensitive taxa were recorded. The ASPT EQI was 0.94, indicating that water quality was good at this site.

(vi) At church, West Hendred (PTHR.0030)

Water quality data with predictions were available for 9 dates between July 1988 and May 1992. BMWP scores varied from 72 to 104 (average 89.9). Predicted BMWP's varied between 130 and 185 (average 166.7). ASPT's varied between 4.5 and 5.21 (average 4.9) with predicted ASPT's between 4.9 and 5.7 (average 5.4).

BMWP's were mostly about half the predicted values, with ASPT's up to 10% below the predicted values. A range of pollution-sensitive taxa was recorded at the site. The average ASPT EQI was 0.91, indicating that water quality was good at this site.

3.3.10 Odhay Hill ditches

Detailed descriptions of individual sites

(i) Ditches Above Ginge Brook (NRA site PTHR.0152)

Water quality data with predictions were available for 2 dates in June and September 1991. BMWP scores varied from 31 and 35 (average 33). Predicted BMWP's were both 128. ASPT's varied between 3.4 and 3.9

(average 3.7) with a predicted ASPT of about 4.9.

The BMWP was less than half the predicted value, with an ASPT's 30% below the predicted values. No pollution-sensitive taxa were recorded. Assuming that this is a running water site, the average ASPT EQI of 0.75 indicates that water quality was low at this site.

3.4 Data held in the Oxfordshire County Records Centre, Woodstock

Records for 17 species, of which 10 were dragonflies, were held in the Oxfordshire County Records Centre. Records date from pre-1906, just over 50% referring to 1970 and later (see Appendix 5).

Only one RDB species was recorded post-1970 (see Appendix 2). This was the caddis fly *Leptocerus lusitanicus* (RDB2) which was recorded at Day's Lock on the Thames (SWORDS site T1).

There was one record of the Downy Emerald dragonfly (*Cordulia aenea*), which is Nationally Notable B: near Frilford, north of the reservoir Study Area.

Most records were for the three riverine dragonflies, the Banded Demoiselle (*Calopteryx splendens*), the White-legged Damselfly (*Platycnemis pennipes*) and the Club-tailed Dragonfly (*Gomphus vulgatissimus*). Of these, the Club-tailed Dragonfly was most notable, but records all referred to the Thames in the Standlake area, at the edge of the area of search and 5km from the reservoir Study Area. Most records for the local White-legged Damselfly also referred to the edge of the area of search, north-west of the reservoir Study Area.

Records of stoneflies, water bugs and water beetles were all pre-1970 (see Appendix 5).

TABLE 2. SUMMARY OF NRA MACROINVERTEBRATE BIOLOGICAL MONITORING DATA FOR SITES IN THE SWORDS STUDY AREA AND ON ADJACENT WATERCOURSES

RIVER	NRA SITE NUMBER	SWORDS NUMBER	SITE NAME	BMWP	Pred. BMWP	BMWP EQI	ASPT	Pred. ASPT	ASPT EQI	No. of surveys	No. of years
Sandford Brook	POCR.0018	-	At A415, Marcham	54	133	0.36	3.92	4.94	0.78	10	3
	POCR.9995	-	At Shippon Road	43	134	0.32	3.80	5.00	0.76	3	2
	POCR.0039	-	At Gozzards Ford	41	134	0.31	3.64	5.03	0.72	4	2
	POCR.9996	-	Above Gozzards Ford	72	130	0.55	5.04	5.00	1.01	3	2
	POCR.0040	-	At Cothill Bridge	81	134	0.60	5.21	5.10	1.02	4	2
	POCR.9997	-	At Dry Sandford	63	143	0.44	5.11	5.30	0.96	3	2
	POCR.9999	-	At Sandleigh	43	136	0.32	4.05	5.37	0.75	3	2
Marcham Brook	POCR.0011	-	At Mill Rd, Marcham	160	139	1.14	5.22	5.00	1.04	7	3
	POCR.0010	-	At Fyfield	12	129	0.09	3.00	4.99	0.60	1	1
Bagpuize Brook	POCR.0033	-	At Swanny Brook	30	93	0.41	3.25	4.60	0.83	3	1
River Ock	POCR.0014	O2	At Abingdon Common	157	160	0.99	5.35	5.15	1.04	9	5
	POCR.0017	O6	At Ock Bridge, Lyford	179	153	1.21	5.45	5.17	1.05	9	5
Childrey Brook	**POCR.0001**	**C1**	**At Mill Rd, Marcham**	**166**	**152**	**1.09**	**5.25**	**5.29**	**0.99**	**9**	**5**
Woodhill Brook	POCR.0034	-	North of E.Challow	23	109	0.23	3.11	4.84	0.64	5	3
Letcombe Brook	POCR.0036	L2	Weir Farm, East Hanney	66	147	0.45	4.06	5.20	0.78	9	5
	POCR.0008	-	Above Wantage STW	67	145	0.47	4.13	5.22	0.79	3	4
	POCR.9994	-	50m below dairy Depot	48	114	0.42	3.69	5.20	0.71	1	1
	POCR.9993	-	100m above Dairy Depot	47	111	0.42	3.62	5.1	0.71	1	1

Sites in **bold** are in the SWORDS Study Area

TABLE 2. **SUMMARY OF NRA MACROINVERTEBRATE BIOLOGICAL MONITORING DATA FOR SITES IN THE SWORDS STUDY AREA AND ON ADJACENT WATERCOURSES (continued)**

RIVER	NRA SITE NUMBER	SWORDS NUMBER	SITE NAME	BMWP	Pred. BMWP	BMWP EQI	ASPT	Pred. ASPT	ASPT EQI	No. of surveys	No. of years
River Thames	PTHR.0083	T1	At Day's Lock	163	183	0.89	5.23	5.73	0.92	2	2
	PTHR.0077	T10	At Abingdon Weir	142	178	0.80	4.89	5.72	0.86	3	3
	PTHR.0109	T14	At top of Sandford Lock Cut	168	180	0.94	5.20	5.60	0.93	9	5
Ginge Brook	PTHR.0029	G1	At B4016 Sutton Courtenay	95	133	0.72	4.62	5.02	0.92	9	5
	PTHR.0106	-	Below Drayton Waste Disposal Site.	93	137	0.68	4.89	5.03	0.97	1	1
	PTHR.9990	-	Meadow Brook Farm, Steventon	37	108	0.34	3.36	4.90	0.69	1	1
	PTHR.9991	**-**	**Below Hill Farm, Steventon**	**22**	**98**	**0.22**	**3.14**	**4.60**	**0.68**	**1**	**1**
	PTHR.9996	**-**	**At Hill Farm, Steventon**	**29**	**110**	**0.27**	**3.41**	**4.28**	**0.81**	**2**	**3**
	PTHR.9995	**-**	**Above Hill Farm, Steventon**	**61**	**111**	**0.55**	**4.36**	**5.00**	**0.87**	**1**	**1**
	PTHR.9988	**-**	**At Wood's Farm**	**56**	**113**	**0.50**	**4.00**	**5.10**	**0.78**	**1**	**1**
	PTHR.0027	-	Below Clearwater Fish Farm	37	104	0.36	3.36	4.90	0.69	1	1
	PTHR.0031	-	At Lud Bridge on A417, E. Hendred	120	105	1.14	4.62	4.90	0.94	1	1
	PTHR.0030	G6	At church, West Hendred	90	167	0.56	4.92	5.43	0.91	9	5
Odhay Hill	PTHR.0152	-	Ditches Above Ginge Brook	38	128	0.26	3.68	4.90	0.75	6	2

Sites in **bold** are in the SWORDS Study Area

4. MACROINVERTEBRATE SURVEY RESULTS

4.1 Introduction

This section summarises the results of macroinvertebrate surveys from the Ock catchment and the R Thames, and gives descriptions of the invertebrate communities recorded from each site. Aquatic macroinvertebrates recorded during the survey are presented in Appendix 6 and notes on the distributions of rare or local species are presented in Appendix 7.

The locations of survey sites are shown on Map 1 and photographs of the sites in Appendix 8. Table 3 and Map 1 summarise the conservation scores and the water quality data for all sites.

4.2 Overview of the results of macroinvertebrate surveys within the Ock catchment and the River Thames

4.2.1 The Ock Catchment

During the course of the SWORDS survey 128 species of aquatic macro-invertebrates were recorded from the Ock Catchment. Species numbers in individual sites varied from 5 (CC3) to 62 (O5). In general, species numbers increased from the south-west to the north-east of the catchment. i.e. the number of species recorded increased with increasing permanence of water and discharge. The R. Ock had consistently more macroinvertebrate species per site than any of its tributaries, with the exception of the Childrey in its lower reaches.

The increasing total number of species of macroinvertebrates in the Ock catchment was parallelled by an increasing proportion of species of snail and caddis-fly species in the samples and a decreasing proportion of beetle species.

Conservation Value

National Conservation Indices (NCI's) of the communities at Ock catchment sites varied from 1.00 (low) to 1.20 (high) at O6 (Ock Bridge, road to West Hanney). 4 of the Ock catchment sites had low, 10 moderate and 1 high NCI's. There was no apparent trend for the NCI's to increase with increasing discharge.

8 local, 9 Nationally Notable B, and one Schedule 5 species were recorded from the catchment (Appendix 7 gives national distribution patterns of these species). In addition, a mayfly initially believed to be the rare *Ephemera lineata* was recorded at Site O6 (Ock Bridge). Although closely resembling specimens of this species collected by J. Biggs in 1987[1] in the Thames (see Bratton, 1990),

[1] *Ephemera lineata* specimens collected from the Thames in 1987 were confirmed by IFE staff.

staff at the Institute of Freshwater Ecology River Laboratory concluded that the Ock specimen was an unusually marked individual of the common species *Ephemera danica* (J. Wright, pers. comm.).

The national NCI scores from each of the sampling sites in the Ock catchment are summarised on Map 1. National and regional scores are given in Table 3.
Water Quality

BMWP scores for the catchment varied from 19 (CC3) to 224 (O6). The BMWP Ecological Quality Index (EQI) varied between 0.2 (CC3) and 2.2 (O6). Within the two smaller Ock tributaries (the Cow Common Brook and the Childrey) the BMWP and BMWP EQI appears to be directly related to the discharge. Within the Letcombe and the Ock no such relationship is apparent. The Ock itself had consistently higher values of BMWP and BMWP EQI than any of its tributaries with the exception of the Childrey at Marcham Mill, near its confluence with the Ock.

ASPT values for the sites varied from 3.2 (CC3) to 5.9 (O3) and ASPT EQI's from 0.68 (CC3) to 1.23 (03). ASPT's and ASPT EQI's showed the same within-river and within-catchment trends as the BMWP's and BMWP EQI's.

Of the sites within the catchment, 1 (CC3) had low, 4 had moderate and 10 had good water quality as suggested by the ASPT EQI's.

The water quality of each of the sampling sites in the Ock catchment is summarised in terms of its water quality class on Map 1 (see also Methods Section 2)

4.2.2 The Thames

During the course of the SWORDS survey 144 species of aquatic macroinvertebrates were recorded from the River Thames. Species numbers in individual sites varied from 27 (T5 - Clifton Reach) to 78 (T14 - Sandford). The number of species recorded from Sandford was particularly high, being 20% greater than for any other site in the SWORDS survey. In general, species numbers decreased from the upper to the lower sections of the river, this decrease being significant at the 0.05% level (Spearman's Rank Correlation).

Conservation Value

National Conservation Indices (NCI's) of the communities of the sites varied from 1.04 at T5 (Clifton Reach) to 1.30 at T3 (Clifton Bridge). 11 of the sites had moderate and 3 had high NCI's. There is no apparent trend for the NCI's to increase with distance downstream. The NCI's were more consistent than those of the Ock catchment or the Ginge with no low NCI's and no very high NCI's.

14 local, 5 Nationally Notable B and 1 Nationally Notable A species were recorded from the Thames.

The NCI's from each of the sampling sites on the Thames are summarised on Map 1. National and regional conservation scores are given in Table 3.

Water Quality

BMWP scores for the Thames varied from 113 at T5 (Clifton Reach) to 230 at T10 (Abingdon Weir). The BMWP EQI varied between 0.9 and 1.8 at the same stations, respectively. There was no significant correlation between BMWP and distance downstream, though there was a significant decrease in BMWP EQI with distance downstream ($p<0.05$).

ASPT values for the sites varied from 4.7 at T5 (Clifton Reach) to 5.6 at T6 (Sutton Pools). ASPT EQI's vary from 0.94 at T5 (Clifton Reach) to 1.12 at T6 (Sutton Pools). Both ASPT and ASPT EQI show a significant decrease with distance downstream ($p<0.02$).

All the Thames sites had good water quality as suggested by their ASPT EQI's.

The water quality of each of the sampling sites on the Thames is summarised in terms of its water quality class on Map 1 (see also Methods Section 2).

4.3 Descriptions of invertebrate communities within the reservoir Study Area

4.3.1 River Ock, Marcham Mill Rd (Site O3)

The Ock at Marcham Mill supported a diverse community for this river (61 species), with a moderate National Conservation Index (1.08). 5 local species were recorded.

The BMWP and ASPT scores were 214 and 5.94 respectively. Both values were outside (higher than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT score for this section was the highest recorded during the SWORDS survey. The ASPT EQI was 1.24, also the highest recorded during the SWORDS survey, indicating that the water quality was good at this site.

4.3.2 River Ock near College Farm (O5)

The Ock near College Farm supported th second most diverse community for this river (67 species), with a moderate National Conservation Index (1.08). 5 local species were recorded.

The BMWP and ASPT scores were 206 and 5.4 respectively. Both values were outside (higher than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI was 1.17, indicating that the water quality was good at this site.

4.3.3 Nor Brook at Common Barn Rd (N1)

The Nor Brook at Common Barn Road supported a restricted number of macroinvertebrates (29 species) with a moderate National Conservation Index (1.10). One Nationally Notable B species and no local species were recorded. The poor diversity of the fauna presumably reflected the small size of the brook.

The BMWP and ASPT scores were 55 and 3.9 respectively. Both values were outside (lower than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI was 0.83, indicating that the water quality was moderate at this site.

