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National Rivers Authority

UPPER KENNET
WEED GROWTH INVESTIGATION

Volume 1 : Final Report

May 1994

HALCROW

National Rivers Authority

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For the attention of Dr Maxine Forshaw

26 May 1994 Our ref: WE/UKW/10/047 Your ref:

Dear Sirs

UPPER KENNET WEED GROWTH INVESTIGATION
Final Report

Please find enclosed ten full colour copies of our Final Report as requested. A single ringbound copy of Volume 2 of the report, containing photographic slides, has also been provided as agreed.

We hope that these meet with your satisfaction and look forward to working with you again in the future. If you have any queries or comments regarding the project please do not hesitate to contact Richard Ashby-Crane.

Yours faithfully

P J HAWKER

Enc

National Rivers Authority
Upper Kennet Weed Growth Investigation
Final Report

Contents Amendment Record

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed
1	0	Final Report	27.05.94	R. Ashby-Crane

The Kennet is assuredly of noble birth; for it is the offspring of the once sacred upland pastures of Avebury, where stand the uncanny fragments of the great prehistoric temple of the sun, and twines its infant arms around the mighty and mysterious mound of Silbury : the child, in fact, of one of the three great wonders of Britain, leaving Stonehenge to its rival the southern Avon.

G Bradley (1909)

Acknowledgements

We wish to thank Dr Nigel Holmes for his help throughout this investigation and would also like to express our appreciation to all those people who provided valuable information during the consultation phase of this investigation; Dr Jack Oliver, the members of Action for the River Kennet, various riparian owners and river keepers.

NATIONAL RIVERS AUTHORITY, THAMES REGION
UPPER KENNET WEED GROWTH INVESTIGATION

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SUMMARY

For several years there has been much local concern over low flows and low water levels in the River Kennet and the associated deterioration in ecological interest. One issue highlighted in the 'River Kennet Catchment Management Plan, Consultation Report' (NRA 1993) was changes in the abundance and community structure of aquatic weeds. Perceived changes included the increasing prevalence of terrestrial plants in the headwaters, reduction in the abundance of Water-crowfoots (*Ranunculus* spp.) and proliferation of filamentous algae (eg *Cladophora* sp.) and Water-cress (*Nasturtium officinale*).

As a result of these perceptions, Sir William Halcrow and Partners Ltd (Halcrow) was commissioned by the NRA in August 1993 to undertake an investigation of weed growth and weed management practices in the Upper Kennet.

The project consisted of two main components:

- a baseline survey of aquatic weeds
- a review of problems and management practices

Analysis of the baseline survey, carried out in autumn 1993, showed that different river reaches were characterised by different macrophyte communities. The upper winterbourne (intermittently flowing stream) was dominated by terrestrial plant species, which were supplanted by winterbourne specialists (capable of thriving in conditions of ephemeral flow) such as Fool's Water-cress (*Apium nodiflorum*), Floating Sweet-grass (*Glyceria fluitans*) and Pond Water-crowfoot (*Ranunculus peltatus*) further downstream. Plant communities indicated that Fyfield Sewage Treatment Works (STW) and the nearby active springs appeared to be the current perennial head of the river. Downstream of this point aquatic weed communities became more diverse and typical of mature chalk streams, with abundant Brook Water-crowfoot (*Ranunculus penicillatus* ssp. *pseudofluitans*), Starwort (*Callitriche* sp.), Water-cress and other emergent species. Growths of filamentous algae and brown algal slimes (benthic diatoms) were common throughout the study area, but these were never prolific or at nuisance levels.

The local distribution of macrophytes was profoundly affected by flow conditions. The faster, less silted reaches showed abundant submerged weed (eg Water-crowfoot and Starwort) whereas the deeper, slower flowing reaches had sparse macrophyte cover or were dominated by emergents such as Water-cress.

Downstream of Marlborough, water velocities and levels are largely dictated by the hatch and weir regime which has been maintained for fisheries management since the demise of the water meadow systems. In general, high velocities and good submerged plant growth occurred immediately downstream of hatches, weirs and groynes etc. Conversely where water backs-up upstream of these structures, the sluggish flows and deep water are reflected in the less diverse macrophyte communities.

Observations and consultations suggest that river flows and macrophyte communities may now be recovering from the drought. Many river keepers carried out weed-cuts in 1993 (albeit generally light), for the first time in several years. In the winterbourne section of the river it is suggested that aquatic plant communities might be 'migrating'

back upstream in response to increased flow strength and duration. Weed-cutting in the winterbourne section appeared to lack selectivity and sensitivity, resulting in ecological and aesthetic damage to the river.

Several recommendations for further investigation, monitoring and management of the Upper Kennet are made in the report. Largely these involve:

- monitoring future changes in the aquatic weed community;
- investigating opportunities for river restoration and enhancement in collaboration with riparian owners, river keepers and organisations such as English Nature and the Countryside Commission;
- investigating the potential for the formation of 'partnerships' for the future management of the river;
- investigating alternative weed management techniques for the winterbourne section of the river;
- further investigation of the significance of groundwater abstractions on river flows; and
- identification of a 'vision' for the Upper Kennet, which would embody realistic environmental objectives and provide a focus for future management and enhancement works. This should be addressed in the forthcoming Kennet Catchment Management Plan, Final Report.

1 INTRODUCTION

1.1 The Project

1.1.1 The Problem

For several years there has been concern over low water levels/flows, and associated changes in riverine ecology, in the upper River Kennet (Figure 1). In recognition of these problems the National Rivers Authority (NRA) Thames Region commissioned an investigation of groundwater levels, surface water flows and environmental quality (Atkins 1992). This investigation formed the basis of the 'Upper Kennet - First Action Plan' (NRA 1992) the objectives of which are laid out in the 'River Kennet Catchment Management Plan, Consultation Report' (NRA 1993).

In early 1989, at a public meeting called by Ramsbury Parish Council, grave concern at the state of the River Kennet was expressed. Thames Water, who were at that time the responsible Authority, were called upon to redress the damage being caused by persistent low flows.

Public distress at the continuing deterioration in the environment of the River Kennet resulted in another public meeting in Marlborough Town Hall in January 1991. As a result of this meeting Action for the River Kennet (ARK) was formed (see section 3.2.7).

The perceived changes in the environmental quality of the Upper Kennet are well documented (Atkins 1992). The apparent impacts are synonymous with those described in many chalk streams in southern England (section 1.2.4) in the Upper Kennet. In summary the major concerns are:

- apparent movement downstream of the perennial head;
- reduced period of flow of the winterbourne section;
- increase in prevalence of terrestrial plant species within the winterbourne channel;
- increase in abundance of vigorous emergent aquatics such as Water-cress *(Nasturtium officinale)* and Fool's Water-cress (*Apium nodiflorum*);
- reduction in the quantity and quality of desirable submerged weed such as Water-crowfoots *(Ranunculus spp.)*, and to a lesser extent Starwort (*Callitriche* sp.), in the perennial river;
- increase in the silted nature of the gravels and associated reduction in trout spawning areas;
- increase in abundance and longevity of blooms of benthic diatom algae and filamentous algae/blanket weed (eg *Cladophora* sp.); and

- increase in the 'flashy' nature of the river, especially above Marlborough.

In an investigation of the causes of the problems in the Upper Kennet, Atkins (1992) concluded that:

- abstraction was playing no significant part in the low flows and associated problems upstream of Marlborough;
- abstraction was a significant contributory factor to reduced flows and associated problems in the reach between Marlborough and Knighton;
- the primary cause of low flows was the severe drought; and
- the main contributory factor to reduced river levels was loss of weed.

There are however a number of people, including ARK, who are highly critical of these conclusions. The final point above appears to have a ring of the 'chicken and the egg' with reduced flow velocities and levels almost certainly being a promotional factor in the loss of weed.

As a result of concerns regarding weed growth, in August 1993, the NRA commissioned Sir William Halcrow and Partners Ltd (Halcrow) to undertake an investigation of weed growth and weed management practices in the Upper Kennet. This report details the results of this investigation.

1.1.2 Objectives

The Terms of Reference (TOR) for this investigation are reproduced in Appendix A. The overall objective of the study was:

- to obtain a comprehensive survey of weed growth in the upper Kennet.

Specific objectives to be fulfilled within this remit were:

- to assess current problems with aquatic weed growth;
- to obtain a baseline against which future changes can be measured;
- to review current management practices;
- to make recommendations and produce guidelines concerning management of aquatic weed; and
- to produce a report which can be used to give clear objective information both to the general public and to action groups.

1.1.3 Approach

It was recognised that the project would contain two main elements:

- survey of aquatic weeds
- review of problems and management practices

Originally it was planned that the weed survey would involve a short monitoring programme; aquatic weeds being surveyed at twenty key reaches once per month, over a three month period. It was also intended that quantitative monitoring of targeted stands of vegetation would also be carried out. However, due to the time of year that the project was awarded it was decided that this was unlikely to be a valuable exercise. In conjunction with the NRA Project Manager it was agreed that survey time would be reduced to allow for greater consultation with river keepers and organisations with management interests.

The weed survey involved the following steps:

- initial walkover survey to identify key reaches;
- recording of aquatic plant species and river characteristics at a number of 10m (approx) long sites. Many of these sites were surveyed twice;
- recording of aquatic plant species and river characteristics at a number of key reaches of approximately 100m in length. All of these sites were surveyed twice (ie at the beginning and end of the survey period); and
- production of a photographic record of sites and interesting river features.

The assessment of management practices and issues of major concern was carried out through:

- review of relevant literature; and
- consultation with river keepers and relevant organisations.

Full descriptions of the methods for weed survey and management review are given in Sections 2.1 and 3.1 respectively.

The results of these component investigations provide the basis of a discussion of the interactions between weed growth and river management and for the production of recommendations and guidelines for future management of aquatic weed growth.

1.2 Background

1.2.1 The River Kennet

The River Kennet rises in the Marlborough Downs to the south of Swindon (Figure 1); the headwater/winterbourne section then flows south past the stone circle at Avebury, to Swallowhead Springs near Silbury Hill. Swallowhead Springs is considered the traditional head of the River Kennet although the river has often been dry (Atkins 1992; Maurice 1947) for several kilometres downstream of this point. From these springs the river flows eastwards through the towns of Marlborough, Hungerford and Newbury to its confluence with the River Thames at Reading. The Kennet has a catchment area of more than 1000 km^2 and in summer it may provide almost half the flow of the Thames. The main river is nearly 100km in length and its major tributaries are the Lambourne and the Enbourne, which enter the Kennet at Newbury and Aldermaston respectively.

The majority of the catchment overlies chalk and the summer flow of the river is provided mainly from the groundwater of the Marlborough and Berkshire Downs. The upper reaches of the Kennet, and its chalk stream tributaries, are of a winterbourne nature and are thus subject to a degree of seasonal migration of source.

The Kennet and its tributaries are generally of good water quality and high conservation value. Between West Kennett and Hungerford river quality was high (National Water Council class 1B) in the years 1989 to 1991 but a reduction in quality (NWC class 2A) was noted in 1992. The River Quality Objective (RQO) for this stretch of the river is class 1A. The diverse range of riverine and wetland habitats support rich plant and aquatic invertebrate communities. This and the valuable riparian wildlife are reason for possible future designation by English Nature (EN) as a riverine Site of Special Scientific Interest (SSSI). The river is also renowned as a high class game and, in its lower reaches, coarse fishery. Between Marlborough and Reading the Kennet is designated as a salmonoid water under the EC Fisheries Directive.

1.2.2 The Study Area

This investigation considers the upper section of the River Kennet between its source at Uffcott and the NRA gauging station at Knighton, just downstream of Ramsbury (Figures 1 and 2). Between these points the Kennet receives only two major tributaries, the Og at Marlborough and the Aldbourne at Knighton. Both of these tributaries, particularly the Og, are also subject to concern over low flows.

In the past much of the Kennet Valley was managed as water meadows and the river had many mills associated with it. Historically mills and water meadows were located as far upstream as West Overton. Many parallel channels and cuts exist alongside the river downstream of Marlborough as relics of this previous management regime. Today, management upstream of Marlborough is largely restricted to maintenance works necessary for

flood protection. Downstream of Marlborough the river is intensively managed as a fishery. In common with changing views on land drainage/flood defence works and the environment, the majority of work now carried out on the Upper Kennet, both by the NRA and riparian owners, is of a restorative/enhancement nature or related to routine maintenance (e.g. weed cutting).

Within the study area there are two major discharges from Thames Water Sewage Treatment Works (STW's), one at Fyfield and one at Marlborough. There are several other discharges from smaller works. The Kennet also supports, and receives effluent from, a fish farm at Mildenhall.

1.2.3 Aquatic Weed Growth In Chalk Streams

As a background to the weed survey of the Upper Kennet this section describes the classic plant assemblages of chalk streams and winterbournes.

Listed below are some of the most common plant species found in the winterbourne, upper perennial and middle sections of chalk streams (Holmes 1992; Mantle and Mantle 1992; Giles et al 1991).

Common in winterbournes are:

- *Alopecurus geniculate* Marsh Foxtail
- *Apium nodiflorum* Fool's Water-cress
- *Veronica beccabunga* Brooklime
- *Ranunculus peltatus* Pond Water-crowfoot
- *Nasturtium officinale* Water-cress
- *Glyceria fluitans* Floating Sweet-grass
- *Mentha aquatica* Water-mint
- *Myosotis scorpioides* Water Forget-me-not
- *Phalaris arundinacea* Reed Canary-grass
- *Veronica spp.* Speedwells
- *Berula erecta* Lesser Water-parsnip

Common in the upper perennial reaches of chalk streams are:

- most of the above
- *Fontinalis antipyretica* Willow Moss
- *Ranunculus penicillatus* ssp. *pseudofluitans* Brook Water-crowfoot
- *Callitriche stagnalis* Common Water-starwort
- *Callitriche obtusangula* Blunt-fruited Starwort

Often appearing in the middle reaches of chalk streams are:

- *Myriophyllum spicatum* Spiked Water-milfoil
- *Zannichellia palustris* Horned Pondweed
- *Potamogeton pectinatus* Fennel-leaved Pondweed

- *Nuphar lutea* — Yellow Water-lily (slower and lower reaches

Bankside and emergent plants characteristic throughout chalk streams include:

- many of the winterbourne plants mentioned above
- *Phragmites australis* — Common Reed
- *Sparganium erectum* — Branched Bur-reed
- *Glyceria maxima* — Reed Sweet-grass
- *Carex acutiformis* — Lesser Pond-sedge
- *Epilobium hirsutum* — Great-hairy Willowherb
- *Eupatorium cannabinum* — Hemp Agrimony
- *Filipendula ulmaria* — Meadowsweet
- *Scrophularia auriculata* — Water Figwort

The flow regime of the winterbourne (as described in Section 1.2.4) means that perennials able to withstand long periods of drying such as Floating Sweet-grass, Marsh Foxtail and Fool's Water-cress, as well as annuals capable of rapid recolonisation on the resumption of flow such as the speedwells and Water-cress are favoured (Holmes 1992). In ephemeral streams Pond Water-crowfoot, which produces viable seeds that can germinate after the resumption of flow (Ladle 1989), is favoured over Brook Water-crowfoot, which reproduces largely by vegetative means.

Thus in the winterbourne an annual cycle occurs whereby specially adapted aquatic plants dominate during the wet periods whilst terrestrial species, such as nettles (*Urtica dioica*) and various grasses (eg *Agrostis stolonifera*), may invade the channel to a greater or lesser extent depending on the length of time the channel is dry. Fool's Water-cress tends to be more successful than Water-cress in ephemeral streams; shallow water, dry periods, lack of management (cutting) and shade (Thommen and Westlake 1981) apparently favouring the former.

In the perennial chalk stream a flow related cycle also occurs (Giles et al 1991; Holmes, 1992; Mantle and Mantle 1992). In late winter, spring and early summer Brook Water-crowfoot, which for healthy growth requires fast flows, clean gravels and highly oxygenated water (Westlake 1967, 1968 and 1973; and Dawson 1979), reproduces rapidly and forms large rafts within the stream. As the spring flows diminish through the summer months and water velocities decrease Water-cress (less often Fool's Water-cress or Lesser Water-parsnip) begins to dominate the stream flora, often resulting in huge beds by the late summer and autumn. This simplified cycle is made more complex by the interactions of the plants themselves and the river hydrology. Large rafts of Water-crowfoot may modify the flow regime in the stream; raising water levels, creating areas of reduced velocity and encouraging siltation. This process is not only self-limiting to the crowfoot but may encourage the growth of plants like Water-cress. Broken pieces of cress may drift downstream, lodge in the crowfoot and, finding suitable conditions for growth, become dominant in the later part of the summer. Shading of the crowfoot by the cress may also add to its recession. The

high winter flows combined with frosting cause the cress to be uprooted from its soft unstable substrate, clearing the channel for the cycle to start once again.

1.2.4 Low Flows in Chalk Streams

There is widespread concern over the prolonged low flow conditions existing in many chalk streams in the south of England. In some cases the combined effects of several years of unusually low rainfall and insensitive abstraction from chalk aquifers appear to have caused considerable ecological damage to chalk stream ecosystems.

The hydrology of chalk streams and chalk aquifers may be summarised as follows (Mantle and Mantle 1992) .

Rain falling on the thin downland soil percolates through the chalk and accumulates in the underground aquifer. Where the top of the saturated rock (the water table) meets the surface, springs flow and wet flushes may develop. The height of the water table varies in response to rainfall, the rate of discharge to surface waters and the rate of abstraction from boreholes. As the water table recedes during the summer months higher springs may fail; the streams issuing from these springs will flow ephemerally and are termed winterbournes. Flow from perennial springs will vary in strength with this annual cycle but in general the aquifer will provide a buffer against short term flow variations.

Traditionally then these chalk streams are characterised by crystal clear water, stable temperatures and unfailing flows due to the purifying and stabilising effects of the chalk aquifer. In many cases these properties have been compromised in recent years by a number of factors including:

- increasing run-off from hard surfaces;
- change from pasture to arable farming;
- decline in traditional water meadow management;
- long term drought; and
- draw down of water tables due to pumped abstractions.

Ecological impacts associated with groundwater abstractions are hard to distinguish from those resulting from drought, changing land use and river management practices. In many places the closure of mills and the abandonment of water meadows and traditional management regimes, as well as land drainage works, have had an effect upon river levels, aquatic weed growth and erosion/deposition of bed substrate.

The scientific detection of impacts on riverine ecology resulting from abstraction is also difficult, due to:

- lack of comparable historic data;
- changes in river management;
- climatic variation, and
- conflicting eyewitness accounts.

Reduced flows in chalk streams have three main effects on the riverine environment:

- long term drying of ephemeral reaches;
- movement downstream of the perennial head;
- lower water levels and velocities in the perennial river.

The major impacts of these changes on river habitats and macrophytes are summarised below.

- reduction in water levels and wetted area;
- increased siltation of river gravels;
- apparent reduction in the scope for growth of Water-crowfoot
- increase in prevalence of filamentous algae eg *Cladophora* spp;
- increase in prevalence of unsightly diatom slimes;
- encroachment into the channel of emergent macrophyte species; and
- reduced dilution of polluting discharges;
- increase in prevalence of terrestrial plant species especially in winterbournes;
- loss of channel definition and even ploughing of winterbourne reaches which have been dry for several years;
- loss of winterbourne species unable to withstand long term drying.

The primary factor affecting the composition of the plant community in running waters is flow velocity (Westlake 1973). The submerged flora of healthy chalk streams is typically dominated by Water-crowfoot which is extremely important in salmonoid and coarse fisheries both in providing lies for the fish and in providing a rich source of invertebrate prey. Much of the public concern over low-flows has manifested itself as complaints about lack of weed growth or changes in the plant community structure.

The natural cycle of weed growth described in Section 1.2.3 may be altered by low flows:

- cress fails to get washed out at the end of the season due to low winter/spring flows;
- spring flows are not high enough to produce clean gravels and encourage crowfoot growth;
- filamentous algal blooms reduce submerged macrophyte growth by shading.

River management practices both for land drainage and fishery purposes may also alter this cycle:

- weed cuts may be undertaken to reduce flood risk;
- water-crowfoot and other submerged weeds may be cut periodically to maintain healthy stands throughout the fishing season;
- historic dredging and over-widening has altered flow regimes in some reaches;
- flow regimes are altered by the weir and hatch systems used in fisheries.

The effects of low flows in chalk streams on macroinvertebrate communities have been less well documented. Obviously there are a number of indirect impacts on macroinvertebrates which arise due to modification of habitats and macrophyte communities. There is also a growing awareness, amongst chalk stream anglers, of reduced insect numbers and especially of reduced mayfly hatches in many rivers (Johnson and Bailey, 1991), but little conclusive scientific evidence of this exists.

The majority of fisheries impacts associated with low flows are also knock-on effects from impacts on physical features, macrophyte assemblages or macroinvertebrate communities. The major impacts upon fish populations and fisheries are summarised below (David Solomon pers comm):

- siltation of salmon and trout spawning gravels;
- reduced populations due to reduction in stream dimensions/current speed (holding capacity);
- reduction in plant cover especially crowfoots;
- truncation of salmon spawning distribution due to low autumn flows;
- effects on smolt migration of reduced spring flows;

- effects of reduced tributary and main river water quality;
- affects on smolts of delayed breakthrough of winterbournes.

2 AQUATIC WEED SURVEY

2.1 Methods

2.1.1 Initial Walkover Survey

An initial walkover of the majority of the river length within the study area was carried out between the 23 August and 2 September. This enabled the survey team to familiarise themselves with the river and to identify representative reaches for the survey of aquatic weeds.

2.1.2 Survey of 100m Reaches

Information gained from the walkover survey and from consultations with NRA staff and river keepers allowed the selection of 19 100m reaches for aquatic macrophyte recording (see Figure 2).

At each 100m reach aquatic macrophytes and a number of physical features were recorded. All plants noted within the channel, whether wet or dry, were recorded but those growing on the banksides were omitted. For each species the percentage cover of the survey area was recorded. Terrestrial grasses and herbs within the channel were not identified but their presence was noted and cover recorded.

The physical features recorded for each reach were:

- mean water width (m)
- mean water depth (cm)
- substrate cover:
  - % cobbles/pebbles
  - % gravel
  - % sand
  - % silt/clay/mud
- habitat cover:
  - % pools
  - % slack
  - % riffle
  - % fast/deep run
- shading,
  left and right banks: none, slight, moderate or dense

Notes were also made as to any obvious management of the reach such as evidence of recent weed cuts and channel modifications. The data recording sheet used for the survey is reproduced in Appendix B1.

The 100m reaches were surveyed twice, once at the beginning of the survey period (28 August to 3 September) and once at the end of the period (3 November to 9 November).

2.1.3 Survey of 10m Sites

In order to gain a more comprehensive species list for the length of the river within the study area 23 other sites were surveyed. Recording of macrophyte and physical data was carried out in exactly the same way as for the 100m reaches except that the survey area was reduced to between 10 and 20m. Surveys were carried out twice at the majority of these sites but some were only surveyed once.

2.1.4 Location of Survey Sites

Figure 2 shows the location of the aquatic weed survey sites on the Upper Kennet. Eighteen sites were surveyed on the Kennet upstream of Marlborough, 25 downstream and 2 on each of the Og and the Aldbourne. A full list of site names, grid references and survey dates appears in Appendix B2.

2.1.5 Photographic Record

Throughout the investigation a photographic record was kept of survey sites and interesting river features. Photographs were taken during site visits with river keepers and a number of prints were also supplied by the NRA Biology and Flood Defence contacts. Several of these photographs are provided as illustrative plates within his document. Volume 2 of the report consists of 84 indexed slides which provide a more detailed visual record of the investigation.