4.3.4 Childrey Brook at Marcham Mill (C1)

The Childrey Brook at Marcham Mill supported a diverse community of macroinvertebrates for this river (57 species), and this was comparable with sites on the Ock and the Thames. This section had a moderate National Conservation Index (1.05) and 3 local species.

The BMWP and ASPT scores were 193 and 5.3 respectively. Both values were outside (higher than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI was 1.15, indicating that the water quality was good at this site.

4.3.5 Childrey Brook at Common Barn Rd (C2)

The Childrey Brook at Common Barn Road supported a moderate number of macroinvertebrates for this river (44 species). This section had a moderate National Conservation Index (1.07), one Nationally Notable B and no local species.

The BMWP and ASPT scores were 114 and 4.8 respectively. Both values were within the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI was 1.04, indicating that the water quality was good at this site.

4.3.6 Letcombe Brook at end of track (L1)

The Letcombe Brook (at end of track) supported a low number of macroinvertebrates for this river (27 species). This was one of the lowest numbers of species recorded during the SWORDS survey and did not compare favourably with other sites of similar size This section had a low National Conservation Index (1.00), and no local species.

The BMWP and ASPT scores were 75 and 4.0 respectively. The BMWP score was within the confidence limits of the predicted score for the summer season. The ASPT was outside (lower than) the confidence limits of the predicted ASPT for the summer season.The ASPT EQI was 0.87, indicating that the water quality was moderate at this site.

4.3.7 Cow Common ditch near Marcham Mill (CC1)

The Cow Common ditch near Marcham Mill supported a high number of macroinvertebrates for this watercourse (35 species), a reasonable number considering the size of the section. This section had a low National Conservation Index (1.00) and no local species.

The BMWP and ASPT scores were 98 and 4.3 respectively. Both values were within the confidence limits of the predicted BMWP and ASPT for the summer season.The ASPT EQI was 0.98, indicating that the water quality was good at this site.

4.3.8 Cow Common Brook at Steventon Road (CC2)

The Cow Common ditch at Steventon Road supported a moderate number of macroinvertebrates for this watercourse (21 species). This section had a moderate National Conservation Index (1.14) with one Nationally Notable B and no local species.

The BMWP and ASPT scores were 43 and 3.9 respectively. The BMWP score was outside (lower than) the confidence limits of the predicted score for the summer season. The ASPT was within the confidence limits of the predicted ASPT for the summer season.The ASPT EQI was 0.87, indicating that the water quality was moderate at this site.

4.3.8 Cow Common Brook at Hutchinsons Copse (CC3)

The Cow Common ditch at Hutchinsons Copse supported a low number of macroinvertebrates for this watercourse (5 species). This section had a low National Conservation Index (1.00) with no local species. The restricted number of macroinvertebrates was presumably due to the small amount of water in the ditch at the time of survey.

The BMWP and ASPT scores were 19 and 3.2 respectively. Both values were outside (lower than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI was 0.68, suggesting that the water quality was low at this site.

Note, due to the low average depth of the site, RIVPACS could not predict the fauna of the site with any certainty. Assumptions of low water quality based on the ASPT EQI should therefore be treated with caution.

4.4 Descriptions of sites outside the reservoir Study Area

4.4.1 River Ock at Ock Bridge, Abingdon (O1)

The Ock at Ock Bridge, Abingdon supported a relatively low number of macroinvertebrate species for this river (53 species), with a moderate National Conservation Index (1.08). 4 local species were recorded.

The BMWP and ASPT scores were 177 and 5.2 respectively. The BMWP score was outside (higher than) the confidence limits of the predicted score for the summer season. The ASPT was within the confidence limits of the predicted ASPT for the summer season. The ASPT EQI score for this section was 1.06, indicating that the water quality was good at this site.

4.4.2 River Ock at New Cut Mill (O2)

The Ock at New Cut Mill supported the lowest number of macroinvertebrate species for this river (52 species), with a moderate National Conservation Index (1.10). 2 local species and one Schedule 5 species were recorded.

The BMWP and ASPT scores were 156 and 5.0 respectively. The BMWP score was outside (higher than) the confidence limits of the predicted score for the summer season. The ASPT was within the confidence limits of the predicted ASPT for the summer season. The ASPT EQI for this section was 1.02, indicating that the water quality was good at this site.

4.4.3 River Ock at Noah's Ark (O4)

The Ock at Noah's Ark supported a high number of macroinvertebrate species for this river (61 species), with a moderate National Conservation Index (1.15). 2 Nationally Notable B and 3 local species were recorded.

The BMWP and ASPT scores were 172 and 5.4 respectively. Both values were outside (higher than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI for this section was 1.15, indicating that the water quality was good at this site.

4.4.4 River Ock at Ock bridge, road to W.Hanney (O6)

The Ock at Ock Bridge, road to West Hanney supported a moderate number of macroinvertebrate species for this river (55 species), with a high National Conservation Index (1.20). 3 Nationally Notable B, 2 local species and one Schedule 5 species were recorded.

The BMWP and ASPT scores were 172 and 5.4 respectively. Both values were outside (higher than) the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI for this section was 1.21, indicating that the water quality was good at this site.

4.4.5 Childrey Brook at Gallows bridge (C3)

The Childrey Brook at Gallows Bridge supported the lowest number of species for this water course (30), with a low National Conservation Index (1.00). No local species were recorded.

The BMWP and ASPT scores were 89 and 4.7 respectively. Both values were inside the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI for this section was 1.07, indicating that the water quality was good at this site.

4.4.6 Letcombe Brook at Weir Farm, E. Hanney (L2)

The Letcombe Brook at Weir Farm, East Hanney supported the highest number of species for this water course (32), with a moderate National Conservation Index (1.03). One local species was recorded. Considering the size of the river and that it had recently flowed over a weir, the number of species is very low.

The BMWP and ASPT scores were 95 and 4.1 respectively. Both values were inside the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI for this section was 0.87, indicating that the water quality was moderate at this site.

4.4.7 River Thames at Day's Lock (T1)

This site supported a community of relatively low diversity for the Thames (44 species recorded). The conservation value of the community was moderate (National Conservation Index 1.07). 3 local species were recorded.

The BMWP and ASPT scores were 125 and 5.0 respectively. Both values were within the confidence limits of the predicted BMWP and ASPT for the summer season.The ASPT EQI was 1.00, indicating that water quality was good at this site.

4.4.8 River Thames at Days reach (T2)

This site supported a community of relatively low diversity for the Thames (44 species recorded). The conservation value of the community was moderate (National Conservation Index 1.14). One Nationally Notable B species and 3 local species were recorded.

The BMWP and ASPT scores were 131 and 5.0 respectively. Both values were within the confidence limits of the predicted BMWP and ASPT for the summer season.The ASPT EQI was 1.00, indicating that water quality was good at this site.

4.4.9 River Thames at Clifton Bridge (T3)

This site supported a community of relatively low diversity for the Thames (44 species recorded). The conservation value of the community was high (National Conservation Index 1.30). One Nationally Notable A species (the Club-tailed Dragonfly, *Gomphus vulgatissimus*), one Nationally Notable B species and 3 local species were recorded.

The BMWP and ASPT scores were 139 and 5.1 respectively. Both values were within the confidence limits of the predicted BMWP and ASPT for the summer season. The ASPT EQI was 1.02, indicating that water quality was good at this site.

4.4.10 River Thames at Long Wittenham (T4)

This site supported a community which was amongst the richer sites surveyed on the Thames (61 species recorded). The conservation value of the community was moderate (National Conservation Index 1.18). Two Nationally Notable B species and 5 local species were recorded.

The BMWP and ASPT scores were 200 and 5.1 respectively. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.02, indicating that water quality was good at this site.

4.4.11 River Thames at Clifton Reach (T5)

Clifton Reach supported the most impoverished community on the Thames with only 27 species recorded. The conservation value of the community was moderate (National Conservation Index 1.04). Only one local species was recorded.

The BMWP was 113, the lowest value recorded on the Thames, with an ASPT of 4.7. Both the BMWP and ASPT were within the predicted confidence limits. The ASPT EQI was 0.94, indicating that water quality was good at this site.

4.4.12 River Thames at Sutton Pools (T6)

This site supported a moderately diverse community (58 species recorded) for the R.Thames. The conservation value of the community was moderate (National Conservation Index 1.12). One Nationally Notable B species and 4 local species were recorded.

The BMWP and ASPT scores were 183 and 5.6 (the second highest ASPT in the survey). The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the predicted confidence limits. The ASPT EQI was 1.12, indicating that water quality was good at this site.

4.4.13 River Thames at Culham Reach (T7)

This site supported a diverse community (65 species recorded) for the R.Thames. The conservation value of the community was moderate (National Conservation Index 1.11). One Nationally Notable B species and 4 local species were recorded.

The BMWP and ASPT scores were 211 and 5.3 respectively. The BMWP score was the second highest recorded in the Thames during the survey and above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.06, indicating that water

quality was good at this site.

4.4.14 River Thames at Abingdon Backwaters South (T8)

This site supported a diverse community (63 species recorded) for the R.Thames. The conservation value of the community was high (National Conservation Index 1.24). One Nationally Notable A species (the alderfly *Sialis nigripes*), two Nationally Notable B species and 2 local species were recorded.

The BMWP and ASPT scores were 201 and 5.3 respectively. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.02, indicating that water quality was good at this site.

4.4.15 River Thames Abingdon Backwaters North (T9)

This site supported a relatively impoverished community for the Thames (47 species recorded). Despite this the conservation value of the community was high (National Conservation Index 1.21). Two Nationally Notable B species and 4 local species were recorded.

The BMWP and ASPT scores were 186 and 5.5 respectively. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.06, indicating that water quality was good at this site.

4.4.16 River Thames at Abingdon Weir (T10)

This site supported the second richest community of the sites surveyed on the Thames (67 species recorded). The conservation value of the community was moderate (National Conservation Index 1.13). One Nationally Notable B species and 6 local species were recorded. Dead shells of the RDB2 snail *Gyraulus acronicus* (the Thames Ramshorn) were recorded but no live specimens were found. This species has not been included in the calculation of Conservation Indices.

Abingdon Weir had the highest BMWP score recorded in the survey (230). The ASPT was 5.3. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.06, indicating that water quality was good at this site.

4.4.17 River Thames near Lock Wood, Nuneham (T11)

This site supported a community of moderate richness for the Thames (50 species recorded). Despite this, the conservation value of the community was amongst the lowest recorded on the Thames (National Conservation Index 1.06). 3 local species were recorded.

The BMWP and ASPT scores were 171 and 5.3 respectively. The BMWP score was above the upper confidence limit predicted for the summer season. The ASPT was within the confidence limits. The ASPT EQI was 1.06, indicating that water quality was good at this site.

4.4.18 River Thames at Radley (T12)

This site supported a community of moderate richness for the Thames (53 species recorded). The conservation value of the community was moderate (National Conservation Index 1.08). 4 local species were recorded. Dead shells of the RDB2 snail *Gyraulus acronicus* (the Thames Ramshorn) were recorded but no live specimens were found. This species has not been included in the calculation of Conservation Indices.

The BMWP and ASPT scores were 193 and 5.4 respectively. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.08, indicating that water quality was good at this site.

4.4.19 River Thames at Sandford Reach (T13)

This site supported a relatively species-rich community for the Thames (61 species recorded). The conservation value of the community was moderate (National Conservation Index 1.10). One Nationally Notable B species and 3 local species were recorded.

The BMWP and ASPT scores were 182 and 5.5 respectively. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.10, indicating that water quality was good at this site.

4.4.20 River Thames at Sandford (T14)

The Thames at Sandford Lock supported the most diverse invertebrate community recorded in the survey (78 species recorded). Three Nationally Notable B species and 6 local species were recorded. In recognition of this high species-richness and the large number of local or Nationally notable species, the conservation value of the community should be regarded as high despite the National Conservation Index being just outside the high band(1.19).

The BMWP and ASPT scores were 203 and 5.3, respectively. The BMWP score was above the upper confidence limit predicted for the summer season.The ASPT was within the confidence limits. The ASPT EQI was 1.06, indicating that water quality was good at this site.

TABLE 3. SITES SURVEYED BY POND ACTION FOR PHASE 1 OF THE SWORDS MACROINVERTEBRATE STUDY: SUMMARY OF WATER QUALITY RESULTS AND CONSERVATION SCORES.

Site	River	BMWP	Predicted BMWP (summer)	BMWP EQI (summer)	ASPT	Predicted ASPT (summer)	ASPT EQI (summer)	Number of Species	CONSERVATION VALUE National Score	National Index	Regional Score	Regional Index
O1	Ock	177	$^{72}106^{141}$	1.67	5.2	$^{4.2}4.9^{5.5}$	1.06	53	57	1.08	58	1.09
O2	Ock	156	$^{72}106^{140}$	1.47	5.0	$^{4.2}4.9^{5.5}$	1.02	52	57	1.10	56	1.08
O3	**Ock**	214	$^{73}107^{141}$	2.00	5.9	$^{4.2}4.8^{5.4}$	1.23	61	66	1.08	64	1.05
O4	Ock	172	$^{68}101^{134}$	1.70	5.4	$^{4.0}4.7^{5.3}$	1.15	61	70	1.15	69	1.13
O5	**Ock**	206	$^{69}100^{131}$	2.06	5.4	$^{4.0}4.6^{5.2}$	1.17	62	67	1.08	66	1.06
O6*	Ock	224	$^{72}101^{141}$	2.22	5.7	$^{4.2}4.7^{5.5}$	1.21	55	66	1.20	67	1.22
N1	**Nor**	55	$^{56}89^{121}$	0.62	3.9	$^{4.0}4.7^{5.4}$	0.83	29	32	1.10	30	1.03
C1*	**Childrey Brook**	193	$^{65}95^{126}$	2.03	5.3	$^{3.9}4.6^{5.2}$	1.15	57	60	1.05	59	1.04
C2	**Childrey Brook**	114	$^{64}96^{128}$	1.19	4.8	$^{3.9}4.6^{5.2}$	1.04	44	47	1.07	45	1.02
C3	Childrey Brook	89	$^{58}87^{117}$	1.02	4.7	$^{3.8}4.4^{5.0}$	1.07	30	30	1.00	30	1.00
L1	**Letcombe Brook**	75	$^{64}96^{128}$	0.78	4.0	$^{4.0}4.6^{5.2}$	0.87	27	27	1.00	27	1.00
L2*	Letcombe Brook	95	$^{67}101^{134}$	0.94	4.1	$^{4.0}4.7^{5.4}$	0.87	32	33	1.03	33	1.03
CC1	**Cow Common (ditch)**	98	$^{58}87^{116}$	1.13	4.3	$^{3.8}4.4^{5.0}$	0.98	34	34	1.00	34	1.00
CC2	**Cow Common Brook**	43	$^{58}89^{120}$	0.48	3.9	$^{3.9}4.5^{5.1}$	0.87	21	24	1.14	24	1.14
CC3	**Cow Common Brook**	19	$^{60}90^{121}$	0.21	3.2	$^{4.0}4.7^{5.3}$	0.68	5	5	1.00	5	1.00

Key: * Site with NRA data reviewed in Section 3 of this report.
Bold Sites in the SWORDS Study Area.