2.2 Results and Discussion

2.2.1 Introduction

A full table of results compiled from the aquatic macrophyte recording sheets appears in Appendix B3. This provides a comprehensive baseline of the presence and abundance of aquatic macrophyte species in the Upper Kennet. The surveys of 100m reaches provide a greater appreciation of the diversity of aquatic plants present in the river but information from the 10m survey sites appears to be comparable, at least for the commonly occurring and dominant plant species.

There is little difference between the results of the September and the November surveys at those sites where both were carried out. Exceptions to this are those sites at which weed-cutting took place during or immediately before the survey period. The NRA carried out a weed cut on the river between Silbury Hill and Clatford during the end of August and beginning of September. This meant that there were significant differences in the abundance of the dominant plants (generally Fool's Water-cress or Water-cress and occasionally Floating Sweet-grass) at several sites. The major differences are summarised below: -

A weed cut prior to the first survey resulted in significantly higher plant cover in the second survey at:

- Site 5, East Kennett (Fool's Water-cress, Water-cress, Pond Water-crowfoot);
- Site 9, Overton Bridge (Pond Water-crowfoot, Floating Sweet-grass); and
- Site 10, Withy Bed, Overton (Fool's Water-cress).

A weed cut between surveys resulted in significant decreases in plant cover at:

- Site 13, d/s Fyfield STW (Fool's Water-cress, Water-cress) An increase in Brook Water-crowfoot was noted at this site; and
- Site 18, Manton Side Channel (Fool's Water-cress).

Figure 3 summarises the results of the aquatic weed survey. It divides the Upper Kennet into a number of reaches according to the plant community present. These community types were identified through a 'by eye' analysis of the survey data. Although this division into reaches or compartments is useful for the discussion of the results it must be remembered that they are not isolated and that they form a gradation/or continuum down the river. The following Sections 2.2.2 to 2.7 discuss the results according to the characteristic community types identified in Figure 3. A table summarising the characteristics of each reach is given at the end of each section.

2.2.2 Uffcott to Winterbourne Monkton

This uppermost reach of the winterbourne section of the river is characterised by terrestrial herbs and grasses; Great Hairy Willowherb and Nettles were often dominant. The channel here was dry, except for localised stagnant pools until the heavy rainfall in mid to late October. It appears that this section responds quickly to run off from the surrounding arable land and unlike a typical chalk stream is quite 'flashy' in nature. Although this section may be bank full and sometimes floods, following high rainfall in the late autumn and winter, it does not hold water for long enough periods to allow the establishment of a significant aquatic flora. Plates 1 and 2 show the ditch-like, shaded and overgrown nature of the majority of the channel above Winterbourne Monkton.

Table 2.1 Summary of reach characteristics: Uffcott to Winterbourne Monkton

Depth (cm)	dry September, 10-20cm November
Width (m)	dry September, 0.8-1.2m November
Substrate type	silt and mud
Emergent aquatics	15-30% cover
Submerged aquatics	zero cover
Terrestrial species	15-50% cover
Dominant plants (% cover)	*Epilobium hirsutum* (20), *Urtica dioica* (20) various terrestrial grasses
Other common plants	*Filipendula ulmaria*, *Phalaris arundinacea*, *Solanum dulcamara*

2.2.3 Winterbourne Monkton to Swallowhead Springs

This stretch, still part of the traditional winterbourne section of the Kennet is characterised by the presence of several aquatic and semi-aquatic plant species which are typical of winterbournes (see Section 1.2.3). Fool's Water-cress, Starwort, Floating Sweet-grass and Reed Canary-grass are all common components of the aquatic flora here. Plates 3 and 4 highlight the rapid change in the appearance of the channel at Winterbourne Monkton following the heavy rains of mid-October. Rapid growth of Fool's Water-cress and Starwort has occurred within two weeks, even at this late stage of the year. Downstream of Avebury (Plates 5 and 6), where Floating Sweet-grass was more common, the difference is less marked. Plate 7 shows the drainage channel character of the Yatesbury Bourne, a tributary which runs through intensive arable farmland and enters the Kennet at Avebury. The flora here is more typical of the upper part of the winterbourne which is dominated by terrestrial plants and largely flows only in response to surface run-off following rainfall.

Table 2.3 Summary of reach characteristics : Winterbourne Monkton to Swallowhead Springs

Depth (cm)	0 (dry) to 15cm Sept, 25-30cm Nov
Width (m)	0 (dry) to 2m Sept, 3.5-4m Nov.
Substrate type	mainly silt and mud, some gravel areas
Emergent aquatics	40-85% cover (generally > 70%)
Submerged aquatics	25% cover
Terrestrial species	1-15% cover (greater in Sept)
Dominant plants (% cover)	*Glyceria fluitans* (0-55), *Callitriche* spp. (2-50), *Apium nodiflorum* (5-30), *Epilobium hirsutum* (1-15)
Other common plants	*Solanum dulcamara*, *Filipendula ulmaria*

2.2.4 Swallowhead Springs to Fyfield STW

Swallowhead Springs is the traditional source of the perennial river. In this stretch the plant communities were richer in aquatics than at any point upstream and the first records of crowfoot (*Ranunculus peltatus*, Pond Water-crowfoot) occurred here. Fool's Water-cress was still dominant but Water-cress, Speedwells, Floating Sweet-grass and Reed Canary-grass were all common. Plates 8, 9 and 10 (East Kennett), and 11, 12, 13 and 14 (West Overton) show the character of the river through this reach and highlight the changes in flow and weed cover that occur throughout the year. The most dramatic change followed the NRA weed cut which removed the majority of vegetation from the channel. Marks in the river appear to indicate that the channel was cleared using a mechanical cutter. The channel here is heavily poached by cattle, feeding on the Floating Sweet-grass, and the bed has become very silty/muddy although gravels do remain underneath.

Table 2.3 Summary of reach characteristics: Swallowhead Springs to Fyfield STW

Depth (cm)	<10cm Sept, 25-40cm Nov
Width (m)	0.5-2.0m Sept, 2.5-5.5m Nov.
Substrate type	mainly silt and mud but with localised gravel beds and cobbled areas
Emergent aquatics	40-70% cover
Submerged aquatics	1-6 % cover
Terrestrial species	<1 % cover
Dominant plants (% cover)	*Apium nodiflorum* (5-50), *Epilobium hirsutum* (0-15), *Glyceria fluitans* (0-10)
Other common plants	*Ranunculus peltatus*, *Nasturtium officinale*, *Myosotis scorpioides*, *Callitriche* spp. *Veronica anagallis-aquatica*, *Phalaris arundinacea*.

2.2.5 Fyfield STW to Marlborough

This reach of the river possesses the first significant growths of submerged Crowfoot. *Ranunculus penicillatus* ssp. *pseudofluitans* (Brook Water-crowfoot) replaces the *Ranunculus peltatus* (Pond Water-crowfoot) indicating the more perennial nature of the stream at this point. There are strong springs, which were active during the survey period, in the Lockeridge to Clatford area and these in conjunction with the STW effluent at Fyfield (Figure 4) appear to provide a relatively unfailing source, except in the most extreme drought conditions. This reach supports a similar, but slightly richer, emergent community to upstream and beds of Starwort are significant in some places. Plates 15, 16, 17 and 18 show the character of the river through this section. At Clatford weed-cutting earlier in the year

reduced the cover of crowfoot but Plates 15 and 16 indicate that the clumps were increasing in size during the study period. The river bed consists of clean gravels for the most part with strong, if shallow, flows. Slower flowing less habitat rich reaches (Plate 18, upstream of Manton Village) occur where the water backs up behind weirs and constrictions.

Table 2.4 Summary of reach characteristics : Fyfield STW to Marlborough

Depth (cm) Width (m) Substrate type	15-75cm (generally approx. 25cm) 4-10m (generally approx. 7m) good range from silts through sand and gravels to cobbles depending on stream energy
Emergent aquatics Submerged aquatics Terrestrial species	5-75% cover (generally approx 10-15%) 5-35% cover (generally approx 5-20%) <1% cover
Dominant plants (% cover)	*Apium nodiflorum* (1-55), *Ranunculus penicillatus* ssp. *psesudofluitans* (1-30)
Other Common plants	*Nasturtium officinale*, *Ranunculus peltatus*, *Callitriche* spp., *Veronica anagallis-aquatica*, *Veronica beccabunga*, *Myosotis scorpioides*, *Mentha aquatica*, *Epilobium hirsutum*, benthic diatoms

2.2.6 Marlborough

Through the town the river is heavily shaded by trees and there is little in the way of floristic interest. Large populations of ducks and swans strip most vegetation from the river other than occasional beds of Water-cress which from in the suitably slow flowing habitats created in sluice pools and mill cuts. Where shading is less complete occasional clumps of blanket weed/filamentous algae (*Cladophora* sp.) occur. Recent housing developments have reduced the velocities, through the town even further by introducing new sluices and weirs.

Table 2.5 Summary of reach characteristics : Marlborough

Depth (cm)	35cm
Width (m)	10m
Substrate type	cobbles, pebbles and gravel
Emergent aquatics	< 1% cover
Submerged aquatics	5% cover
Terrestrial species	< 1% cover
Dominant plants (% cover)	*Cladophora* sp.(2), *Fontinalis antipyretica* (2)
Other common plants	*Callitriche* sp,. *Nasturtium officinale*

2.2.7 Marlborough to Knighton

Downstream of Marlborough the Kennet develops into a mature chalk stream of high ecological and fisheries value. It is highly managed as a fishery and the flow regime, which largely dictates the quality of macrophyte communities, is artificially maintained by the use of the hatch/sluice systems (Section 3.2.2). Macrophyte communities also appear to be profoundly affected by past flood defence works on the river, which in places have left an overdredged (deepened) or widened channel (Plates 21 and 30).

Plant communities through this stretch of the river are dominated by mature beds of Water-crowfoot and Starwort in the areas with sufficient velocity. Water-cress dominates the emergent fringe, with beds reaching four metres in width on both sides of the channel in certain slower flowing reaches (Plate 21). A species-rich emergent fringe including many reeds, rushes and sedges exists throughout most of the river length.

The River Og (Plates 19 and 20) enters the Kennet just downstream of Marlborough. In its lower reaches the plant community in the Og is dominated by Water-cress and Water-crowfoot and is similar to the shallow, fast sections of the Kennet. As mentioned earlier the management of flows in the river is a key factor in the determination of macrophyte communities and where velocities are relatively high Crowfoot and Starwort are prolific instream (see Plates 22, 23, 24, 28,31, 34 and 35). However at wider, deeper and lower velocity sites submerged vegetation is virtually absent and Water-cress becomes dominant, often encroaching many metres into the channel (Plates 21, 30 and 33).

In certain reaches, (Plate 24) Common Club-rush (*Scirpus lacustris*) is locally abundant, often causing channel constriction and increasing Water-crowfoot cover immediately downstream.

On moving downstream from Marlborough to Knighton Horned Pondweed (*Zannichellia palustris*) becomes locally common. At certain locations eg downstream of Axford Bridge (Plates 27, 28 and 29) and upstream of Knighton Weir (Plate 35) the *Zannichellia* appeared to be selectively colonising and thriving at the bases of the senescent Water-crowfoot clumps.

The major leats and cuts off the main Kennet (eg Knighton Loop) were shallower than the main river and, as would be expected, similar in physical structure and plant community to sites further upstream.

A small tributary, the Aldbourne, enters the Kennet via the Knighton Loop. At Whittonditch, only one kilometre upstream of its confluence with the Knighton Loop, the Aldbourne was virtually dry in November despite heavy rain in the previous month (Plate 37). Plant communities here were dominated by Fool's Water-cress, Water-cress and various terrestrial species, much like the headwaters of the Kennet itself.

At no point did the main channel support large unsightly growths of blanket weed. However prior to the October rains several of the slower flowing reaches, often with considerable tree cover, showed extensive growths of benthic algae (diatoms).

Table 2.6 Summary of reach characteristics : Marlborough to Knighton

Depth (cm) Width (m) Substrate type	35-95 8-16m ranges from silts through sand and gravel to occasional cobbles depending on stream energy
Emergent aquatics Submerged aquatics Terrestrial species	5-40% cover (generally approx. 20%) 5-55% cover (generally approx 30%) <1% cover
Dominant plants (% cover)	*Callitriche* spp (0-20, generally *C. Stagnalis*) *Nasturtium officinale* (1-30), *Ranunculus penicillatus* ssp. *pseudofluitans* (1-30),
Other common plants	*Epilobium hirsutum*, *Mentha aquatica*, *Myosotis scorpioides*, *Veronica beccabunga*, *Phalaris arundinacea*

2.2.8 Other Macrophyte Studies

Dr Nigel Holmes (Alconbury Environmental Consultants) has been monitoring aquatic weed communities in the Upper Kennet for several years. This work is part of a wider surveillance exercise which he is carrying out in order to monitor the effects of drought and abstraction, and subsequent recovery following groundwater recharge, in a number of chalk streams.

Survey of results seasons survey on the Upper Kennet are reproduced in Appendix B4. Several of these survey sites are coincident with those used in this investigation. Results of survey and recent observations indicate that flows are recovering following the drought and that plant communities are reflecting this. The abundance of terrestrial species in the channel is decreasing and true aquatics are beginning to migrate upstream in response to stronger and more prolonged flows (Dr N Holmes pers comm). It appears that the plant community is returning to that which was recorded by Holmes (1983) prior to the drought years (Appendix B4).

Dr Jack Oliver a member of the Wiltshire Botanical Society with a keen interest in the River Kennet has also been collecting data for several years regarding plant communities upstream of Marlborough. A record of consultation with Dr Oliver appears in Appendix C. He has been concerned at the increasing prevalence of terrestrial plant species, such as Stinging Nettles and grasses, in the winterbourne channel in response to reduced duration and quantity of flows over the latter part of the recent drought. It may be that his more recent and future surveys will also demonstrate the recovery of the river as indicated by Dr Holmes.

3 MANAGEMENT OF THE RIVER KENNET

3.1 Introduction

3.1.1 Methodology

The common management practices both in the chalk streams of southern Britain and more specifically on the Upper Kennet were reviewed. A literature search was undertaken and relevant organisations were consulted. The subsequent review forming the basis for the general description of management practices reproduction in Appendix B7.

To accurately assess the current management techniques practised on the Upper Kennet, each riparian owner downstream of Marlborough and other relevant bodies were contacted by letter. Meetings were then held with the principal river keepers and appropriate National Rivers Authority staff.

The full list of consultees is reproduced in Appendix C1. Relevant responses, records of telephone conversations and notes of meetings held are also reproduced in Appendix C. The consultations and literature review were then used to produce the following description of management practices in the Upper Kennet catchment.

3.1.2 Background

The management of the River Kennet is largely carried out by two groups:

- the National Rivers Authority, Thames Region, and
- river keepers and riparian owners.

The majority of the NRA's work within the study area is centred on routine maintenance works carried out on the Kennet above Marlborough and on its tributaries; the Og and the Aldbourne. These reaches are too small to support a paying fishery and are therefore unkeepered and receive little management from their riparian owners. Most of the riparian owners upstream of Marlborough did not respond to our consultation.

Below Marlborough the NRA's involvement is most often in flood defence emergencies or in joint enhancement ventures with the river keepers and riparian owners. Here the river is heavily maintained as a fishery and a number of river keepers are employed to manage the river appropriately.

The work of the NRA and the keepers, summarised from the consultations reproduced in Appendix C, is discussed reach by reach below. Figure 4 shows the location of the main hatches within the study area.

3.2 Management, Keepering and Concerns

3.2.1 Source to Marlborough

The majority the river management upstream of Marlborough is carried out by the National Rivers Authority in its role as the body responsible for flood protection. It has been noted that since the recent drought the maintenance workload on the Upper Kennet has drastically reduced, although requirements are now increasing again (Mr T Lambourne, pers. comm., Appendix C2). However this has been coincident with a change in the outlook of the river manager; the current trend being towards a lower key, demand driven, flood defence role, rather than the insensitive engineering works (eg channel widening/deepening) often carried out in the past. The vast proportion of the work carried out by the NRA in the winterbourne stretch of the Upper Kennet is annual trimming of bankside and in-stream vegetation, usually at the request of the various Parish Councils. This limits the risk of spring/summer flooding and removes any nuisance which might be caused by rotting vegetation. Trimming works such as this were carried out on the virtually dry section of the winterbourne Kennet above Winterbourne Monkton in the summer of 1993.

Weed, principally Fool's Water-cress and Water-cress, was cut by the NRA in September/October 1993 between West Kennett and Manton. This routine cut is carried out to reduce the likelihood of flooding from the build up of drifting weed following autumn frosts. Mr Lambourne said that the cutting was carried out by hand to ensure that Water-crowfoot was left intact. However it was noted on a site visit, that in many locations following the weed cut (especially between the bridges at Overton), there were tractor tracks within the channel (Plate 13) and all weed had apparently been indiscriminately removed and dumped on the banksides. At East Kennett (Plates 8 to 10) the rotting weed left on the banks was producing a potentially polluting liquor which was running back into the barely flowing channel. To carry out this maintenance programme three men were employed working 8 hours/day for the periods specified in Table 3.1.

Table 3.1 Upper Kennet maintenance works carried out by the NRA in 1993

Reach	NRA Reach Number	Length (m)	Man Days
u/s Winterbourne Monkton	21	1650	12.75
Silbury Hill to East Kennett	18	2250	36.75
East Kennett to Overton Bridge	17	1600	12.25
Overton Bridge to Lockeridge	16	2456	25.13
Lockeridge to Clatford	15	1650	43.38

Similar weed trimming was carried out early in 1993 on the River Og, again at the request of the local Council. The cut weed is usually burnt or left to

rot, with a flail mower being used to break-up the cut material in some instances. The lower reaches of the Aldbourne are also prone to becoming overgrown and generally need cutting once a year as the weed impedes the drainage of the discharge from Ramsbury sewage treatment works.

At Fyfield (Plate 15) the NRA have carried out an enhancement scheme using sarsen stone boulders. These groynes act as flow deflectors and create velocity variations within the channel and keep areas of gravel silt free. These works can also encourage the formation of a more sinuous low flow channel in overwidened reaches. Similar works could be carried out on other straight and overwide reaches within the study area as mentioned later.

3.2.2 Marlborough to Axford

The majority of this stretch is owned by the Crown Estates and is managed by John Hounslow (river keeper). The downstream end of this stretch is owned by Mr J Burrows (NGR 228,698 - 231,698) and Lady Fermoy (NGR 231,698 - 234,698), with both John Hounslow and Toby Lewington (the keeper for the Axford Estate, immediately downstream) giving advice and often carrying out necessary management. The hatches between Mr Burrows' and Lady Fermoy's reaches are owned by the Axford Estate and are operated by Toby Lewington.

In general Mr Hounslow keeps his hatches open between late autumn and early spring to maintain high water velocity which promotes growth of Water-crowfoot (see Section 1.2.3). The hatches are then closed from about May (some keepers close as early as April) to allow water levels to rise for angling. The hatches are flushed through occasionally to clean the gravels and wash out the silt. In the past Mr Hounslow has carried out extensive weed-cutting, with the help of the NRA, but has not cut the submerged weed for several years now. Some beds of Water-cress are cut and removed and sections of bank are mown to improve access for anglers.

In recent years a number of problems have been apparent in Mr Hounslow's section of the river:

- reduction in river levels (if unhatched) and reduction in velocities under the hatched regime;
- submerged weed such as Water-crowfoot and Starwort has not been as prolific as in the past;
- encroaching beds of Water-cress have increased in abundance;
- appearance of small clumps of submerged Forget-me-not, which were not present previously;
- increase in the silted nature of the gravels in many reaches resulting in poor trout spawning habitat; and

- increase in the number of swans and geese and subsequent damage to plants.

Mr Hounslow believes that the reduction in the quality of submerged weed growth was not coincident with the drought, but started about two years earlier. He also feels that the recent low flows have exacerbated many of the problems associated with historic engineering works to increase conveyance. A number of sections (eg upstream of the railway bridge at Marlborough; between Elcot Mill and Mildenhall trout farm (Plate 21); between Mildenhall hatches and Durnsford Mill) are overwide and have been dredged too deep in the past.

To combat these problems Mr Hounslow, in conjunction with the NRA, has carried out a number of enhancement works including:

- placing of sarsen stone groynes and half-weirs downstream of Elcot Mill and upstream of Mildenhall hatches (Plate 25);
- channel narrowing, using rock infill and geotextile bank stabilisation, upstream of Mildenhall hatches (Plate 22); and
- planting of Water-crowfoot plants.

The works downstream of Elcot Mill have met with little success but those upstream of Mildenhall hatches, have produced an attractive, relatively fast flowing reach with a good cover of submerged weed (Plates 23, 24 and 25). Low velocities immediately above the hatch systems generally produce deep silty unattractive habitat. Conversely the faster velocities produced directly downstream of hatches, bridges and weirs produce good conditions for healthy Water-crowfoot growth.

Weed growth is poor through the short stretches owned by Mr Burrows and Lady Fermoy, just downstream of the Crown Estates' land. No weed cuts have been made here for at least three years.

3.2.3 Axford to Cutnights

This stretch is owned by the Axford Estate who employ Toby Lewington as river keeper. Management follows traditional lines and is carried out to enhance and maintain the fishing potential of the stretch for some 25 rods.

Mr Lewington checks the hatches every day during the fishing season (beginning of May to the end of September) and when water levels are rising. Rags Hatches downstream of Axford (Plate 31) are operated most frequently as these control the flows into the mill pound at Ramsbury Manor. Most of the hatches along this stretch have overflows or spillways, and have gates rather than boards, letting water flow underneath and so keeping the silt moving rather than building-up. The hatches are kept open for as long as possible prior to the start of the fishing season to maximise the period of higher velocity flows promoting Water-crowfoot growth.

Submerged weed mainly Water-crowfoot and Starwort has been cut twice this year in the traditional 'cut-and-bar' pattern using hand-held scythes. The cut weed is deflected into a lagoon which was dug about twenty years ago by Thames Water Authority under supervision of Mr A Barrett (river keeper to the Ramsbury Estate). No cuts were made last year. The Water-cress growth has been particularly prolific this year. In the past Mr Lewington has tied Water-crowfoot plants and roots onto rocks and placed them in the channel to encourage improved weed cover. Several areas along the banks have been planted with willows in recent years, and more tree planting is planned.

Several channel modifications have been carried out, including in the last five years the construction of six weirs mainly of sarsen stones (Plate 31) or boards, and a weed lagoon below the public house at Axford. Weed growth appears to have increased downstream of the structures and the appearance is one of a very attractive stream. Other modifications include the narrowing of the channel and improvement of bank stability using nicospan upstream of Axford and below Rags Hatches (Plate 32) respectively.

3.2.4 Cutnights to Ramsbury

The uppermost reaches of this stretch are owned by the Ramsbury Estate, and the lower ones by Mrs Ball. Archie Barrett is the river keeper for all of this stretch, none of which is fished on a regular basis. The management undertaken is minimal and reflects the lack of fishing.

The gate hatches have been replaced with boards and the water is allowed to spill over them rather than being drawn underneath. The top board is kept to just below the water surface. The hatches are checked on a regular basis. Traditionally the hatches were operated for supplying the water meadows. Water was diverted onto the meadows on the 1st November and drained off on the 1st March. The hatches in Ramsbury were used for this purpose until 1938.

There has been insufficient submerged weed to require a cut this year, and over recent years the weed has only been cut once a year in June/July for this reason. The traditional 'cut-and-bar' pattern was used in the past, but the lack of growth has meant that patterns are not presently cut. At Ramsbury Manor the river has been widened in the past to create a broadwater. The large population of geese and swans on the broadwater often cause severe damage to submerged weed in adjacent reaches of the river. Ten bags of Water-crowfoot were planted below Ramsbury Lake in 1992, but none grew because of the heavy grazing of the weed by geese and swan.