Predicted BMWP and ASPT values have lower and upper confidence limits (10%) before and after the mean values.
E.g. a predicted BMWP scorewritten as: $^{72}106^{141}$ has a mean value of 106, a lower confidence limit of 72 and an upper confidence limit of 141.

TABLE 3. SITES SURVEYED BY POND ACTION FOR PHASE 1 OF THE SWORDS MACROINVERTEBRATE STUDY: SUMMARY OF WATER QUALITY RESULTS AND CONSERVATION SCORES (continued).

Site	River	BMWP	Predicted BMWP (summer)	BMWP EQI (summer)	ASPT	Predicted ASPT (summer)	ASPT EQI (summer)	Number of Species	CONSERVATION VALUE National Score	National Index	Regional Score	Regional Index
T1*	Thames	125	$^{95}129^{163}$	1.03	5.0	$^{4.5}5.0^{5.6}$	1.00	44	47	1.07	45	1.02
T2	Thames	131	$^{93}128^{163}$	1.02	5.0	$^{4.5}5.0^{5.6}$	1.00	44	50	1.14	50	1.14
T3	Thames	139	$^{94}129^{164}$	1.08	5.1	$^{4.5}5.0^{5.6}$	1.02	44	57	1.30	52	1.18
T4	Thames	200	$^{96}130^{165}$	1.53	5.1	$^{4.5}5.0^{5.6}$	1.02	61	72	1.18	69	1.13
T5	Thames	113	$^{92}128^{164}$	0.88	4.7	$^{4.5}5.0^{5.6}$	0.94	27	28	1.04	28	1.04
T6	Thames	183	$^{93}129^{164}$	1.42	5.6	$^{4.5}5.0^{5.6}$	1.12	58	65	1.12	64	1.10
T7	Thames	211	$^{93}128^{164}$	1.65	5.3	$^{4.4}5.0^{5.6}$	1.06	65	73	1.11	70	1.08
T8	Thames	201	$^{88}126^{165}$	1.60	5.3	$^{4.5}5.2^{5.8}$	1.02	63	78	1.24	76	1.21
T9	Thames	186	$^{88}127^{166}$	1.46	5.5	$^{4.5}5.2^{5.8}$	1.06	47	57	1.21	54	1.15
T10*	Thames	230	$^{96}130^{163}$	1.77	5.3	$^{4.5}5.0^{5.5}$	1.06	67	76	1.13	74	1.10
T11	Thames	171	$^{95}129^{164}$	1.33	5.3	$^{4.5}5.0^{5.6}$	1.06	50	53	1.06	52	1.04
T12	Thames	193	$^{95}130^{165}$	1.48	5.4	$^{4.5}5.0^{5.5}$	1.08	53	57	1.08	56	1.06
T13	Thames	182	$^{94}129^{164}$	1.41	5.5	$^{4.4}5.0^{5.6}$	1.10	61	67	1.10	66	1.08
T14*	Thames	203	$^{94}129^{164}$	1.57	5.3	$^{4.5}5.0^{5.5}$	1.06	78	93	1.19	89	1.14
G1*	Ginge Brook	129	$^{68}103^{138}$	1.25	4.8	$^{4.1}4.8^{5.4}$	1.00	40	44	1.10	44	1.10
G2	Ginge Brook	50	$^{63}95^{127}$	0.53	3.6	$^{3.9}4.6^{5.2}$	0.78	19	19	1.00	19	1.00
G3	Ginge Brook	94	$^{63}94^{124}$	1.00	4.5	$^{3.9}4.5^{5.1}$	1.00	33	37	1.12	35	1.06
G4	Ginge Brook	86	$^{65}97^{129}$	0.87	4.5	$^{4.0}4.6^{5.3}$	0.98	26	26	1.00	27	1.04
G5	Ginge Brook	81	$^{62}96^{129}$	0.84	4.3	$^{4.0}4.7^{5.3}$	0.91	30	31	1.03	32	1.07
G6*	Ginge Brook	73	$^{69}107^{144}$	0.68	4.9	$^{4.4}5.1^{5.9}$	0.96	20	23	1.15	24	1.20

Key: * Site with NRA data reviewed in Section 3 of this report.
Bold Sites in the SWORDS Study Area.

Predicted BMWP and ASPT values have lower and upper confidence limits (10%) before and after the mean values.
E.g. a predicted BMWP scorewritten as: $^{72}106^{141}$ has a mean value of 106, a lower confidence limit of 72 and an upper confidence limit of 141.

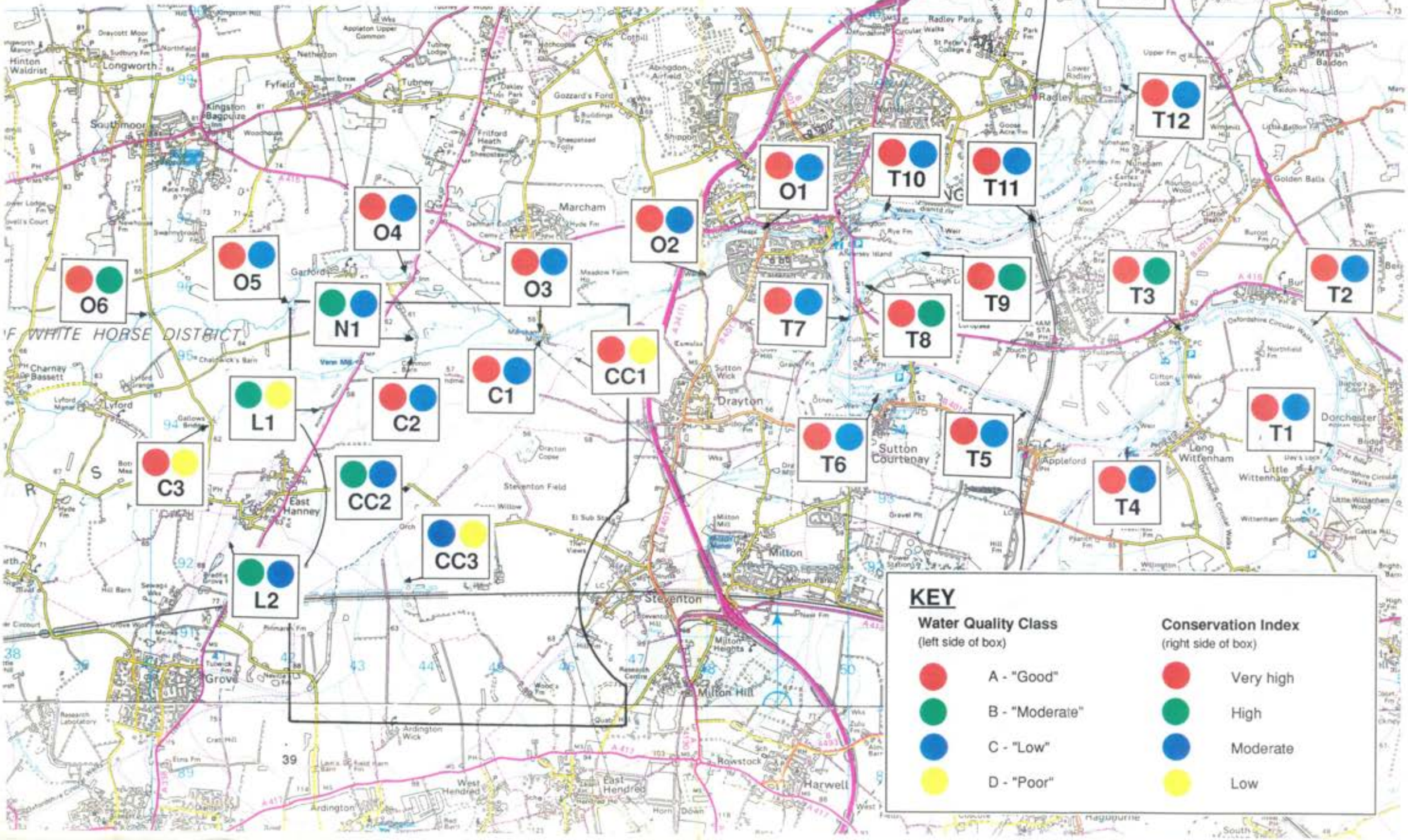
TABLE 4. NUMBERS OF LOCAL, NATIONALLY NOTABLE AND RED DATA BOOK SPECIES FOUND AT EACH SURVEY SITE.

Site	River	Local	Nationally Notable B	Nationally Notable A	RDB 2
O1	Ock	4	-	-	-
O2	Ock	2	1	-	-
O3	**Ock**	5	-	-	-
O4	Ock	3	2	-	-
O5	**Ock**	5	-	-	-
O6	Ock	2	3	-	-
N1	**Nor**	-	1	-	-
C1	**Childrey Brook**	3	-	-	-
C2	**Childrey Brook**	-	1	-	-
C3	Childrey Brook	-	-	-	-
L1	**Letcombe Brook**	-	-	-	-
L2	Letcombe Brook	1	-	-	-
CC1	**Cow Common (ditch)**	-	-	-	-
CC2	**Cow Common Brook**	-	1	-	-
CC3	**Cow Common Brook**	-	-	-	-
T1	Thames	3	-	-	-
T2	Thames	3	1	-	-
T3	Thames	3	1	1	-
T4	Thames	5	2	-	-
T5	Thames	1	-	-	-
T6	Thames	4	1	-	-
T7	Thames	4	1	-	-
T8	Thames	2	2	1	-
T9	Thames	4	2	-	-
T10	Thames	6	1	-	*
T11	Thames	3	-	-	-
T12	Thames	4	-	-	*
T13	Thames	3	1	-	-
T14	Thames	6	3	-	-
G1	Ginge Brook	1	1	-	-
G2	Ginge Brook	-	-	-	-
G3	Ginge Brook	1	1	-	-
G4	Ginge Brook	-	-	-	-
G5	Ginge Brook	1	-	-	-
G6	Ginge Brook	-	1	-	-

Key: **Bold** Sites in the SWORDS Study Area.

* *Gyraulus acronicus* - empty shells (not included in conservation scores

MAP 1. SUMMARY OF THE WATER QUALITY AND CONSERVATION VALUE OF SITES SURVEYED BY POND ACTION FOR THE SWORDS MACROINVERTEBRATE STUDY (THAMES AND OCK CATCHMENTS)



KEY

Water Quality Class
(left side of box)

- A - "Good"
- B - "Moderate"
- C - "Low"
- D - "Poor"

Conservation Index
(right side of box)

- Very high
- High
- Moderate
- Low

5. RECOMMENDATIONS FOR PHASE 2 SURVEY WORK

Four categories of site were recommended for further survey work (see Table 5):

(i) Ditches and ponds **in the reservoir Study Area** which preliminary reconnaissance had suggested could be important macroinvertebrate habitats.

(ii) Sites on the River Ock and Childrey Brook chosen to provide more information about the distribution of crayfish (*Austropotamobius pallipes*). The initial selection of Ock and Childrey sites for Phase 2 survey was also based on the possible occurrence of the rare mayfly *Ephemera lineata* at site O6. However, this occurrence was not confirmed (see Section 4.2.1).

(iii) Additional watercourses **outside the Study area** which were not included in the initial sampling programme but which could be affected by the scheme.

(iv) One site on the Ginge Brook (**outside the study area**) where the BMWP score from this study was less than that recorded during NRA routine sampling.

5.1 Additional sites which preliminary reconnaissance suggested could be important macroinvertebrate habitats

5.1.1 Permanent ditches and ponds

A selection of permanent ditches and ponds were recommended for further survey in the autumn. All of these held water during July and August, and looked of sufficient interest to merit survey work. Some may hold only small amounts of water in the autumn and ideally they would be surveyed in spring or early summer, but an autumn survey would be feasible for most.

5.1.2 Ditches and ponds which hold water seasonally

Most of the extensive network of ditches (and some of the ponds) in the reservoir Study Area are seasonally wet. However they still have the potential to be of invertebrate conservation interest.

It would be prohibitively expensive to survey large numbers of ditch sites so we recommend that one ditch site is surveyed in each of the 1 x 1km square of the reservoir Study Area (where ditches are present).

It was recommended that these sites be surveyed in spring (when water levels are likely to be at their highest).

5.2 Sites on the River Ock and Childrey Brook chosen to provide more information about the distribution of crayfish (*Austropotamobius pallipes*)

Survey sites were recommended in the following areas to provide further information about crayfish distribution:

(i) the Ock where it runs through the reservoir Study Area.

(ii) the lower section of the Childrey Brook, upstream of its confluence with the Ock in the reservoir Study Area.

(iii) the R. Ock upstream of Site O6.

5.3 Additional watercourses outside the Study area which were not included in the initial sampling programme but which may be affected by the scheme

5.3.1 Sites downstream of the study area.

Two sites were recommended on the Mill stream where it runs through Milton. However, this stream passes through Didcot Power Station and appears to emerge as the Moor Ditch, flowing into the Thames at Long Wittenham. Further survey sites on this stream/ditch could be investigated if required.

5.3.2 Sites upstream of the study area.

During the present survey, rivers were visited up to 2 km above the study area. If the construction work and the reservoir are likely to affect the streams above the study area, then further sites on streams would be recommended for sampling up to 2km above the point at which hydrological effects of the construction work and the reservoir itself are thought to be negligible.

5.3.3 Further sites on the Thames.

When the inlet and outlet positions of the reservoir are finalised, it is recommended that further survey work be undertaken in the river immediately around the outlets.