In the past the weed-cutting was carried out in April by a 'saw gang' from the village working with chain scythes under the supervision of the river keeper. The cut weed was collected on weed racks and pulled out using forks and rakes. There were six weed racks between Mildenhall and Axford Farm, and four racks at Ramsbury Manor.

No changes have been made to the channel morphology along this part of the River Kennet, and none are planned. The stretch of river below Ramsbury Lake was raked in Autumn 1992 by horses, which removed much of the silt and debris from the bed; however, the high quantities of calcium carbonate accreted on the gravels make them poor spawning habitat for trout, and much of the silt has already returned.

The Ramsbury Estate has entered into the Countryside Stewardship (Countryside Commission, 1992) scheme for re-instating the water meadows and promoting traditional management techniques, although no work has been undertaken as yet.

3.2.5 Ramsbury to West Lodge

This stretch of the River Kennet is owned by Martin Arbib, and managed by Tony Barrett for private fishing.

There are eight hatches on this stretch all of which have had the gates replaced with boards but with a baton underneath the bottom board to allow the water to be drawn underneath, as well as spilling over the top.

The weed has not been cut for the past three years as there has not been sufficient growth. Prior to 1991 Mr T Barrett cut the weed in the traditional manner at least twice a year; at Whitsun and again in September, in the 'cut-and-bar' pattern. The weed was caught and deflected into a weed lagoon which was built in 1985/6. Thames Water last cut the weed in 1985. The Water-crowfoot has declined markedly over recent years with increases in the more prolific species such as blanket weed (filamentous algae) and Starwort. The blanket weed was particularly vigorous in the low flow years of 1991 and 1992 but was not particularly evident during the summer of 1993. On several occasions, Mr Barrett has tied plants, mainly Water-crowfoot onto rocks in the channel in an attempt to increase the amount of weed cover.

There are twelve nesting pairs of canada geese and one pair of nesting swan which heavily graze the weed. Mr Barrett stocks the river with brown trout at least once a year, and less frequently with rainbow trout.

A number of channel modifications, to improve the flow velocity and oxygenation in the river, have been implemented. A concrete sill weir, into which boards can be inserted, was built in 1982/83 upstream of West Lodge and sarsen stones have been placed in the channel upstream of the footbridge by Howe Mill. The channel has been narrowed by approximately 1m downstream of the footbridge at Howe Mill although no improvements, in terms of more vigorous weed growth, have yet been noted. A large fallen willow has also been left to narrow the channel at one point along this stretch. Horses were used in October 1992 to rake the gravels upstream of the footbridge at Howe Mill; the silt levels have dropped as a result, but no improvements in the weed growth have been seen yet.

Mr Barrett commented that crayfish have not been found in the River Kennet here for about eight years, with 'the mayfly' (*Ephemera* spp.) population declining greatly from the 1950's. He also commented that the loss of 'the mayfly' is coincident with the sealing-off of the carrier streams, which were used for flooding water meadows, and with the start of mechanical dredging. However as mentioned elsewhere in this report the Kennet is renowned for its lack of 'mayfly' in its upper reaches (Bradley, 1909).

3.2.6 West Lodge to Knighton

The last stretch of the Upper Kennet under study falls within the Wills Estate and is managed by Mr Peter Woolnough for 27 rods. He too follows a traditional management regime.

There are six hatches along the full stretch managed by Mr Woolnough, each consisting of four gates which open from the bottom allowing water to be drawn underneath (Plate 34). They are checked every day as there is a problem with debris and other material being washed down which often blocks them.

Mr Woolnough carries out four weed cuts per year in the 'cut-and-bar' pattern, cutting 10m and leaving 20m, in rotation. He uses hand scythes, and link scythes to cut the 'ribbon weed' (*Scirpus lacustris*, Common Club-rush) in the deeper waters. The weed is collected and rotted in weed lagoons. Mr Woolnough commented that the weed growth has been much reduced since 1985, particularly 1989-92. The gravels are raked by hand in October/November to improve spawning conditions.

No channel modifications have been made although sarsen stones have been placed temporarily in the channel at periods of extreme low flow to raise water levels and increase the oxygen content of the water.

The Wills Estate entered into the Countryside Stewardship scheme for re-instating water meadows. The scheme was agreed in 1992, and to date the grant aid has been used to replace hatches and carriers supplying water to the meadows. Since the start of the scheme the small blue butterfly has been seen once more, along with four breeding pairs of snipe and one pair of redshank.

3.2.7 Action for the River Kennet

Action for the River Kennet (ARK) was set up in 1991 with the aims of restoring and improving "rivers, streams and water tables for farming, recreation, wildlife and the environment in the Kennet Valley" (DeVere, 1993). ARK is a voluntary pressure group of locals and other interested people who have concerns about the present state of the River Kennet and its tributaries. They have campaigned strongly for reductions in abstractions of water from the Kennet Valley aquifer, mainly at Axford and Ogbourne, and are fighting for planning restrictions to prevent future developments outside the Kennet Valley which would require water supply from the Kennet

system, and therefore result in the need for more water from the catchment. ARK have brought many of the low flow problems in the river to the attention of the NRA and have provided a focus for both public opinion and the views of local experts such as the river keepers and anglers.

ARK (Service, 1992) have an agenda which includes a request for the NRA to:

- stop abstractions which prevent the rivers flowing, and wildlife and river plants flourishing;
- repair the stream beds damaged by dredging;
- conserve summer waters once guarded, by riparian owners, with sluice gates and meanders to retain the river levels;
- conserve water supplies by cutting mains leakages, by public education and by metering; and
- insist on major investment to bring water from wetter areas.

3.2.8 Other Consultees

A full list of consultees is given in Appendix C1, which is followed by the most interesting and relevant responses.

English Nature and the Wiltshire Trust for Nature Conservation both offered to meet with us to discuss this study, but indicated that they had little local knowledge of the river other than its' proposed future designation as a SSSI. The Wiltshire Trust for Nature Conservation have recently begun a 'river watch' scheme which aims to get the public involved in monitoring quality changes in rivers, including the Kennet, throughout the county.

Dr Jack Oliver, a local botanist and member of the Wiltshire Botanical Society provided us with large numbers of plant records for the winterbourne section of the river. It was not possible to reproduce these here, but a summary of his work is given in Section 2.1.8 and Appendix C8.

3.3 Discussion

3.3.1 Management Overview

Upstream of Marlborough the river is relatively unmanaged, other than routine maintenance weed cuts and trimming carried out by the NRA. Some small enhancement schemes have also been implemented. It is noticeable in several reaches that the lack of management has caused problems; the indiscriminate poaching by cattle at Overton (Plates 11 to 14) has undoubtedly contributed to the silty/muddy nature and lack of definition of the channel.

The weed-cutting carried out by the NRA during 1993 appears to have been rather 'heavy-handed'. Machinery appears to have been used in the channel at West Overton (Plate 13) and a lack of selectivity in the cutting left the river bed bare in most reaches. The removal of weed (August/September), which causes lowering of water levels, and the associated bed disturbance appears to have encouraged the disappearance of the last traces of flow from the river above Fyfield (Plates 8 to 14). There was little evidence of selectivity in the cutting programme with Water-crowfoot being removed from the channel as well as the large beds of Floating Sweet-grass, Fool's Water-cress and Water-cress, which provide the major flooding hazard in this section.

Downstream of Marlborough the management is based on traditional chalk stream fishery keepering. Weed cutting has decreased markedly since the beginning of the drought, but there is evidence that flows are now recovering with some keepers carrying out limited cutting of Water-crowfoot during 1993. Cutting has generally been carried out by hand in the rotational 'cut and bar' pattern (Figure 5). Trimming of emergent reeds and Water-cress has continued to be carried out, generally on one bank, for the benefit of anglers.

Much of the keepering effort, especially between Marlborough and Ramsbury, has been spent on enhancing the river for fisheries purposes. Localised channel narrowing and the installation of groynes and weirs (Plates 22, 28, 31 and 32) have been carried out in order to improve water velocities, clean gravels and encourage the growth of submerged weed. It appears that much of this work has been necessary due to the low flows exacerbating the problems caused by past insensitive river engineering works.

The most profound management tool in affecting weed growth and river habitats appears to be the use of the hatches (Figure 4, Plates 26, 31 and 34). The hatched regime of the river makes it difficult to appreciate the extent of the effects of low flows due to the artificial raising of water levels. In general hatches are left open throughout the winter period encouraging the scouring of gravels and the growth of Water-crowfoot. At the start of the fishing season (beginning of May) the hatches are dropped to raise water for angling. This then encourages siltation, the recession of Water-crowfoot and the proliferation of Water-cress, blanket weed and benthic diatom blooms. Unless the silt is washed out to sea, or allowed to accumulate in areas of the river system where it might be beneficial, it merely creates a problem by settling upstream of the next control structure.

The effect of weed cutting on subsequent weed growth cannot be overlooked. Thames water last cut the Ramsbury to West Lodge reach in 1985. Was cutting curtailed due to a lack of weed, or has it actually resulted in a reduction in weed growth?

3.3.2 Changes in Land Use and Legislation

The typical post-war land use of lowland Britain is very different to that practised before. Modern farming methods have meant that land which was too wet or steep for arable production can now be cultivated. This has led to the loss of the traditional pastures, hay meadows and water meadows. The rapid rise in labour costs and increased mechanisation has resulted in a reduction in the number of farm labourers. In turn, the lack of labour has meant that fewer staff are available for the management of watercourses by hand and therefore the increased use of machines or reduced management has resulted.

The changes in land use have seen parallel shifts in legislation, with the founding of the European Community (EC) and the introduction of the Common Agricultural Policy (CAP) being of particular significance. In recent years, particularly since the 1970's with the EC overproducing and stockpiling agricultural produce, there has been a shift in emphasis in an attempt to reduce outputs. The approach taken by the EC has been two pronged. Firstly, reducing output by deterring overproduction through penalising those who produce more than a specified amount dictated by a quota system, and secondly, by encouraging the removal of land from intensive agriculture. Financial incentives and advice are available to promote diversification and alternative land uses, for example grants for tree planting under the Farm Woodland scheme, and for returning land to fallow under the Set-aside scheme.

Within the Kennet valley, the changes in landscape and land use have reflected the general trend as described above, with the subdivision of the large estates into smaller farming units, the increase in acreage of arable and loss of the traditional water meadows and the associated farming systems. The upper reaches of the Kennet, particularly the winterbourne section, flow through predominantly arable land. Further downstream, arable is also prevalent although much pasture remains immediately adjacent to the river. The ploughing-up of the pasture and water meadow has had a significant impact upon the riverside landscape since the 1950's. The once numerous carriers and channels have been infilled, the hatches and sluices removed or fallen into disrepair. This has allowed a subsequent loss of habitat and ecological diversity. This change in land use is frequently used to explain the increasingly flashy nature of the flow in the Upper Kennet. Precipitation and run-off reach the channel much more quickly from the well drained arable land than it would have from the upland and lowland pastures, both of which would have added a degree of stabilisation of flows. Run-off from arable land is also likely to be partly responsible for an increase in the silt loading of the river. An increase in hard surfaces such as roads and built-up areas, may also contribute to the peaked nature and high silt loading of run-off. It is also possible that increased use of fertilizers has encouraged algal growth in the river and the reduction in other species.

This trend of arable replacing permanent grassland is now beginning to reverse, with the influence of current EC and CAP legislation. For example, in the Upper Kennet catchment several landowners have entered into

agreements with the Countryside Commission and English Nature to reinstate water meadows under the Countryside Stewardship scheme. This and English Nature's new Habitat Scheme which is targeting waterside fringe habitats, in conjunction with the aforementioned agricultural grant systems offer, great opportunities for producing ecologically valuable buffer zones along river corridors.

Other legislation which has a bearing upon the Kennet catchment is that associated with the protection of areas of importance or value to ecology, for example Areas of High Ecological Value (AHEVs) or Sites of Special Scientific Interest (SSSIs). English Nature are proposing to designate the middle reaches of the River Kennet itself, upstream of Newbury, as an SSSI because of its importance and value to wildlife (NRA, 1993).