5.4 Re-survey of Phase 1 sites: sites which require a second season of survey work to confirm the results of Phase 1

A second season of survey is recommended for sites which have an unusually low BMWP or ASPT compared to that shown in previous NRA surveys. Only one site fulfils this requirement: the R. Ginge at West Hendred.

TABLE 5. SITES RECOMMENDED FOR SURVEY IN SWORDS PHASE 2

1. Additional ditches and ponds in the reservoir Study Area which preliminary reconnaissance suggested could be important macroinvertebrate habitats

Priority sites are shown in **bold**.

SITE	GRID REFERENCE
Pond north of railway line	**SU433916**
Pond north of railway line	**SU439916**
Pond at Venn Mill (seasonal)	**SU432948 (spring survey)**
Pond north of railway line (seasonal)	**SU428915 (spring survey)**
Pond north of railway line	SU424915
Pond north of railway line	SU435916
Pond at East Hanney (seasonal)	SU422921 (spring seasonal)
Roadside ditch west side of A338	**SU429948**
Ditch south of railway line	**SU436914**
Ditch alongside concrete track	**SU465953**

We recommend that at least one ditch site per 1km x 1km square in the reservoir Study Area be surveyed. The following sites could be surveyed in autumn:

Ditch running under Hanney Road	SU450926
Ditch	SU457944
Ditch by Drayton Copse	SU455935
Ditch by bridle-path	SU466961
Ditch near A34	SU470946
Mere ditch	SU463962
Ditch by A338 north of East Hanney	SU423937
Pond north of railway line	SU423915
Ditch along south side of dry railway pond	SU426914
Pill ditch	SU424901
Ditch near Common Barn	SU434947
Portobello ditch	SU431916
Ditch	SU443931
Marcham Brook	SU457957
Ditch by bridle-path	SU458946
Ditch alongside Hanney road	SU454926
Ditch alongside old canal	SU468956
Ditch near drying sheds	SU464942
Ditch near electricity sub-station	SU466923
Pond at Hill Farm	SU462910

TABLE 5. SITES RECOMMENDED FOR SURVEY IN SWORDS PHASE 2 (continued)

2.	**Sites on the River Ock and Childrey Brook chosen to provide more information about the distribution of crayfish (*Austropotamobius pallipes*)**	
	River Ock	SU420965 SU442957 SU447957 SU452955 SU458958
	Childrey Brook	SU445953
3.	**Additional watercourses outside the Study area which were not included in the initial sampling programme but which may be affected by the reservoir scheme**	
	Mill stream overflow, Milton*	SU484921
	Mill stream overflow, Milton park estate (not seen)	SU494920
4	**Re-survey of Phase 1 sites: sites which require a second season of survey work to confirm the results of Phase 1**	
	Ginge Brook, Church at West Hendred	SU447883

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APPENDICES

APPENDIX 1. NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

SANDFORD BROOK

Site	At A415, Marcham											At Shippon Road			
SWORDS site number	S1											S2			
Grid reference	SU46609680											SU46909770			
Day	3	9	20	3	20	5	21	1	12	22		9	20	5	
Month	Apr	Aug	Aug	Oct	Nov	Feb	Mar	Jul	Sep	Apr		Aug	Nov	Feb	
Year	1990	1990	1990	1990	1990	1991	1991	1991	1991	1992	AVERAGE	1990	1990	1991	AVERAGE
Sample number	0211*	0608*	0631	0766	0973*	0128*	0082	0377	0546	0129	SCORES	0965*	0972*	0127*	SCORES
BMWP score	33	47	73	65	34	50	70	62	55	54	**54**	37	52	40	**43**
Predicted BMWP score	126	124			140	140		134	134	134	**133**	134	134	134	**134**
BMWP/Pred. BMWP	0.26	0.38			0.24	0.36		0.46	0.41	0.40	**0.36**	0.28	0.39	0.30	**0.32**
ASPT	3.3	3.9	4.1	4.1	4.3	3.9	4.1	3.9	3.9	3.9	**3.9**	3.7	3.7	4.0	**3.8**
Predicted ASPT	5.1	4.8			5.0	5.0		4.9	4.9	4.9	**4.9**	5.0	5.0	5.0	**5.0**
ASPT/Pred. ASPT	0.65	0.81			0.85	0.77		0.79	0.80	0.79	**0.78**	0.74	0.74	0.80	**0.76**
Biotic Class	D	D	C	C	D	D	C	C	C	C		D	C	D	

Site	At Gozzards Ford					Above Gozzards Ford				At Cothill Bridge					
SWORDS site number	S3					S4				S5					
Grid reference	SU46909850					SU46609910				SU46509960					
Day	3	9	20	5		9	20	5		3	9	20	5		
Month	Apr	Aug	Nov	Feb		Aug	Nov	Feb		Apr	Aug	Nov	Feb		
Year	1990	1990	1990	1991	AVERAGE	1990	1990	1991	AVERAGE	1990	1990	1990	1991	AVERAGE	
Sample number	0210*	0609*	0971*	0126*	SCORES	0964*	0970*	0125*	SCORES	0209*	0610*	0969*	0124*	SCORES	
BMWP score	35	54	48	28	**41**	48	92	75	**72**	91	120	51	60	**81**	
Predicted BMWP score	136	127	136	136	**134**	130	130	130	**130**	142	128	130	136	**134**	
BMWP/Pred. BMWP	0.26	0.43	0.35	0.21	**0.31**	0.37	0.71	0.58	**0.55**	0.64	0.94	0.39	0.44	**0.60**	
ASPT	3.9	3.9	3.7	3.1	**3.6**	4.4	5.8	5.0	**5.0**	5.1	5.2	5.1	5.5	**5.2**	
Predicted ASPT	5.2	5.0	5.0	5.0	**5.0**	5.0	5.0	5.0	**5.0**	5.2	5.1	5.0	5.1	**5.1**	
ASPT/Pred. ASPT	0.75	0.78	0.74	0.62	**0.72**	0.87	1.15	1.00	**1.01**	0.97	1.03	1.02	1.07	**1.02**	
Biotic Class	D	C	D	D		D	C	C		C	B	C	C		

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

SANDFORD BROOK (CONT.)

Site	At Dry Sandford				At Sandleigh			
SWORDS site number	S6				S7			
Grid reference	SP46700070				SU46700070			
Day	9	20	5			20	5	
Month	Aug	Nov	Feb		Aug	Nov	Feb	
Year	1990	1990	1991	**AVERAGE**	1990	1990	1991	**AVERAGE**
Sample number	0963*	0968*	0123*	**SCORES**	0962*	0967*	0122*	**SCORES**
BMWP score	57	59	73	**63**	48	45	37	**43**
Predicted BMWP score	143	143	143	**143**	136	136	136	**136**
BMWP/Pred. BMWP	0.40	0.41	0.51	**0.44**	0.35	0.33	0.27	**0.32**
ASPT	4.8	5.4	5.2	**5.1**	4.4	4.1	3.7	**4.1**
Predicted ASPT	5.3	5.3	5.3	**5.3**	5.5	5.3	5.3	**5.4**
ASPT/Pred. ASPT	0.90	1.01	0.98	**0.96**	0.79	0.77	0.70	**0.75**
Biotic Class	C	C	C		D	D	D	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

MARCHAM BROOK

Site	At Mill Rd, Marcham								At Fyfield	Above Appleton Stw
SWORDS site number	S30								S31	S32
Grid reference	SU45509610								SU42709880	SU44300120
Day	24	11	13	21	17	9	22		26	26
Month	Apr	Jul	Nov	Mar	Jun	Sep	Apr		Jun	Jun
Year	1990	1990	1990	1991	1991	1991	1992	**AVERAGE**	1990	1990
Sample number	0271	0510	0870	0084	0327	0530	0131	**SCORES**	0463*	0464*
BMWP score	166	159	156	166	157	154	163	**160**	12	26
Predicted BMWP score					139	139	139	**139**	129	129
BMWP/Pred. BMWP					1.13	1.11	1.17	**1.14**	0.09	0.20
ASPT	5.4	5.1	5.2	5.2	5.4	5.0	5.3	**5.2**	3.0	3.3
Predicted ASPT					5.0	5.0	5.0	**5.0**	5.0	4.7
ASPT/Pred. ASPT					1.08	0.99	1.05	**1.04**	0.60	0.69
Biotic Class	A	A	A	A	A	A	A		E	D

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

BAGPUIZE BROOK

Site	At Swanny Brook			
SWORDS site number	S35			
Grid reference	SU40209620			
Day	24	27	22	
Month	May	Nov	Apr	
Year	1990	1991	1992	**AVERAGE**
Sample number	0360	0834	0132	**SCORES**
BMWP score	12	39	38	**30**
Predicted BMWP score			93	**93**
BMWP/Pred. BMWP			0.41	**0.41**
ASPT	2.4	3.6	3.8	**3.3**
Predicted ASPT			4.6	**4.6**
ASPT/Pred. ASPT			0.83	**0.83**
Biotic Class	D	D	D	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

OCK

Site	At Abingdon Common									
SWORDS site number	S33									
Grid reference	SU48009620									
Day	14	28	19	31	16	21	1	30	22	
Month	Sep	Jun	Apr	Jul	Nov	Mar	Jul	Oct	Apr	
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992	**AVERAGE**
Sample number	0301	0173	0267	0562	0915*	0081	0378	0676	0128	**SCORES**
BMWP score	146	197	162	154	143	143	172	124	169	**157**
Predicted BMWP score	170	170	178	170	178	170	148	106	148	**160**
BMWP/Pred. BMWP	0.86	1.16	0.91	0.91	0.80	0.84	1.16	1.17	1.14	**0.99**
ASPT	4.9	5.5	5.2	5.3	6.0	5.5	5.4	5.0	5.5	**5.3**
Predicted ASPT	5.2	5.2	5.2	5.2	5.2	5.2	5.1	4.8	5.1	**5.2**
ASPT/Pred. ASPT	0.93	1.05	1.00	1.02	1.14	1.05	1.05	1.03	1.07	**1.04**
Biotic Class	B	A	A	A	B	B	A	B	A	

Site	At Ock Bridge, Lyford									
SWORDS site number	S34									
Grid reference	SU40009560									
Day	14	28	10	30	16	21	17	9	10	
Month	Sep	Jun	Apr	Jul	Nov	Mar	Jun	Sep	Jun	
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992	**AVERAGE**
Sample number	0300	0172	0264	0563	0917	0085	0326	0532	0200	**SCORES**
BMWP score	187	180	166	182	190	170	182	193	158	**179**
Predicted BMWP score	160	160	160	160	160	160	157	99	157	**153**
BMWP/Pred. BMWP	1.17	1.13	1.04	1.14	1.19	1.06	1.16	1.95	1.01	**1.21**
ASPT	5.5	5.6	5.4	5.4	5.4	5.3	5.5	5.5	5.5	**5.5**
Predicted ASPT	5.2	5.2	5.2	5.2	5.2	5.2	5.2	4.7	5.2	**5.2**
ASPT/Pred. ASPT	1.05	1.07	1.02	1.02	1.04	1.01	1.06	1.17	1.05	**1.05**
Biotic Class	A	A	A	A	A	A	A	A	A	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

CHILDREY BROOK

Site	At Mill Rd, Marcham									
SWORDS site number	S29									
Grid reference	SU45709520									
Day	9	28	30	9	3	21	17	9	22	
Month	Dec	Jun	Apr	Aug	Oct	Mar	Jun	Sep	Apr	
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992	**AVERAGE**
Sample number	0361	0171	0288	0600	0768	0083	0328	0529	0130	**SCORES**
BMWP score	138	157	155	206	177	141	158	186	174	**166**
Predicted BMWP score	141	160	160	160	160	160	143	143	143	**152**
BMWP/Pred. BMWP	0.98	0.98	0.97	1.29	1.11	0.88	1.10	1.30	1.22	**1.09**
ASPT	5.1	5.4	5.2	5.4	5.1	5.0	5.3	5.5	5.3	**5.2**
Predicted ASPT	5.0	5.6	5.6	5.6	5.6	5.4	5.0	5.0	5.0	**5.3**
ASPT/Pred. ASPT	1.01	0.97	0.93	0.98	0.91	0.94	1.05	1.09	1.05	**0.99**
Biotic Class	B	A	A	A	A	B	A	A	A	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

WOODHILL BROOK

Site	North of E. Challow					
SWORDS site number	S24					
Grid reference	SU37908988					
Day	21	30	30	22	10	
Month	Feb	Nov	Jan	Nov	Jun	
Year	1990	1990	1991	1991	1992	AVERAGE
Sample number	0056	0931	0018	0813	0201	SCORES
BMWP score	24	12	15	28	36	**23**
Predicted BMWP score	123	123	123	90	86	**109**
BMWP/Pred. BMWP	0.20	0.10	0.12	0.31	0.42	**0.23**
ASPT	3.4	2.4	3.0	3.1	3.6	**3.1**
Predicted ASPT	5.0	5.0	5.0	4.8	4.5	**4.8**
ASPT/Pred. ASPT	0.69	0.48	0.60	0.65	0.80	**0.64**
Biotic Class	D	D	D	D	D	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

LETCOMBE BROOK

Site	Weir Farm, East Hanney										Above Wantage Stw			
SWORDS site number	S20										SU40709160			
Grid reference	SU41309260										S21			
Day	21	13	19	30	16	21	17	9	10		21	13	30	
Month	Oct	Sep	Apr	Jul	Nov	Mar	Jun	Sep	Jun		Oct	Sep	Jan	
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992	AVERAGE	1988	1989	1991	AVERAGE
Sample number	0337	0277	0266	0564	0916	0086	0325	0531	0199	SCORES	0336	0276	0017	SCORES
BMWP score	61	80	52	73	57	42	73	79	78	**66**	67	86	58	**67**
Predicted BMWP score	149	149	149	149	149	149	144	144	144	**147**	142	142	142	**145**
BMWP/Pred. BMWP	0.41	0.54	0.35	0.49	0.38	0.28	0.51	0.55	0.54	**0.45**	0.47	0.61	0.41	**0.47**
ASPT	3.8	4.2	4.0	4.1	3.8	3.8	4.6	4.2	4.1	**4.1**	4.2	4.3	4.1	**4.1**
Predicted ASPT	5.3	5.3	5.3	5.3	5.3	5.3	5.0	5.0	5.0	**5.2**	5.4	5.4	5.4	**5.2**
ASPT/Pred. ASPT	0.72	0.79	0.75	0.77	0.72	0.72	0.91	0.83	0.82	**0.78**	0.78	0.80	0.77	**0.79**
Biotic Class	C	C	C	C	C	D	C	C	C		C	C	C	

Site	50m Bel. Dairy Dt	100m Above Dairy Depot
SWORDS site number	S22	S23
Grid reference	SU39908920	SU39908900
Day	16	16
Month	Apr	Apr
Year	1991	1991
Sample number	0156*	0157*
BMWP score	48	47
Predicted BMWP score	114	111
BMWP/Pred. BMWP	0.42	0.42
ASPT	3.7	3.6
Predicted ASPT	5.2	5.1
ASPT/Pred. ASPT	0.71	0.71
Biotic Class	D	D

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

THAMES

Site	At Days Lock			At Abingdon Weir			
SWORDS site number	S17			S18			
Grid reference	SU56809350			SU50609700			
Day	5	14		15	8	5	
Month	May	Nov		Jun	May	Jun	
Year	1989	1990	AVERAGE	1988	1989	1990	AVERAGE
Sample number	0110	0875	SCORES	0180	0112	0374*	SCORES
BMWP score	180	145	**163**	142	149	134	**142**
Predicted BMWP score	183	183	**183**	170	182	182	**178**
BMWP/Pred. BMWP							
ASPT	5.5	5.0	**5.2**	5.1	4.8	4.8	**4.9**
Predicted ASPT	5.7	5.7	**5.7**	5.6	5.8	5.8	**5.7**
ASPT/Pred. ASPT							
Biotic Class	A	B		B	B	B	

Site	At Top of Sandford Lock Cut									
SWORDS site number	S19									
Grid reference	SP52800210									
Day	13	8	17	20	8	8	3	30	26	
Month	Jun	May	Apr	Aug	Oct	Apr	Jul	Oct	May	
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992	AVERAGE
Sample number	0178	0113	0255	0632	0771	0118	0395	0672	0170	SCORES
BMWP score	162	187	143	170	182	157	157	182	173	**168**
Predicted BMWP score	172	179	179	170	179	185	185	185	185	**180**
BMWP/Pred. BMWP	0.94	1.04	0.80	1.00	1.02	0.85	0.85	0.98	0.94	**0.94**
ASPT	5.2	5.3	5.1	5.0	5.5	5.1	5.1	5.2	5.2	**5.2**
Predicted ASPT	5.7	5.8	5.8	5.8	5.8	5.4	5.4	5.4	5.4	**5.6**
ASPT/Pred. ASPT	0.92	0.92	0.88	0.87	0.96	0.94	0.94	0.96	0.97	**0.93**
Biotic Class	A	A	B	A	A	A	A	A	A	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

GINGE BROOK

Site	Mead. Brk Fm, St'n	Below Hill Farm	At Hill Farm			Above Hill Farm	At Wood's Farm	Below Fish Fm	At Ludbridge/A417
SWORDS site number	S9	S10	S11			S12	S13	S14	S15
Grid reference	SU47569178	SU46339107	SU46309105			SU46259097	SU45459012	SU45518959	SU45458921
Day	5	31	11	31		4	16	16	16
Month	Jun	May	Oct	May		Jun	Jul	Jul	Jul
Year	1991	1991	1989	1991	AVERAGE	1991	1991	1991	1991
Sample number	0262*	0261*	0246*	0259*	SCORES	0260*	0447*	0466*	0445*
BMWP score	37	22	32	26	**29**	61	56	37	120
Predicted BMWP score	108	98	121	98	**110**	111	113	104	105
BMWP/Pred. BMWP	0.34	0.22	0.26	0.27	**0.27**	0.55	0.50	0.36	1.14
ASPT	3.4	3.1	3.6	3.3	**3.4**	4.4	4.0	3.4	4.6
Predicted ASPT	4.9	4.6	4.0	4.6	**4.3**	5.0	5.1	4.9	4.9
ASPT/Pred. ASPT	0.69	0.68	0.90	0.71	**0.81**	0.87	0.78	0.69	0.94
Biotic Class	D	D	D	D		C	C	D	B

Site	At Church West Hendred									
SWORDS site number	S16									
Grid reference	SU44708830									
Day	29	24	9	27	3	19	13	25	5	
Month	Jul	May	Apr	Jun	Sep	Mar	Jun	Sep	May	
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992	AVERAGE
Sample number	0241	0141	0237	0453	0684	0075	0304	0581	0143	SCORES
BMWP score	72	104	76	96	87	95	95	85	99	**90**
Predicted BMWP score	185	185	185	185	185	185	130	130	130	**167**
BMWP/Pred. BMWP	0.39	0.56	0.41	0.52	0.47	0.51	0.73	0.65	0.76	**0.56**
ASPT	4.5	5.2	4.5	5.1	5.1	4.8	5.3	4.7	5.2	**4.9**
Predicted ASPT	5.7	5.7	5.7	5.7	5.7	5.7	4.9	4.9	4.9	**5.4**
ASPT/Pred. ASPT	0.79	0.91	0.78	0.89	0.90	0.83	1.08	0.96	1.06	**0.91**
Biotic Class	C	B	C	C	C	C	C	C	C	

APPENDIX 1. (CONTINUED). NRA WATER QUALITY DATA FOR THE SWORDS STUDY.

ODHAY HILL

Site	Ditches Above Ginge Brook						
SWORDS site number	S26						
Grid reference	SU50129432						
Day	18	2	15	19	13	25	
Month	Apr	Jul	Nov	Mar	Jun	Sep	
Year	1990	1990	1990	1991	1991	1991	**AVERAGE**
Sample number	0259	0483	0877	0078	0302	0583	**SCORES**
BMWP score	45	39	42	36	35	31	**38**
Predicted BMWP score					128	128	**128**
BMWP/Pred. BMWP					0.27	0.24	**0.26**
ASPT	3.8	3.6	3.8	3.6	3.9	3.4	**3.7**
Predicted ASPT					4.9	4.9	**4.9**
ASPT/Pred. ASPT					0.79	0.70	**0.75**
Biotic Class	D	D	D	D	D	D	

MILL BROOK

Site	At B4016 Sutton Courtenay										Below Drayton Waste Disposal Site
SWORDS site number	S27									AVERAGE	S28
Grid reference	SU50009390									SCORES	SU48309330
Day	29	24	9	27	3	19	13	25	5		12
Month	Jul	May	Apr	Jun	Sep	Mar	Jun	Sep	May		Oct
Year	1988	1989	1990	1990	1990	1991	1991	1991	1992		1989
Sample number	0240	0142	0240	0454	0683	0076	0303	0582	0144		0342*
BMWP score	112	134	57	110	125	83	51	90	95	**95**	93
Predicted BMWP score	137	137	137	137	137	137	138	99	138	**133**	137
BMWP/Pred. BMWP	0.82	0.98	0.42	0.80	0.91	0.61	0.37	0.91	0.69	**0.72**	0.68
ASPT	5.3	5.6	4.1	4.8	5.0	4.4	3.6	4.5	4.3	**4.6**	4.9
Predicted ASPT	5.1	5.1	5.1	5.1	5.1	5.1	5.0	4.7	5.0	**5.0**	5.0
ASPT/Pred. ASPT	1.05	1.10	0.80	0.94	0.98	0.86	0.73	0.96	0.86	**0.92**	0.97
Biotic Class	B	B	C	B	B	C	C	C	C		C

APPENDIX 2. SWORDS SITES - ENVIRONMENTAL DATA FOR PREDICTIONS

Key: * A routine study site for NRA
† A site with some NRA information (usually just one survey)

Site	River	Site name	Grid ref	Date sampled	Width(m)	Average depth (cm)	%boulders/ cobbles	%pebbles/ gravel	%sand	%silt/ clay
O1	Ock	Ock Bridge, Abingdon	SU487968	9/7/92	4	25	0	55	40	5
O2*	Ock	New Cut Mill	SU477962	4/8/92	5.2	25	2	54	34	10
O3*	Ock	Marcham Mill Rd	SU456953	20/7/92	7	100	20	60	10	10
O4	Ock	Noah's Ark	SU437962	3/8/92	6.1	25	4	18	18	60
O5†	Ock	Nr College Fm	SU420957	9/7/92	5	60	0	25	25	50
O6*	Ock	Ock bridge, road to W.Hanney	SU400956	20/7/92	6	90	10	30	30	30
N1	Nor	Common Barn Rd	SU437953	22/7/92	1.4	6	0	0	0	100
C1	Childrey Brook	At Marcham Mill	SU456953	20/7/92	4	100	0	25	25	50
C2	Childrey Brook	Common Barn Rd	SU437950	22/7/92	3.8	28	0	5	48	47
C3	Childrey Brook	Gallows bridge	SU408940	22/7/92	1.4	12	1	5	5	89
L1*	Letcombe Brook	At end of track	SU424943	9/7/92	3.5	40	0	30	30	40
L2	Letcombe Brook	Weir Farm, E. Hanney	SU412923	22/7/92	4.1	20	1	14	25	60
CC1	Cow Common Bk.	Nr Marcham Mill	SU461949	3/8/92	1.4	15	0	0	0	100
CC2	Cow Common Bk.	Steventon Road	SU437931	9/7/92	2.1	15	0	0	0	100
CC3	Cow Common Bk.	Hutchins copse	SU437917	9/7/92	2	0.5	0	0	0	100

APPENDIX 2. SWORDS SITES - ENVIRONMENTAL DATA FOR PREDICTIONS (continued)

Site	River	Site name	Grid ref	Date sampled	Width(m)	Average depth (cm)	%boulders/ cobbles	%pebbles/ gravel	%sand	%silt/ clay
T2	Thames	Days reach	SU566955	28/7/92	40	150	10	53	35	2
T3*	Thames	Clifton Bridge	SU547954	3/8/92	45	150	4	25	70	1
T4	Thames	Long Wittenham	SU540937	3/8/92	35	150	0	5	75	20
T5	Thames	Clifton Reach	SU526942	28/7/92	45	150	5	50	40	5
T6	Thames	Sutton Pools	SU503945	3/8/92	40	150	0	50	25	25
T7	Thames	Culham Reach	SU500955	20/7/92	55	150	10	60	25	5
T8	Thames	Backwaters South	SU502961	20/7/92	18	110	0	60	38	2
T9	Thames	Backwaters North	SU509965	28/7/92	12	120	0	56	40	4
T10*	Thames	Abingdon Weir	SU504972	28/7/92	75	150	0	5	85	10
T11	Thames	Near Lock Wood, Nunehar	SU526970	28/7/92	50	150	10	60	24	1
T12	Thames	Radleigh	SU538990	20/7/92	40	150	0	45	45	10
T13	Thames	Sandford Reach	SP535000	28/7/92	40	150	5	63	30	2
T14*	Thames	Sandford	SP527022	9/7/92	60	150	0	40	50	10
G1†	Ginge Brook	Sutton Courtenay	SU499939	9/7/92	2.5	25	10	40	40	10
G2	Ginge Brook	Drayton Mill	SU488933	9/7/92	2	20	0	0	0	100
G3	Ginge Brook	Milton Lane	SU480923	9/7/92	4	50	0	0	0	100
G4†	Ginge Brook	Hill Farm	SU460908	20/7/92	2.5	50	0	25	25	50
G5†	Ginge Brook	Lud Bridge	SU454892	20/7/92	2.6	28	0	5	10	85
G6*	Ginge Brook	Church in W.Hendred	SU447883	4/8/92	1.4	2	6	33	33	28

APPENDIX 3 NRA INFORMATION ON THE BMWP (BIOLOGICAL MONITORING WORKING PARTY) SYSTEM AND RIVPACS (RIVER INVERTEBRATE PREDICTION AND CLASSIFICATION SYSTEM)

BIOLOGY INFORMATION SHEET

Water Quality Assessment
Using Freshwater Macroinvertebrates

THE ROLE OF WATER CREATURES

Macroinvertebrates are the small animals which inhabit the bottom sediments of rivers. They include insect larvae such as those of mayflies and caddis flies, together with snails, shrimps, worms and many others.

These organisms can give us information about the water quality in a river. They are unable to move very far and respond to everything contained in the water, including pollutants which occur only infrequently or at very low levels and which may easily be missed by normal chemical sampling.

SAMPLING

The sampling methods used by the NRA have been developed with the Institute of Freshwater Ecology (IFE) who are acknowledged as world leaders in this field.

A site is selected which is considered to be representative of the stretch of river to be assessed. Then, the different habitats such as gravel, silt and weed beds are sampled (using a pond net in shallow water and a grab, dredge or air-lift in deeper water) to obtain representatives of the majority of macroinvertebrate types living in that stretch of river.

Samples are analysed in the laboratory to provide a complete list of the taxa found. (*Taxa/taxa* are useful terms which cover organisms identified to species, family or any other required level).

For major surveys, sampling is carried out in spring, summer and autumn. This allows us to remove the influence of seasonal variations. The samplers' results are audited by IFE to ensure their accuracy.

THE BMWP SCORE SYSTEM

This was devised by the Biological Monitoring Working Party for the 1980 Water Quality Survey of England and Wales. It has since become nationally accepted as a simple means of assessing water quality.

A score of from one to ten is allocated to each invertebrate taxon found in the sample and is based on their sensitivity to pollution. For example, most mayfly nymphs and caddis larvae score ten, water beetles five, molluscs three, and worms one. The final BMWP score is calculated by summing the scores for each taxon represented in the sample.

In addition, the number of taxa describes the richness of the population, with high numbers indicating a healthy environment.

The Average Score Per Taxon (ASPT) may also be used. This is simply the BMWP score divided by the number of taxa, and represents the "average sensitivity" of the families found. It can offer a more reliable index than the score as it is less dependant on sampling effort or the absence of a few rare species (sometimes caused by minor habitat differences).

As a guide to interpretation, a BMWP score of 200 and an ASPT above 6.00 is exceptional, whilst scores and ASPTs greater than 100 and 4.00 respectively, generally indicate good water quality.