These trends in agriculture have, not by chance, coincided with a change in the outlook of river managers. The insensitive river engineering schemes undertaken for land drainage purposes, although never particularly prevalent in chalk streams, are largely a thing of the past. Flood defence management is now carried out with greater regard for the river environment and the NRA are also implementing many river enhancement and restoration schemes. It has also been realised that a 'soft' approach to river management works can be more economic in the long run. The River Restoration Project (Dr J Biggs and Dr N Holmes pers. comm.) has been set up as an independent group with the aim of restoring rivers to their natural state. They are currently liaising with the NRA, English Nature and various potential funding organisations to set up a programme of restoration trials.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Weed Growth, Low Flows and River Management

In summary the following conclusions can be drawn from the results of the weed survey and the review of management practices on the Upper Kennet:

a) aquatic macrophyte communities are typical of those associated with winterbournes and the upper reaches of chalk streams;

b) marked spatial variation in aquatic macrophyte communities is associated with the continuous gradient of environmental conditions present between the headwaters and the lower end of the study area. The most significant factor is the strength and duration of flow;

c) at a local level macrophyte communities are largely determined by the variations in flow regime which are associated with hatches, weirs and channel modifications;

d) although large amounts of Water-cress were recorded, blanket weed (filamentous algae) was not as prevalent as indicated by the concerns of the consultees;

e) the aquatic macrophyte communities and associated habitats and wildlife are of high ecological interest and conservation value;

f) in the winterbourne section of the river (upstream of Fyfield) it is suggested that over the period of the drought macrophyte communities have 'migrated downstream' in response to reductions in the strength and duration of flows;

g) recent studies suggest that this 'migration' is reversing in response to increased flows/groundwater recharge following two years of relatively high rainfall;

h) anecdotal evidence and a reduction in weed-cutting effort downstream of Marlborough suggest that submerged macrophyte communities have been poor compared to the pre-drought period. Recent cutting, although light, indicates that a recovery may also be apparent here;

i) occurring maintenance weed-cutting upstream of Marlborough appears to lack sensitivity and selectivity;

j) localised enhancement schemes, such as groyne and weir installation, channel narrowing and gravel raking (aimed at improving submerged weed growth and fish habitats) have met with mixed success;

k) enhancement schemes to redress the effects of previous river engineering works are likely to be more valuable in the long run than those attempting to achieve short term solutions to flow problems;

l) enhancements to the river largely involve locally increasing flow velocities or water depths in order to maintain clean gravels, high oxygen levels and submerged weed growth for salmonid fisheries. There is therefore a tendency towards seeking a riffle/pool/fast run regime throughout the fishery. Evidence suggests that such a situation cannot be maintained with the gradients concerned unless a much narrower channel were provided. Reaches of reduced velocity, which provide different habitats, are required within the system. Currently these slacks tend to occur on the overwide sections just upstream of sets of hatches;

m) many of the problems highlighted by the consultees have not been apparent during 1993 due to recent periods of high autumn and winter rainfall and improved aquifer recharge. ARK and many of the river keepers are anxious that the end of the drought should not be seen as the solution to the problems. Consultees believe that although, in magnitude problems are likely to remain significant whilst abstraction proceeds at current rates.

4.2 Recommendations

The following recommendations for future investigations, monitoring and management are proposed:

a) carry out further monitoring of aquatic weed communities in the Upper Kennet in order to confirm or disprove the theory that they and the flows which support them, are recovering. Monitoring should start in early spring 1994 and continue for two years before reviewing the situation;

b) monitoring should be carried out in close liaison with Dr N Holmes (Alconbury Environmental Consultants) and Dr J Oliver (Wiltshire Botanical Society), both of whom have considerable data relating to the River Kennet upstream of Marlborough;

c) a statistical analysis of the existing data should be carried out in order to confirm the 'by-eye' assessment of macrophyte distribution. Future changes could then be identified and analysed in the same manner;

d) investigate the advantages and disadvantages of employing less destructive or 'softer' weed control measures in the river upstream of Marlborough;

e) hatch operating regimes and their effects on river levels and river ecology should be investigated;

f) investigate the need for enhancement/restoration works on the River Kennet and the type of work which should be undertaken. Enhancement should not necessarily be driven by fisheries interests, but should be aimed at raising the overall ecological interest/value of the river as well as maintaining/restoring the natural character. The requirements for any water quality improvements or nutrient reductions should also be addressed;

g) enhancement opportunities should not concentrate solely on the river itself but should include projects which will provide long term benefit for the river corridor as a whole. This might include restoration of water meadow systems and setting up of buffer zones to mitigate the affects of arable run-off;

h) management and restoration activities should be widely discussed with riparian owners, river keepers and Action for the River Kennet (ARK);

i) management and restoration opportunities should be widely discussed with relevant funding and implementation organisations such as English Nature, Countryside Commission and the River Restoration Project;

j) a 'vision' for the Upper Kennet should be prepared as part of the catchment management planning process. This should embody realistic objectives for the future status and management of the riverine environment and provide a focus for enhancement and restoration opportunities.

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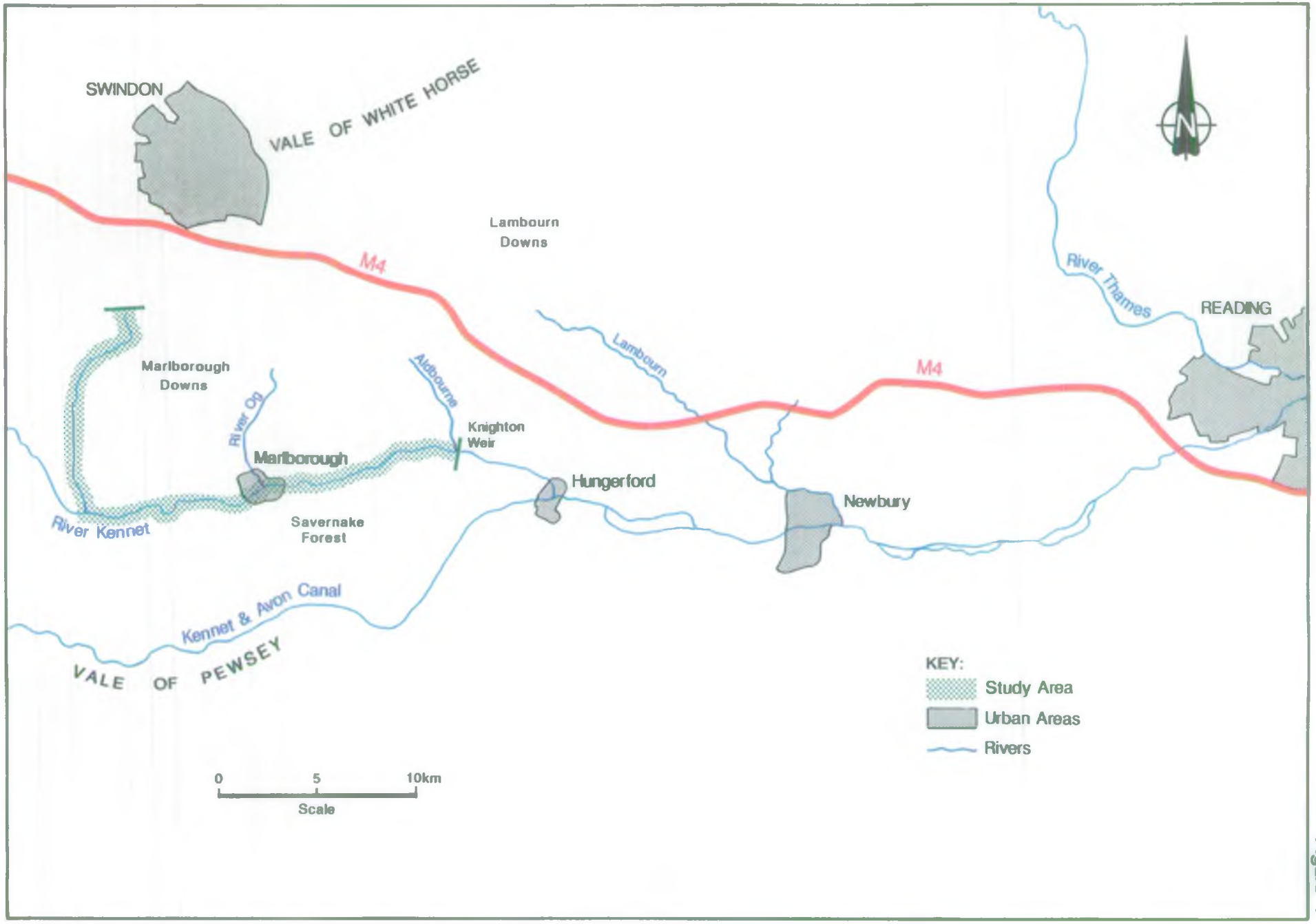
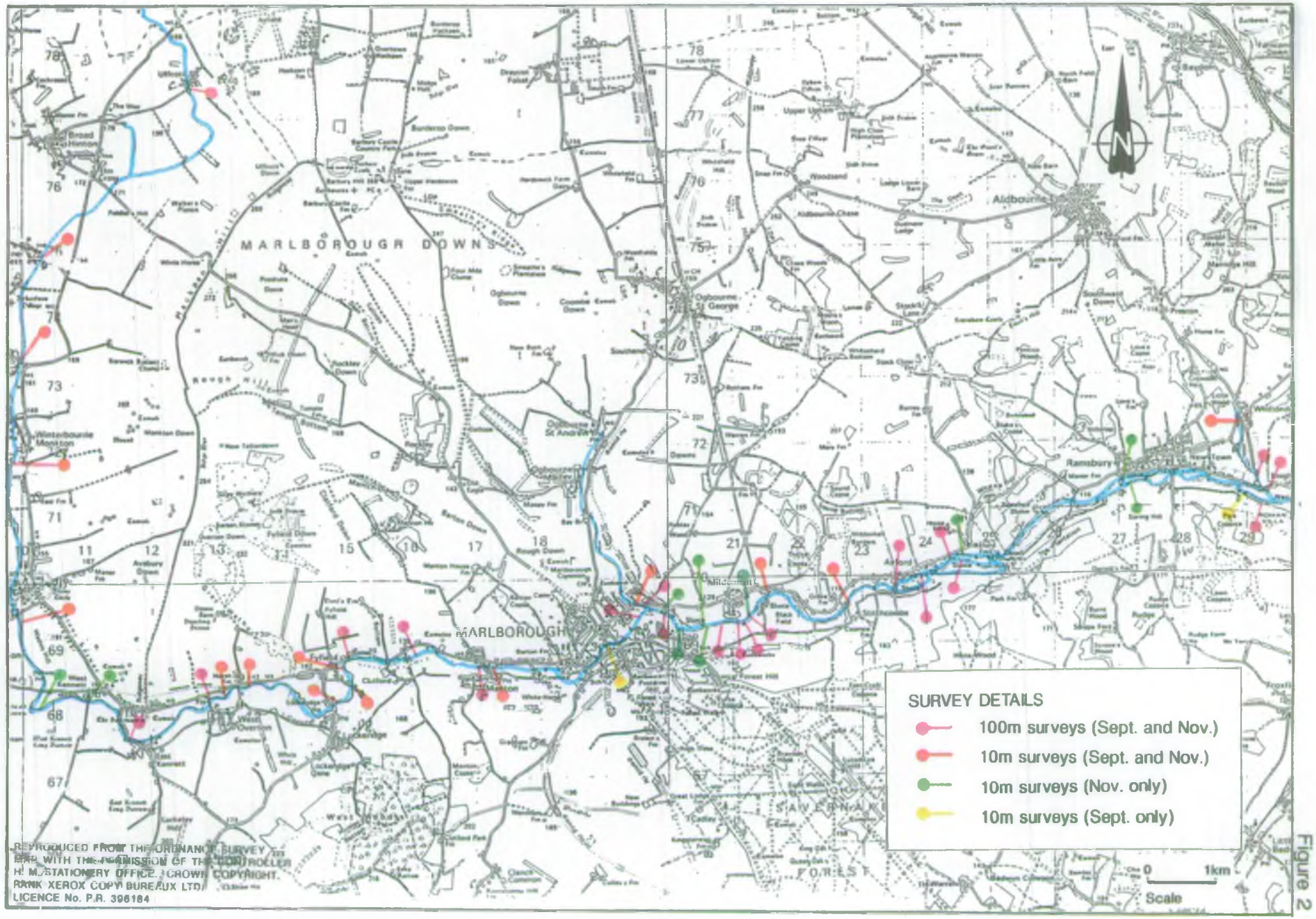
FIGURES

HALCROW



THE STUDY AREA: LOCATION MAP

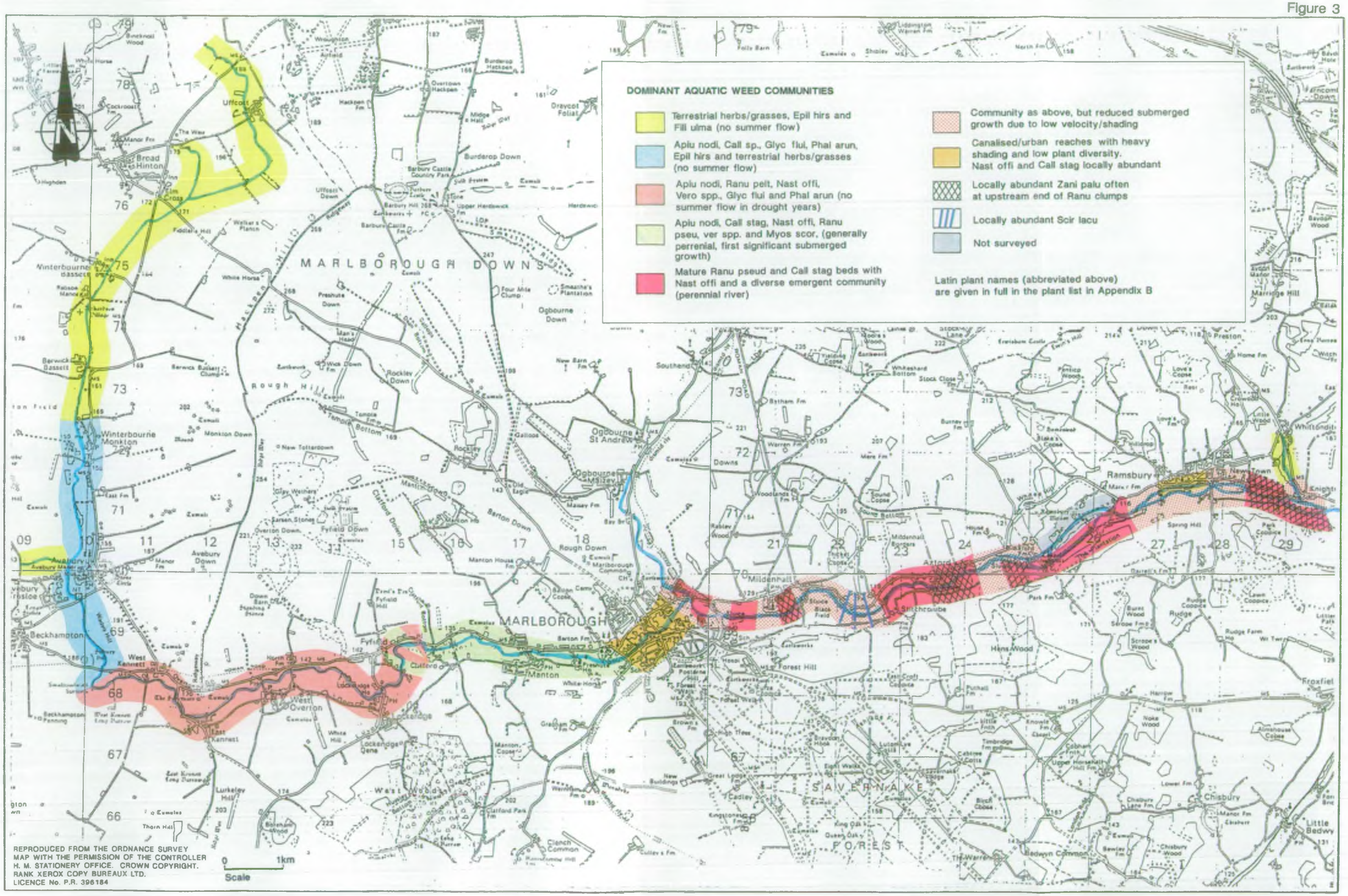
Figure 1



THE STUDY AREA: AQUATIC WEED SURVEY SITES

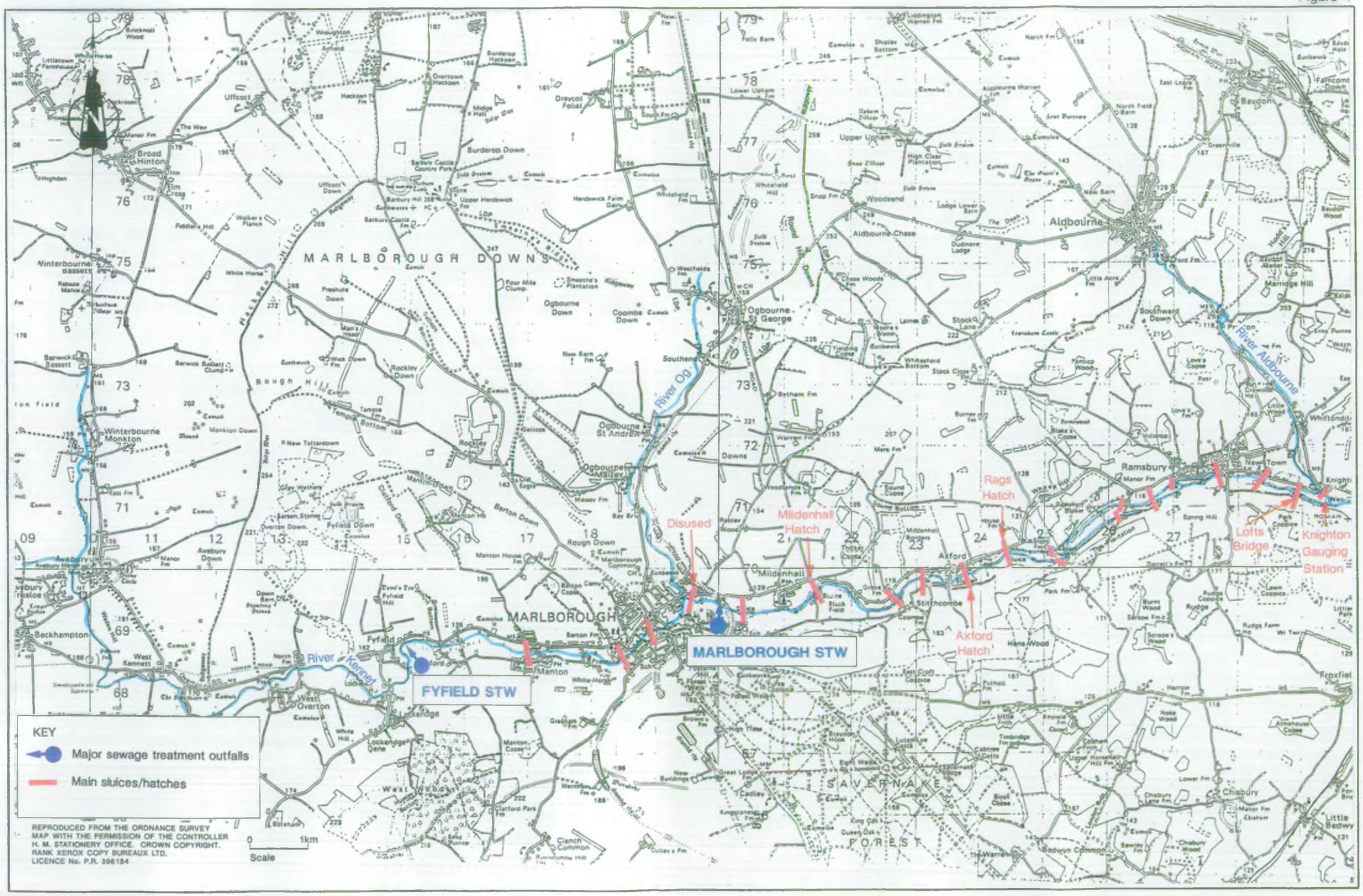
Figure 2

Figure 3



AQUATIC WEED COMMUNITY TYPES IN THE UPPER KENNET

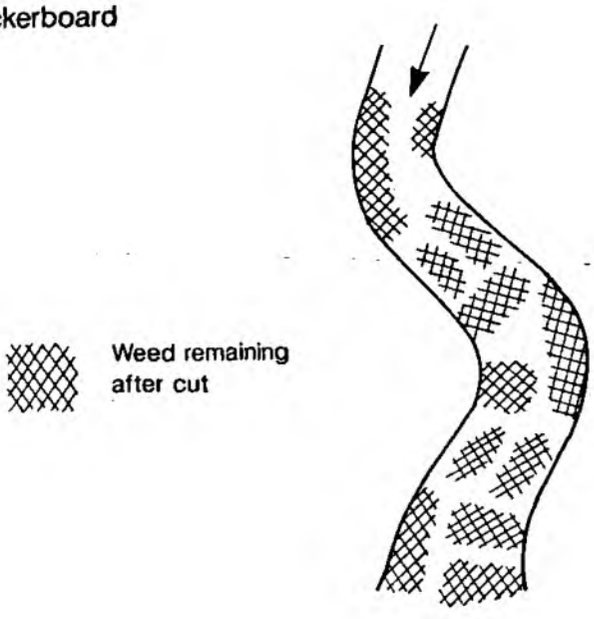
Figure 4



MAIN HATCHES IN THE UPPER KENNET

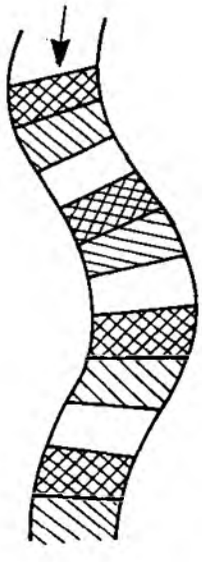
Figure 5

a) Checkerboard



Weed remaining after cut

b) Cut and bar



Cuts made across the width of the river when required

First cut

Second cut

Third cut

TRADITIONAL WEED CUTTING PATTERN

PLATES

HALCROW

Plate 1: Kennet downstream of Uffcott roadbridge, dry, heavily shaded ditch (3.11.93)

Plate 2: Kennet downstream of Winterbourne Bassett roadbridge following heavy rainfall (3.11.93)

Plate 3: Kennet downstream of Church Lane, Winterbourne Monkton (1.9.93)

Plate 4: Kennet downstream of Church Lane, Winterbourne Monkton showing recovery of aquatic weeds following heavy rain (3.11.93)

Plate 5: Kennet upstream of A4361, Avebury. Dry, overgrown channel prior to heavy rain (7.10.93)

Plate 6: Kennet upstream of A4361, Avebury after heavy autumn rain (3.11.93)

Plate 7:
Yatesbury Bourne 1km upstream of the Kennet at Avebury. Ditch like channel draining intensive arable land

Plate 8: Kennet upstream of roadbridge, East Kennet.
High flows and good weed cover in the spring (3.5.93)

Plate 9: Kennet upstream of roadbridge, East Kennet. Dry stream bed (7.10.93)

Plate 10: Kennet upstream of roadbridge, East Kennet. Gradual recovery of flows and weed following heavy rain (3.11.93)

Plate 11: Kennet downstream of roadbridge, West Overton. Bank full channel choked with Floating Sweet-grass (3.5.93)

Plate 12: Kennet downstream of roadbridge, West Overton. Declining flows through summer (10.6.93)

Plate 13: Kennet downstream of roadbridge, West Overton. Virtually dry bed with tractor tracks, following weed cutting (1.9.93)