A study of the particular taxa present (or absent) can give an insight into the type of pollution which is occurring. It can, however, be difficult to distinguish the effects of pollution from those of natural factors such as changing sediments or flow rates. To overcome this problem we now use a computer programme called RIVPACS (River InVertebrate Prediction And Classification System), developed over the last ten years by IFE.

RIVPACS

RIVPACS is based on a set of information about invertebrate populations throughout England and Wales and the characteristics of the rivers in which they were found. It is derived from samples taken at over 400 sites chosen because they had high water quality.

Sophisticated mathematical analysis on computer has classified a range of river types and their associated fauna. The computer can predict, from the physical and chemical characteristics of a site, the likely BMWP score which would be found assuming the site is unpolluted. Comparison of the score observed from a real sample with the RIVPACS predicted score will indicate any deficiencies which may be attributable to pollution.

This comparison is most easily expressed as the ratio of the observed to predicted scores, known as the Ecological Quality Index (EQI). If this is equal to or greater than one (i.e. the observed score at least matches the predicted score) water quality is satisfactory. As the value drops below one, progressively poorer water quality is indicated.

NRA
Thames Region

Produced in association with NRA Southern Region

APPENDIX 4. Minutes of meeting between Joint Nature Conservation Committee (Invertebrate Site Register team), English Nature and Pond Action to discuss applications of invertebrate conservation indices

Meeting held at Monkstone House, Peterborough (JNCC) 3 November 1992.

Present

Dr Stuart Ball (JNCC: responsible for the Invertebrate Site Register team).
Dr Martin Drake (EN: with special responsibility for invertebrate conservation).
Dr Jeremy Biggs (PA)
Mr Dave Walker (PA)
Ms Mericia Whitfield (PA)

1. Objectives of meeting

The objectives of the meeting were outlined by JB.

(i) To describe briefly the application of the National Conservation Score (NCS) and Index (NCI) system, devised by Pond Action, in the SWORDS study.

(ii) To review briefly the use of score and index systems for assessing the conservation value of invertebrate communities by JNCC, EN and others.

(iii) To review briefly the advantages and disadvantages of score and index systems in invertebrate conservation.

(iv) To obtain a statement from JNCC/EN on the suitability of the NCS and NCI system as applied by PA to the SWORDS study.

2. The NCS and NCI system applied to the SWORDS study

DW, JB and MW briefly outlined the NCS and NCI system and its application to the SWORDS study.

JB noted that within the SWORDS study:

(i) most emphasis had been placed on the NCI in order to allow comparisons between sites of different sizes (eg River Thames compared to River Ock) and different type (eg streams compared to ponds).

(ii) neither NCI or NCS were used as absolute measures but as numerical aids to interpretation.

3. Other applications of score and index systems in invertebrate conservation

SB outlined two projects on which score and index systems had been applied by JNCC/NCC staff (assessments of the conservation value of invertebrate communities on Thorne Moors in Yorkshire[1] and the Public Enquiry into A13 road improvements affecting Rainham Marshes[2]).

[1] Ball, S.G. (1992). The importance of the invertebrate fauna of Thorne and Hatfield Moors: an exercise in site evaluation. Thorne and Hatfield Moors Papers, **3**, 34-65.

[2] Ball, S.G. (1990). Department of Transport A13 Road Improvements. Ferry Lane to London Road Section. Proof of Evidence, Volume 1. Nature Conservancy Council, Peterborough.

He also noted that the other principal application of scores and indices to invertebrate conservation has been made in the assessment of the conservation value of water beetle communities by Foster and co-workers (see, for example, Foster et al, 1992[3]).

All present agreed that methods used in these studies were very similar to those used by PA for the SWORDS study. In general, scores are assigned to species on a geometric scale according to their uncommonness and the individual scores for each species added together to obtain a single quality index.

Note: similar systems to the NCS have been termed "Species Quality Score" (SQS). Foster (see Footnote 3) has called the value, eqivalent to PA's National Conservation Index, "Mean quality score per species" (MQS).

4. Advantages and disadvantages of conservation score and index systems

DW and JB noted, and SB and MD agreed, that the principal advantage of conservation score and index systems in invertebrate conservation is that an element of objectivity is introduced into the comparisons of sites.

SB noted that scores and indices are useful as long as they are not considered in isolation but are used to guide decision making. In particular, SB noted that JNCC does not approve of the use of scores or indices to "write-off" sites which do not reach a particular threshold value. So, for example, if a NCI of 1.2 is taken to indicate "high" value sites, sites which fail to reach this threshold and are labelled as being of "low" or "moderate" value should not be needlessly damaged since they may support valuable species which have not yet been recorded.

SB noted that in many invertebrate surveys sampling effort varies, making number of species an unsuitable measure of conservation value. In surveys where sampling effort is similar for all samples, number of species alone can be a useful measure.

SB pointed out the following shortcomings of conservation indices and scores:

(i) Species which are confined to unnatural habitats (e.g. sand dunes) are likely to be rated as Nationally Notable, at least because such habitats do not occur in many 10 km squares. Conversely, species which are similarly confined to other habitats which are more widespread (e.g. ancient woodland) may not be rated so highly because they occur in many more 10 km squares. Therefore the NCS and NCI of a sample from the former is likely to be higher than a similar sample from the latter, even if they contain equal numbers of species confined to the relevant habitat. This can be seen as an advantage if one is trying to achieve some absolute measure of habitat quality based on the rarity of species within a given formation. It can also be seen as an advantage in more general conservation evaluation, in that it gives an extra weighting to scarce habitats.

(ii) Whilst NCI attempts to correct for sampling effort, it is not perfect and bias may be introduced for under-sampled or very over-sampled sites. (DW noted that in the SWORDS study, sampling effort was constant.)

(iii) The discrimination between sites achieved by such scores is improved by increasing the number of categories into which species may be placed - especially by having more categories at the lower end where most species fall. For example, JNCC use "Regionally Notable" as an extra category between local and "Nationally Notable". (DW noted that for most aquatic invertebrates (dragonflies may be an exception) there is insufficiently

[3] Foster, G.N., Nelson, B.H., Bilton, D.T., Lott, D.A., Merritt, R., Weyl, R.S. and Eyre, M.D. (1992). A classification and evaluation of Irish water beetle assemblages. Aquatic conservation: marine and freshwater ecosystems, 2, in press.

detailed distribution data to make this reliably possible.)

(iv) Numbers of species should not be used uncritically as an evaluation criterion and, in particular, should attempt to exclude "tourist" species not resident in the habitat sampled.

(v) It is not appropriate to compare very dissimilar communities (eg water beetles in ditches with dry grassland ground beetles) using score or index systems.

(vi) In surveys of limited areas (eg single large sites like Thorne Moors) one specimen of a very rare species (e.g. RDB1) can "bump up" the scores of an otherwise uninteresting sample to rank it highly. If this happens it needs looking at very carefully. It may be quite appropriate to protect a population of an extremely rare species even if the site has nothing else going for it (e.g. Guidelines for Biological SSSIs (NCC, 1989) p277 "*All sites with populations of species listed in Schedule 5 of the Wildlife and Countryside Act 1981 qualify for consideration* [as candidates for SSSI designations]"), but one would need further work to establish that there was actually a viable, resident population to justify this sort of special case.

In the the Thorne and Hatfield moors work', *Bembidion humerale* (RDB1 - known only from Thorne and Hatfield) was noted to be present all over the site, though it only appeared twice (as single individuals) in the pitfall traps which formed the core of the constant sampling effort programme. Giving these two individuals high scores distorted the indices of these two samples quite markedly, which made no sense since it reflected only the slim chance of this species entering a pitfall trap.

DW also noted that score and index systems must be used particularly carefully where a small number of species are recorded (eg 12 or less) with one or two local species. Such sites will have a higher NCI than sites with more species and one or two local species. In such cases the NCS should be taken into account.

5. Concluding statement from Dr Stuart Ball on the application of conservation scores and indices in invertebrate conservation: with particular reference to the SWORDS study.

'The Nature Conservation Review (Ratcliffe, 1977) established a set of criteria for the evaluation of conservation sites which have been widely followed. Of the 10 criteria many relate to the site as a whole (e.g. size, recorded history), whilst a few relate to the species which occur on that site (e.g. diversity, rarity) and can be quantified in relation to lists of species derived from surveys. NCI and NCS represent the best means available at the moment to quantify rarity. Like any of these criteria, they should not be used uncritically or in isolation and it is perfectly possible that a site which is not noted for rarities may be valued highly using other criteria.

'The NCI provides a robust and sensitive way of ranking sites according to the rarity of their fauna relative to other sites sampled in the same way. It is sensitive to differences in sampling, but in this study, samples have been taken in a systematic way according to a standard method, so this problem does not arise. Within such a study it is reasonable to evaluate the rarity of the fauna using the NCI and to establish a set of criteria (such as those used in the SWORDS report) to evaluate the quality of sites based on this. If a new site in the same geographical area and habitat formation was sampled in future in the same way, it would be reasonable to evaluate it using these criteria. It would not, however, be reasonable to suppose that these criteria in any way establish an absolute standard and that, for example, an NCI of ">1.5" would represent a site of "Very high conservation value" in studies of other areas or habitats or using other sampling methods.'

APPENDIX 5. BIOLOGICAL DATA HELD IN OXFORDSHIRE COUNTY RECORDS CENTRE RELATING TO THE RESERVOIR STUDY AREA AND ADJACENT WATERBODIES

SPECIES	DESIGNATION	GRID REF.	DATE
Dragonflies			
Calopteryx virgo		499 968	1987
		42 98	1906
		44 99	1950
		444 99 2-4	1926
Platycnemis pennipes		420 000	1983
		4000/4200/4202	1989
		372 002	1985
		36 00	1989
		44 98	1991
Aeshna mixta		44 98	1984, 1991
Cordulea aenea	NNB	440 980	1983
Orthetrum cancellatum		44 98	1986
		44 99	
Gomphus vulgatissimus	Locally	42 00	1989
	uncommon	372 002	1985
		360 000	1982
		380 000	1982
Brachytron pratense	NNB	459 997	1947, 1926, 1961
Sympetrum danae		459 997	1926
Ceriagrion tenellum		467 975	1983
		459 997	1910, 1950, 1949
Orthetrum coerulescens		459 997	1923, 1974, 1950
Stoneflies			
Nemoura cambrica		540 940	1945
Nemoura dubitans	Notable	440 980	1950
Bugs			
Micronecta minutissima	RDB3	400 000	1945
Caddis			
Leptocerus lusitanicus	RDB2	Days Lock (T1)	1977
Ecnomus tenellus		Days Lock (T1)	1977
		40 00	1977
Beetles			
Chaetarthria seminulum	NNB	4/9	pre-1906
Helochares punctatus	NNB	4/9	pre-1906

APPENDIX 6. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORDS STUDY.

SPECIES	O1	O2	O3	O4	O5	O6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
FLATWORMS																																			
Dendrocoelidae													*												*										
Dendrocoelum lacteum													3												2										
Dugesiidae																		*					*												
Dugesia tigrina																		1					1												
Polycelidae													*				*								*										*
Polycelis felina																																			5
Polycelis nigra													1																						
Polycelis tenuis																	8								1										
TRUE WORMS																																			
Oligochaeta	*	*			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
LEECHES																																			
Erpobdellidae	*	*	*		*	*	*	*	*	*	*	*	*	*					*	*		*	*	*	*	*	*		*	*	*	*	*	*	
Erpobdella octoculata	1	2	3		5		1	12	16	3	32	32	1	1				+	4	1		3	16	24	7	3	8		1	7	+	6	1	1	
Glossiphoniidae		*	*		*	*		*	*	*		*	*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Glossiphonia complanata	3	8	3		9	1		5	8	2		2	9						3	1		7	1	8	4	1	8	7	5	15		41	5	1	1
Glossiphonia heteroclita					+			1											1						1		1		2	+		+		1	
Helobdella stagnalis	8	1	1			11		4	40	1		3	2				16	4	3	6		10	16	8	3	5	8	1	1	8	8		2	54	
Hemiclepsis marginata			1									1										2			1				4						
Theromyzon tessulatum			4						+							+					1	1			3	2	+	1	8	3					
Piscicolidae	*	*			*	*		*											*			*	*	*	*		*	*	*	*		*	*		
Piscicola geometra	1	1		+	1	1		5								+			1			3	8	1	1		1	1	1	9		1	1		
WATER SNAILS																																			
Ancylidae	*	*	*	*		*		*	*			*				*		*	*	*	*	*	*	*		*	*	*	*			*			
Acroloxus lacustris			1	1		2		4								1		1	1			11	16			19			4						
Ancylus fluviatilis	273	14	10	16		16		3	16			5								24	6	1	48	16		5	3	4	1	2			1		
Hydrobiidae	*	*	*	*	*	*	*	*	*	*	*				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Bithynia leachi		1	9	3				2								32	4	2	15		2	9	72	4	112	4	1	2	130						
Bithynia tentaculata	1	6	7	6	16			5	1							12	8	3	46	+	14	17	128	16	88	18	1	9	260	3					
Potamopyrgus jenkinsi	1056	244	972	12	840	1600	7	15	1	4	1				10	7	48	4	12	88	7	1			208	11	32	12	175	1656	1	22	80	24	128
Lymnaeidae	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Lymnaea auricularia	2		3	3	1	4										4		1	14	1	2	3	24		16	2	16	1	15					1	
Lymnaea palustris	1	+		3			14	4	+			8		2								1	1			+					3	2	2	
Lymnaea peregra	32	6	90	6	496	30	1744	13	2	1	2	10	560	25		9	32	2	26		2	37	24	16	64	4	16	10	23	848	4		3	24	+
Lymnaea stagnalis	16	1	34	10	56	14		7	+	2						6	2	2	38		6	8	8	2	31	2			18	224		4040			
Lymnaea truncatula							2			6	1				1			1	1				+								4	3			
Neritidae			*	*	*	*		*								*			*	*		*			*	*		*	*						
Theodoxus fluviatilis		44	5	22	200	13		6								2			2	1		1			6	3		1	9						
Physidae	*			*												*	*	*	*	*	*	*	*		*	*	*	*	*						
Physa acuta																12	1	8	588	2	1	1			88	1	2	3	2						
Physa fontinalis	1			1												2			2		+	9	1		64	6		1	130						

APPENDIX 8. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORDS STUDY (continued).

SPECIES	D1	D2	D3	D4	D5	D6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
WATER SNAILS (continued)																																			
Planorbidae	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Anisus leucostoma							1504						86												+						1				
Anisus vortex	24	18	48	21	464	85		40	120	17	1	9	1472			33	62	14	79		5	185	88	1	336	18	1	2	785	248	+	2	5	16	
Armiger crista	3	20	18	1	176	40			2												2	1	16	24	16			2		1		2		+	
Bathyomphalus contortus		4	12	10	56	105	16	19	3	18			656	5		17	1	5	11	+	1	35	32		24	1		1	170	504		240		32	
Gyraulus acronicus																									8		1								
Gyraulus albus	32	11	543	22	256	325	1	20	3	3						7	3	1	22		5	1	24	2	56	12	+	16	4	48		1040	1	40	
Hippeutis complanatus													3			12	1		7		1	5				4			2					
Planorbarius corneus																						3							3					
Planorbis carinatus	1	1	19	7	80			14	1		1	48				12	24	1	8		1	25	8		56	2	1	2	110						
Planorbis planorbis				1			+																		8										
Valvatidae	*	*	*	*	*	*	*	*	*	*	*	*	*			*	*	*	*	*	*	*	*		*	*	*		*	*					
Valvata cristata			2	10					3			2	64			12	2					40	16						85						
Valvata piscinalis	1	16	28	30	56	70		40	16	4	2	20	1			4	112	1	37	18	2	6	16		32	5	32	13	1	17					
Viviparidae						*										*	*	*	*	*	*	*	*	*	*	*	*	*	*						
Viviparus fasciatus																2										1			1						
Viviparus viviparus						1										17	40	3	32	2	2	2	16	8	66	8	27	6	6						
BIVALVES																																			
Sphaeriidae	*	*	*	*	*	*			*		*	*							*	*	*	*	*	*	*			*	*	*		*		*	
Sphaerium corneum		4	3	1	24	30				+	+	+						+	3	1	1	13	20		3		1	1	17	2			1	+	
Sphaerium lacustris						2																	2						1						
Sphaerium rivicola					2																	1	2						2						
Unionidae																	*		*	*	*	*	*	*	*	*		*	*		*				
Anodonta anatina																	2		1	2	2	1	16	5	4	5	22	3	1		1				
Anodonta cygnea																	1	+		2	2		8	1		2	8		1						
Unio pictorum																					1														
CRUSTACEANS																																			
Asellidae	*	*	*	*	*		*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*		*	*		*		*	*
Asellus aquaticus	58	96					1152	9	2	150	4	130	536	10		21	96	48	1092	1	7	525	200	4	344	115	58	9	535					9	1
Asellus meridianus	1		5	1	32			5	5		3	2		1				3			1		1							1			1	
Astacidae		*				*																													
Austropotamobius pallipes		1				3																													
Corophiidae																	*			*	*				*										
Corophium curvispinum																	5	+		5	10				3			2							
Gammaridae	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*
Crangonyx pseudogracilis	1						4							5		15	16	12	37	2	6	615	80	1	88	150	32	1	1015						
Gammarus pulex	2	144	562	17	744	565	32	22	360	390	10	104	128			1			14		1				56		1	8	1	38		64	1600	33	1472

APPENDIX 6. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORDS STUDY (continued).

SPECIES	O1	O2	O3	O4	O5	O6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
MAYFLIES																																			
Baetidae	*	*	*	*	*	*		*	*		*	*	*			*	*	*	*			*	*	*	*	*		*	*	*		*	*	*	*
Baetis rhodani	36	2	27	4	64	61		5	6		11	6									+	3	9	14	5		1	1		8		3	26	3	1
Baetis vernus		+																																	
Centroptilum luteolum		+		+		6			1							+							1				+	3							
Cloeon dipterum	5			1				5	1			+	2			5	1	11	2	+		4	16		2	1	15	8	162	1				+	
Procloeon bifidum																						+				+									
Caenidae	*		*	*	*	*														*	*	*		*	*	*		*							*
Caenis horaria																						1			+		1	2							
Caenis luctuosa	33		43		248	3														51	6			1	3	1		138						1
Caenis macrura	3		6															+		11	1													
Caenis robusta																									1		1								
Ephemeridae	*	*	*	*	*	*												*			*		*	*		*		*	*						
Ephemera danica		5	8	7	88	42															1		8	2										
Ephemera vulgata	8	1	5	31	72	14												1			6		8	3		2	1	1	2						
Ephemerellidae	*	*	*	*	*	*		*														*								*		*	*	*	
Ephemerella ignita	19	1	66	13	320	19		4				+										2								2		1	2	1	
Leptophlebiidae			*		*	*				*																								
Habrophlebia fusca			1		8	2				4																									
DRAGONFLIES & DAMSELFLIES																																			
Aeshnidae								*								*			*				*		*	*			*						
Aeshna cyanea							+									2			1					+			1		5						
Aeshna grandis																							16		1				3						
Anax imperator																													1						
Calopterygidae	*		*	*	*	*		*	*								*		*		*	*	*	*	*			*	*						
Calopteryx splendens	1	+	32	14	17	19		10	2								1		5		1	1	16	16	2			1	1			+			
Coenagrilidae			*					*					*			*	*	*	*		*	*		*		*		*	*			*			
Enallagma cyathigerum																			2			+					1		1						
Erythromma najas																		2	7		3							1	2						
Ischnura elegans			4					2					1			1	2	2	10		3			1	2	2			9	+		2			
Gomphidae																		*																	
Gomphus vulgatissimus																		1																	
Libellulidae																												*		*					
Sympetrum sanguineum																														1					
Sympetrum striolatum												+															1	+		*					
Platycnemidae						*												*	*			*	*	*	*			*	*						
Platycnemis pennipes						2												2	26			3	32	3	2			1	1						

APPENDIX 6. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORDS STUDY (continued).

SPECIES	O1	O2	O3	O4	O5	O6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
WATER BUGS																																			
Aphelocheiridae						+															+		+	+											
Aphelocheirus aestivalis						5															1		152	368											
Corixidae	+		+	+	+	+		+			+		+				+	+	+	+		+	+				+		+	+	+	+		+	
Callicorixa praeusta																															1				
Corixa punctata						1																													
Hesperocorixa sahlbergi		+			8			4			2	+	34																						
Micronecta poweri			1		+											+	1			1									1						
Sigara distincta																							1												
Sigara dorsalis	2		60	7	232	73		7			8						2	1	36										15	1		5		1	
Sigara falleni			16	1	8	11		49			1						5		7			5												
Sigara fossarum				1	+	2													2								1								
Sigara lateralis																														11					
Sigara limitata																																		+	
Gerridae		+	+			+		+					+			+			+		+	+	+	+	+	+		+		+				
Gerris lacustris	+	1	1			1		2	+				1			3			6		2	14	3	+	5	+		+	13		1				
Gerris nympha				+	+													+						+			+					+			
Hydrometridae				+	+						+					+					+		+	+	+										
Hydrometra stagnorum				1	1					+		2				1					1		8	1	5					+					
Nepidae					+		+	+		+						+			+			+			+		+							
Nepa cinerea					1		3	1		3		4				1			2			2		+	1		1		4						
Ranatra linearis																											1								
Notonectidae			+	+		+		+					+						+		+	+	+	+	+	+	+		+						
Notonecta glauca		+	2			1		2					1						2		1		1	8	1				1						
Notonecta maculata				1				1														1													
Notonecta marmorea viridis																			2																
Veliidae					+		+		+	+		+		+																	+	+	+		
Velia caprai	+				1		4		1	1	+	3		8																	5	1	1	1		+
ALDERFLIES																																			
Sialidae	+	+	+	+	+	+	+	+		+	+	+	+			+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+		
Sialis fuliginosa					+																					1								1	
Sialis lutaria	2	4	32	10	264	13	104	26		30	105	2	131			3		2	1	1	2	41	8	+	8	11	3	10	25	428	15	54	9	1	
Sialis nigripes																							1												
CADDIS FLIES																																			
Brachycentridae			+		+																														
Brachycentrus subnubilus			1																					+										
Goeridae	+		+	+	+	+			+												+	+			+								+		
Goera pilosa	21		1	9	1	1			2													1											1		
Hydropsychidae	+	+	+	+	+	+		+	+	+	+	+							+				+	+						+					
Cheumatopsyche lepidus	1				1																														
Hydropsyche angustipennis				3	1			1	2	14		16							1				8						1						
Hydropsyche contubernalis	33	3	6	6	11	9		22															58	28											
Hydropsyche pellucidulus	14	8	17	64	7			23	113		1												104	44											
Hydropsyche silfalai								1																											
Hydroptilidae	+	+	+	+	+	+					+	+				+	+			+	+		+	+	+	+	+	+	+	+		+		+	
Agraylea multipunctata																	8		+		2				4	1	1	1							

APPENDIX 8. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORD9 STUDY (continued).

SPECIES	O1	O2	O3	O4	O5	O6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
CADDIS FLIES (continued)																																			
Leptoceridae		+	+	+	+	+		+	+							+	+	+	+		+	+	+	+	+	+	+	+	+	+					
Athripsodes albifrons	47		10		13	7		1																											
Athripsodes aterrimus					1																								1						
Athripsodes cinereus	4	1	2		3				1												1														
Ceraclea dissimilis	2																																		
Mystacides azurea	8	156	19	1	2	8		19	4																1					28		+			
Mystacides longicornis			1													1	+		1		11	2	8		28	3	3	4	2						
Mystacides nigra					1											4	1		8		6	6		1	13			5	1						
Oecetis lacustris																		1				3			2			+							
Triaenodes bicolor																												+	5						
Limnephilidae		+	+	+	+	+	+	+					+	+			+	+			+	+	+	+	+	+	+	+	+	+				+	+
Anabolia nervosa		1		1													1	1			4						9	1	2						
Chaetopteryx villosa																																		1	1
Crunoecia irrorata																								4											
Drusus annulatus																																			6
Halesus digitatus		2			1																													+	
Halesus radiatus	1		1	7	1	1		2													+	1	10			+	2	2	2						1
Limnephilus lunatus	5	3	38	6	23	5	1	19					11	2			1					3	1		5	2	1	1	1	1					
Potamophylax cinqulatus																																			2
Potamophylax latipennis	4																											1							+
Potamophylax rotundipennis	2			2		1																													
Molannidae			+		+	+		+											+			+			+	+	+	+	+					
Molanna angustata			5		1	1		27											1			1			1	2	2	3	3						
Phryganeidae								+								+	+	+	+		+		+	+	+	+	+	+	+						
Phryganea bipunctata								6								6	2	1	7		6		1	4	1	1	13	1	18						
Polycentropodidae + Ecnomidae		+		+	+			+									+	+	+	+	+	+	+	+	+	+	+	+	+						+
Cyrnus flavidus																	1	1	1		3				3	1	6	3	2						
Cyrnus trimaculatus																	1	4		7	3		2				4	5							
Ecnomus tenellus																	+																		
Neureclepsis bimaculata																							8	2											
Plectrocnemia conspersa																							8												1
Polycentropus flavomaculatus	9	17		1	1			3													2	6	48	13											
Psychomiidae	+							+	+							+		+		+	+	+	+		+		+	+	+						
Lype phaeopa																					2	1							1						
Lype reducta																2		3			2		8				1								
Tinodes waeneri	2							1	2									+		6	1				1		2	1							
Sericostomatidae																														+					+
Sericostoma personatum																														6					6

APPENDIX 6. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORDS STUDY (continued).

SPECIES	O1	O2	O3	O4	O5	O6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
WATER BEETLES																																			
Dryopidae	+											+																							
Dytiscidae + Noteridae	+	+	+	+	+	+		+	+	+	+		+	+			+		+			+	+	+	+	+	+	+	+	+	+	+	+	+
Agabus bipustulatus		+					+	1	+		+			4																					
Agabus chalconatus														7																					
Agabus didymus							+				1		2	+					1					+							+				
Agabus paludosus												+																		1					
Agabus sturmi													2									2													
Coelambus impressopunctatus																																		+	
Hydroporus discretus															1																				
Hydroporus incognitus																						1													
Hydroporus nigrita														2																					
Hydroporus palustris		+					4					+	35	3											1					1			+		+
Hygrotus inaequalis																																		1	
Hygrotus versicolor																						9			2										
Hyphydrus ovatus		1	3		1	2							1						3				1		1	1		1	3	8				
Ilybius ater																	1																		
Ilybius fuliginosus		+				2	1	1	+	1	1	2	10					+	1					1					1		3		+	
Ilybius quadriguttatus																																			
Laccophilus hyalinus																	1		27	+	+		1	+	3	1		+	15						
Noterus clavicornis																+	+		1			1			7	8			1						
Oreodytes sanmarkii																																	2	3	1
Platambus maculatus	1	+	3	2	7	15		1	1	2	+													+			1	+			1	1			
Potamonectes depressus elegans	+	26	12	2	10	5		3	16		54						1				+	1	2	1	2	2	2	5		9		3			
Stictotarsus duodecimpustulatus								2															1					1							
Elmidae		+	+	+	+	+		+	+	+		+	+						+	+	+	+	+	+	+					+		+	+	+	+
Elmis aenea	8	132	21	74	176	36		4	3	84		1	2																	1			429	1	2
Limnius volckmari		2	+	7																		2											57		
Oulimnius tuberculatus	4	52	21	13	208	12		4	4	39									1		1		8		1					3		1	3	1	
Riolus subviolaceus																																			5
Haliplidae		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	
Brychius elevatus		1	2	57	9	22		2		1			1			1																	+		
Haliplus flaviocollis																+					+				+			3	3					
Haliplus fluviatilis	+		41	2	24	5			+		+					3	4	2	41		4	+			10	5	8	17	21						
Haliplus immaculatus																			7							1	+		12						
Haliplus laminatus																			5													1			
Haliplus lineatocollis	+		17	4	16	3	18	1	3		3	4	29	7		1			29						4				1	2	1	1	1		
Haliplus obliquus																			1																
Haliplus ruficollis				1			+						1									2		1		1		1	7						
Haliplus wehnckei										+																									

APPENDIX 6. MACROINVERTEBRATE SPECIES RECORDED IN PHASE 1 OF THE SWORDS STUDY (continued).

SPECIES	O1	O2	O3	O4	O5	O6	N1	C1	C2	C3	L1	L2	CC1	CC2	CC3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	G1	G2	G3	G4	G5	G6
Hydrophilidae + Hydraenidae			+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+			+						+	+	+	+	+			
Anacaena bipustulata				+					1																				2						
Anacaena globulus			2				10			2	1		8	10															6		5	1	3		
Anacaena limbata				1		2	1							1	2	1				+									7						
Cercyon convexiusculus							+																												
Helophorus brevipalpis					48		6		+			1	1	12			1	+				1									6	2			
Helophorus grandis																																1			
Helophorus minutus																																1			
Hydraena riparia													1																						
Hydrobius fuscipes				1									5									2							1	2					
Laccobius bipunctatus							2			2														+					1			1			
Laccobius minutus							+			+						+	6		1					+					1						
Laccobius sinuatus																	1												1						
Laccobius striatulus									+			+						1										8							
Ochthebius dilatatus																														1	+				
Ochthebius minimus										3	+			1	1																				
Gyrinidae		+	+	+	+	+		+	+				+								+				+	+								
Gyrinus substriatus													2	+													+								
Gyrinus urinator				1					2				2																						
Orectochilus villosus	1	4	3	1	4			2																											
FLIES																																			
Chironomidae	+	+		+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Simuliidae	+	+	+	+	+	+		+	+														+	+					+	+				
Tipulidae	+	+	+	+	+	+		+	+	+	+								+			+			+				+			+	+	+
TOTAL NUMBER OF SPECIES	53	52	61	61	62	55	32	60	50	30	27	33	38	24	5	44	44	44	61	27	58	65	53	47	67	50	53	61	78	40	19	33	26	30	20

APPENDIX 7. RARE, NOTABLE AND LOCAL SPECIES OF MACROINVERTEBRATES RECORDED DURING THE SWORDS STUDY

Red Data Book species are marked with an asterisk *.

Glossiphonia heterocilta (HIRUDINEA: Glossiphoniidae). A leech

(O5, C1, T4, T10, T12, T14)

A species, chiefly of lakes and ponds and marginal vegetation in slow flowing rivers. The species is widespread but nor common. (Elliott and Tullet,1982).

Hemiclepsis marginata (HIRUDINEA: Glossiphoniidae). A leech

(O3, L2, T7, T10, T14)

An ectoparasite of freshwater fish and amphibian larvae. Widespread but not common in the British Isles. (Elliott and Tullet, 1982).

Bithynia leachi (GASTROPODA: Hydrobiidae). Leach's Bithynia.

(O2, O3, O4, C1, T1, T2, T3, T4, T6, T7, T8, T9, T10, T11, T12, T13, T14)

This snail is confined to south-east England, where it is locally common in large ponds and slow-flowing rivers. (J.Bratton, pers. comm.).

Gyraulus acronicus (GASTROPODA: Planorbidae). The Thames Ramshorn.

A Red Data Book 2 (RDB2 - Vulnerable) species. No live snails were found in this survey although empty shells were found at T10 and T12. In Britain the snail is only found in the upper reaches of the Thames (Marlow to Oxford) and some of its tributaries. The species apparently lives in quiet backwaters of the river and is rarely found alive. There are 11 recent 10 km. square records for this species.

Viviparus fasciatus (GASTROPODA): Viviparidae). Listers's River Snail.

(T2, T11, T14)

A species of slow-flowing rivers and large ponds. The species is locally common in much of the south east of England. (Kerney,1976 and Macan 1977).

Austropotamobius pallipes (MALACOSTRACA: Astacidae). The Atlantic Stream Crayfish.

(O2, O6)

A species of rivers, streams and, occasionally, ponds. The species is listed under Schedule 5 of the Wildlife and Countryside Act. The species has suffered declines in recent years due to the spread of the Signal Crayfish (*Pacifastacus leniusculus*) which carries a fungal disease to which *A.pallipes* has little immunity. (Hogger. 1988).

Caenis macrura (EPHEMEROPTERA: Caenidae). An anglers' curse.

(O1, O3, T3, T5, T6)

A species of rivers usually in silt. One of the less common caenids. (Elliott et. al.1988).

APPENDIX 7. RARE, NOTABLE AND LOCAL SPECIES OF MACROINVERTEBRATES RECORDED DURING THE SWORDS STUDY (continued)

Caenis robusta (EPHEMEROPTERA: Caenidae). An anglers' curse.

(T10, T12)

A species of rivers, canals and ponds. The species is widely scattered in the south east of England but Notable in the north. (Elliott et. al., 1988, Ball, 1986).

Erythromma najas (ODONATA: Coenagrionidae). The Red-eyed Damselfly.

(T3, T4, T6, T13, T14)

Locally common, predominantly in the south of England. Generally associated with large ponds and lakes. (Hammond and Gardner, 1985.)

Gomphus vulgatissimus (ODONATA: Gomphidae). The Club-tailed Dragonfly.

(T3.)

Nationally Notable A. Well-established in several localities along the Thames, Wye and Severn rivers and in Sussex, but does seem to be declining. Breeds in slow-flowing streams and rivers with sandy or silty bottoms. (Hammond and Gardner, 1985.)

Platycnemis pennipes (ODONATA: Platycnemididae). The White-legged Damselfly.

(O6, T3, T4, T7, T8, T9, T10, T13, T14.)

Nationally Notable B. Locally common, where it occurs, in southern and midland counties of England, but appears to be susceptible to even slight pollution. Prefers streams and rivers with abundant marginal and aquatic vegetation. (Hammond and Gardner, 1985.)

Aphelocheirus aestivalis (HETEROPTERA: Aphelocheiridae) A saucer bug.

(O6, T6, T8, T9.)

Nationally Notable B. Widespread but very scarce over most of England and Wales. Requires clean, well-oxygenated water and is usually found in fast-running rivers with gravel or stony bottoms. (Savage,1989; Fitter and Manuel, 1986.)

Notonecta marmorea viridis (HETEROPTERA: Notonectidae). A greater water boatman.

(T4.)

Appears at present to be an uncommon species which was in the past restricted to coastal areas of southern England, but is now moving inland and increasing greatly in numbers. Found in ponds and gravel pit lakes. (Savage, 1989 and Pond Action, unpublished data.)

Ranatra linearis (HETEROPTERA: Nepidae). The Water Stick Insect.

(T12.)

A local and scarce species which prefers ponds and lakes, but is also found in slow-flowing rivers. Requires some plant cover. (Savage, 1989 and J. Bratton, pers. comm.)

APPENDIX 7. RARE, NOTABLE AND LOCAL SPECIES OF MACROINVERTEBRATES RECORDED DURING THE SWORDS STUDY (continued)

Sialis fuliginosa (MEGALOPTERA: Sialidae). An alderfly.

(O5, T11.)

Little is at present known of the distribution or ecology of this species, but it is thought to be less common than *S. lutaria* and is known to be limited to moderately fast streams and the upper reaches of rivers. (Elliott, O'Connor and O'Connor, 1979.)

Sialis nigripes (MEGALOPTERA: Sialidae). An alderfly.

(T8).

The existence of this third *Sialis* species in Britain was established in 1977, and as yet no clear picture of its status and distribution has emerged, though it would appear to have a distribution similar to a Nationally Notable A species. The species has been recorded from the south of England and from Ireland, and appears to be restricted to running water. (Elliott, O'Connor and O'Connor, 1979.)

Brachycentrus subnubilus (TRICHOPTERA: Brachycentridae). A cased caddis fly.

(O3, T9.)

Locally abundant throughout Britain. Found in moderate to fast flowing streams and rivers with some submerged vegetation. (Wallace, 1991.)

Cheumatopsyche lepidus (TRICHOPTERA: Hydropsychidae). A caseless caddis fly.

(O1, O5.)

Common in the south, but rarer in the north, Wales and Scotland. Usually found in large streams and occasionally rivers, generally "low down on a watercourse where the water is warm and rich". (Wallace, 1991.)

Ecnomus tenellus (TRICHOPTERA: Ecnomidae). A caseless caddis fly.

(T2.)

Locally common in the south of England but rarer elsewhere. Found in slow rivers, canals and lakes on a variety of substrata, often at considerable depth. (Wallace, 1991.)

Hydropsyche contubernalis (TRICHOPTERA: Hydropsychidae). A caseless caddis fly.

(O1, O2, O3, O4, O5, O6, C1, T8, T9.)

Generally common in England but less so in the north and in Scotland. Found in rich streams and rivers in the south. (Wallace, 1991.)

Mystacides nigra (TRICHOPTERA: Leptoceridae). A cased caddis fly.

(O5, T1, T2, T4, T6, T7, T9, T10, T13, T14.)

Locally common throughout England and Wales but uncommon in Scotland. Found in streams, lakes, rivers and canals on a variety of substrata but not usually mud. (Wallace, 1991.)

APPENDIX 7. RARE, NOTABLE AND LOCAL SPECIES OF MACROINVERTEBRATES RECORDED DURING THE SWORDS STUDY (continued)

Potamophylax rotundipennis (TRICHOPTERA: Limnephilidae). A cased caddis fly.

O1, O4, O6.)

Restricted to England where it is locally scarce. Found in streams and small rivers with a sandy bottom. (Wallace, 1991.)

Agabus chalconatus (COLEOPTERA: Dytiscidae). A diving beetle.

(CC2)

Nationally Notable B. A species of shaded, often acid water. The species is locally common throughout southern England but uncommon in the north. Friday, (1988).

Anacaena bipustulata (COLEOPTERA: Hydrophilidae). A hydrophilid water beetle.

(O4, C2, T14)

Nationally Notable B. Frequent in the south, and in the eastern part of the Midlands.
Found in streams, rivers and pits. (L. Friday, 1988; Foster, 1987)

Cercyon convexiusculus (COLEOPTERA: Hydrophilidae). A hydrophilid water beetle.

(N1)

Nationally Notable B. This species has a scattered distribution throughout Britain, but mainly eastern. Typical of fen litter. (Friday, 1988; Foster,1987.)

Gyrinus urinator (COLEOPTERA: Gyrinidae). A whirligig beetle.

(O4)

Nationally Notable B. A species, principally, of rivers. The distribution is mainly coastal and southern. There is only one recent record for Oxfordshire, from the Hinksey Stream. (Foster 1985).

Haliplus laminatus (COLEOPTERA: Haliplidae). A haliplid water beetle.

(T4)

Nationally Notable B. The distribution pattern shows this species to be confined to the eastern half of England (pre-1950 records suggest that it has declined drastically in the west.) Found in canals, rivers and silt ponds. (Foster 1981

Haliplus obliquus (COLEOPTERA: Haliplidae). A haliplid water beetle.

(T4)

Widespread but local, occurring throughout Britain except the Highlands. Apparently associated with stoneworts. (Foster, 1981.)

APPENDIX 7. RARE, NOTABLE AND LOCAL SPECIES OF MACROINVERTEBRATES RECORDED DURING THE SWORDS STUDY (continued)

Red Data Book species are marked with an asterisk *.

Hygrotus versicolor (COLEOPTERA: Dytiscidae). A diving beetle.

(T7, T10)

Found mainly in clay pits and fen drains, though the natural habitat is presumably rivers such as the Thames. The species is locally scattered throughout eastern England. (Foster, 1981).

Laccobius sinuatus (COLEOPTERA: Hydrophilidae). A water scavenger beetle.

(T2, T14)

Nationally notable B. A species more usually found in new ponds, and particularly gravel-pit lakes. The species is local and scarce throughout England. (Friday, 1988).

APPENDIX 8 ACRONYMS

ASPT	Average Score Per Taxon
BMWP	Biological Monitoring Working Party
EQI	Ecological Quality Index
EN	English Nature
IFE	Institute of Freshwater Ecology
JNCC	Joint Nature Conservation Committee
NCI	National Conservation Index
NCS	National Conservation Score
NRA	National Rivers Authority
PA	Pond Action
RDB	Red Data Book
RIVPACS	River Invertebrate Prediction and Classification System
STW	Sewage Treatment Works
SWORDS	South-West Oxfordshire Reservoir Development Study
TWUL	Thames Water Utilities Limited

APPENDIX 9 PHOTOGRAPHS

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Ock 1. Ock Bridge, Abingdon. Taken from footbridge looking upstream.

Ock 2. New Cut Mill. Taken from left bank looking upstream.

Ock 3. Marcham Mill Road. Taken from bridge looking upstream.

Ock 4. Noah's Ark. Taken from bridge looking upstream

Ock 5. Near College Farm. Taken from footbridge looking downstream.

Ock 6. Ock Bridge, road to West Hanney. From bridge, looking upstream.

Nor Brook 1. Common Barn Road. Taken from the bridge looking upstream.

Letcombe Brook 1. Taken from the bridge looking upstream.

Letcombe Brook 2. Weir Farm, East Hanney. Taken from the road bridge looking downstream.

Childrey Brook 1. Marcham Mill. From the bridge, looking upstream.

Childrey Brook 2. Common Barn Road. From the bridge looking downstream.

Cow Common Brook 1. From near Marcham Mill. Looking downstream.

Cow Common Brook 2. Looking downstream from the road bridge.

Cow Common Brook 3. Looking downstream from bridge.

Thames 1. Days Lock. From east bank of river looking upstream.

Thames 2. Days Reach. From west bank of river, looking upstream.

Thames 3. Clifton Bridge. From bridge looking upstream.

Thames 4. Long Wittenham. From west bank looking upstream.

Thames 5. Clifton Reach. From the south bank, looking downstream.

Thames 6. Sutton Pools. From south bank looking upstream.

Thames 7. Culham Reach. From east bank looking upstream.

Thames 8. Backwaters (south). Looking upstream from east bank.

Thames 9. Backwaters (north). Taken from the river, looking upstream.

Thames 10. Abingdon Weir. Looking downstream from north end of footbridge.

Thames 11. Near Lock Wood, Nuneham. From north bank, looking downstream.

Thames 12. Radley. Taken from west bank looking upstream.

Thames 13. Sandford Reach. Taken from west bank looking downstream.

Thames 14. Sandford Lock. Taken from west bank looking upstream.

Childrey Brook 3. Gallows Bridge. From the road bridge looking upstream.