Plate 14: Kennet downstream of roadbridge, West Overton. Flows and weed recovering following heavy autumn rainfall (3.11.93)

Plate 15: Kennet downstream of Fyfield Church. Sarsen stone groyne enhancement works (1.9.93)

Plate 15a: Kennet; terrestrial growth of Pond Water-crowfoot at Fyfield Church (1.9.93)

Plate 16: Kennet downstream of roadbridge, Clatford. Weed was cut during the summer (23.8.93)

Plate 17: Kennet downstream of roadbridge, Clatford. Increased weed cover (3.11.93)

Plate 18: Kennet upstream of Manton. Slow flowing, deep channel with poor plant communities (1.9.93)

Plate 19: River Og upstream of the Kennet (7.10.93)

Plate 20: Kennet downstream of confluence with the Og (right hand channel as viewed), (4.11.93)

Plate 21: Kennet downstream of Elcot Mill. Deep, wide and slow flowing with extensive Water-cress fringes (4.11.93)

Plate 22: Kennet; channel narrowing works upstream of Mildenhall hatches (4.11.93)

Plate 23: Kennet; Starwort and Water-crowfoot at above location (4.11.93)

Plate 24: Kennet upstream of Mildenhall hatches. Common Club-rush (trimmed) in the enhanced (sarsen stone groyne) section of the channel (4.11.93)

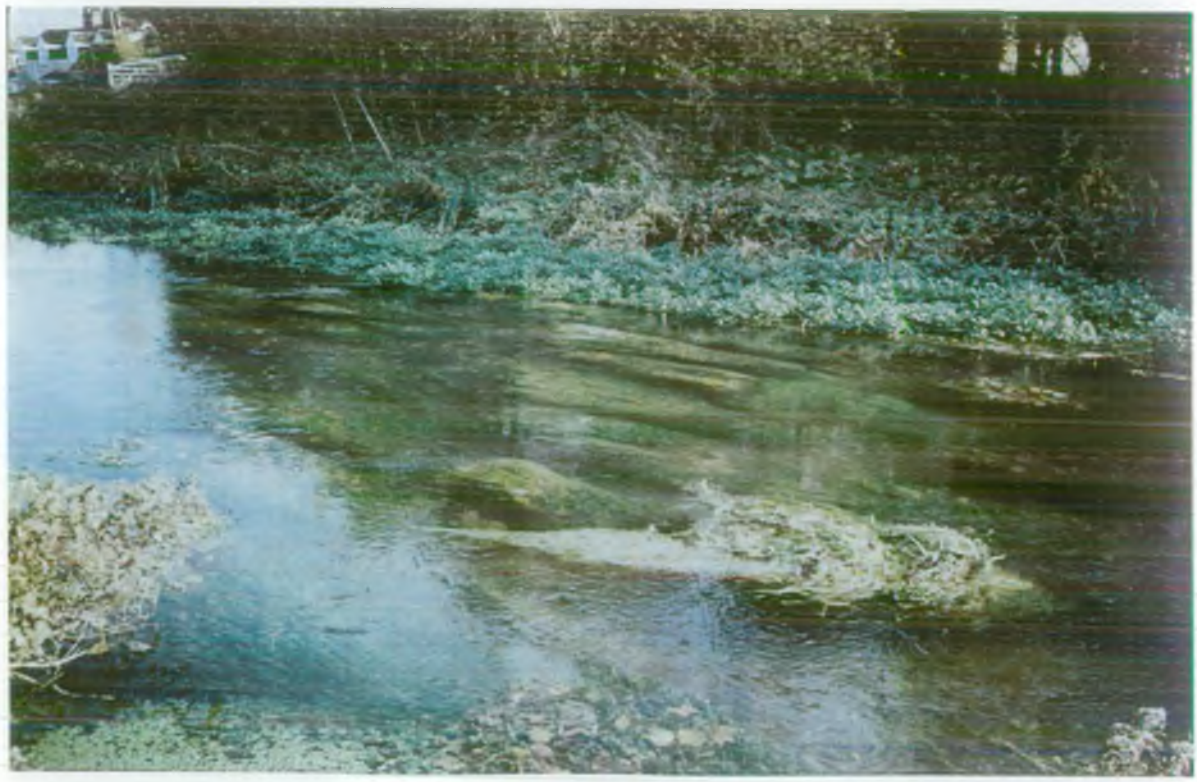


Plate 25: Kennet upstream of Mildenhall hatches. Good submerged weed growth downstream of sarsen stone groynes (4.11.93)

Plate 26: Kennet immediately upstream of Mildenhall hatches (4.11.93)

Plate 27: Kennet immediately downstream of Stone Lane, Axford (2.9.93)

Plate 28: Kennet downstream of Stone Lane, Axford (2.9.93)

Plate 29: Kennet downstream of Stone Lane, Axford following trimming of Water-cress (4.11.93)

Plate 30: Kennet; deep slow flowing channel, with large swan population, upstream of Rags Hatches, Axford Estate (4.11.93)

Plate 31: Kennet downstream of Rags Hatches, Axford Estate (4.11.93)

Plate 32: Kennet; channel narrowing and weir construction downstream of Rags Hatches, Axford Estate (4.11.93)

Plate 33: Kennet; canalised mill stream downstream of Mill Lane, Ramsbury (9.11.93)

Plate 34: Kennet; good Water-crowfoot growth upstream of Lofts Bridge, Wills Estate (2.9.93)

Plate 35: Kennet; good submerged weed growth upstream of Knighton Gauging Station (2.9.93)

Plate 36: Aldbourne at Whittonditch pumping station (9.11.93)

Plate 37: Aldbourne upstream of Knighton Loop (9.11.93)

Appendix A
TERMS OF REFERENCE

HALCROW

6 July 1993

Date

Richard Ashby-Crane
Sir William Halcrow & Partners Ltd
Burderop Park
Swindon
Wiltshire
SN4 0QD

NRA

National Rivers Authority
Thames Region

Ref: OI/T/002

Dear Mr Ashby-Crane

Invitation to Tender for an NRA Thames Region Operational Investigation

As you are probably aware the National Rivers Authority (NRA) places considerable emphasis on research and development as a means of addressing regional and national operational issues. The NRA is now inviting tenders for the Regional Operational Investigation entitled:

WEED GROWTH INVESTIGATION OF THE UPPER KENNET

Outlined in the attached Terms of Reference is information relating to the objectives of the research, the proposed method of working, the timescales, and the outputs.

You may provide a tender for a different method of working if you feel it is appropriate but this must accompany a tender for the method of working specified in the Terms of Reference.

You should be aware that the contract with the successful tenderer will be based on the NRA's Standard Conditions of Agreement for a Research and Development Contract. As these are likely to have a bearing on your tender, you will find a copy attached for your information.

Please note that a provisional budget of £15,000 has been given to this proposal. It is emphasised that tenders will be judged on the cost, technical quality and practicality of the proposals which are put forward to meet the objectives.

Kings Meadow House Kings Meadow Road Reading Berks RG1 8DQ Tel: Reading (0734) 535000 Telex: 849614 NRATHA G Fax: (0734) 500388

NRA

I would be grateful if you could provide your tender in two separate sections:- 1) Strategy and Experience, 2) Financial Information - each in a separate sealed envelope, inside another envelope with the address label provided. All envelopes used should bear no distinguishing mark intended to indicate the identity of the sender; they should carry only the reference number OI/T/002 and either part 1 or part 2.

The two parts should be structured in the following way:

Part 1: Strategy and Experience

- Objectives - Interpretation of objectives
- Strategy - Proposed method of working
- Programme - For all stages of work
- Variation - Explanation of any variations from Terms of Reference
- Staff - CVs and time input of all staff
- Experience - Previous experience of research with direct relevance to this project.
- Literature - Details of any relevant publications

The method of working shall identify in detail the activities required to achieve the objectives. Details must be given of all proposed office based activities and fieldwork. The programme shall clearly show intermediate target dates when each specific objective or other major identified activities are completed.

Part 2: Financial Information

- Summary schedule of costs to be identified under:

i staff
ii travel and subsistence
iii capital items
iv consumables
v reports
vi others eg sub-contractors

- breakdown of staff costs under the categories of time to be input and charge rate.

- summary of company accounts for the previous two years.

Three copies of Part 1 are required, but only one copy of Part 2.

1R47

NRA

Although the project is being let by competitive tender, the NRA reserve the right not to accept any of the tenders and to negotiate the extent and terms of reference subsequent to any offer. Note that the conditions of agreement provide for payment on the basis of measured work charged at the prevailing rates up to a ceiling price.

The NRA Thames Region Project Leader will be Paul Logan, but during the tendering process liaison should be undertaken through either Maxine Forshaw or Nicky Bailey in the R&D Section.

The final date for the receipt of all tenders and supporting information is 12 noon on 22nd July 1993, any tender received after this date and time may not be considered.

All tenders should be addressed to:

Mr J Eaglesham
Internal Control Group
National Rivers Authority
Thames Region
Kings Meadow House
Kings Meadow Road
Reading
RG1 8DQ

using the address label provided.

We look forward to receiving your tender.

Yours sincerely

Nicky Bailey

PP Dr M A Forshaw
R&D Co-ordinator

Encl a. Terms of Reference
b. Examples of the Memorandum of Agreement and Contract Schedules

TR47

Operational Investigation

Reference: OI/T/002 Function: Water Resources

Title: Weed Growth Investigation of the Upper Kennet

Terms of Reference

1. Description of Problems or Need

The need for an investigation into the aquatic weed growth of the Upper Kennet has been recognised as part of the Upper Kennet Action Plan. Many of the public concerns with respect to the river, identified in the Upper Kennet River Levels Study, were associated with aquatic weed growth. There appears to be little information on both the current status of aquatic weed growth in the river and the current management practises used.

2. i) Overall Objective

To obtain a comprehensive survey of weed growth in the Upper Kennet.

ii) Specific Objectives

1. To assess current problems with aquatic weed growth.
2. To obtain a baseline against which future changes can be measured.
3. To review current management practises.
4. To make recommendations and produce guidelines concerning management of aquatic weed.
5. To produce a report which can be used to give clear objective information to both the general public and action groups.

3. Project Implementation

The work is to be undertaken by an external research contractor and will be supervised by a Project Leader based in the Region (Paul Logan, Senior Biologist).

A Contractor with expertise in aquatic plant sampling, identification and management is to undertake the following:

1. Surveys to be carried out three times during the growing season (July to September). Aquatic plant species to be identified for the entire area being surveyed (source of Kennet to Knighton). Plant cover to be estimated for key reaches there are approximately 8-10 key reaches. In order to define the key reaches, liaison must be made with NRA Thames Region Biology, Fisheries and Conservation sections.

2. Ascertain the river management practises currently being used to control aquatic weed growth. Liaison with operational staff from NRA Thames Region (and other Regions), plus English Nature will be essential when attempting to determine the suitability of various management practises for weed control in large chalk rivers.

3. Consideration of the conservation value of the aquatic plant communities, in the light of the possible designation of the Kennet as a riverine SSSI, should be given and included in the final report.

4. Outputs

Progress Report to be produced at the end of the second month of the study. Final Report to consist of two distinct sections:

i) Survey of the current status of aquatic weed growth in the Upper Kennet.

ii) Assessment of the current management of aquatic weed growth in the Upper Kennet; consideration of the suitability of currently available management practises.

Number of copies of both progress and final report - 10.

5. Targets and Timescales

Work Item	Date of Completion	Month
July - first survey	31 July 1993	1
August - second survey	31 August 1993	2
September - third survey	30 Sept 1993	3
Progress Report	31 August 1993	2
Draft Final Report	31 October 1993	4
Final Report	31 December 1993	6

6. Project Cost

For budgetary purposes only, it is anticipated that the project cost, inclusive of travel, subsistence, consumables and printing, will be in the region of £15,000.

Appendix B
WEED SURVEY RECORDS

HALCROW

MACROPHYTES IN WATERCOURSES – FIELD CHECK LIST

RIVER _____ SITE _____ SURVEYOR _____

NGR top _____ NGR bottom _____ Date + time _____

Survey method (for keys to Relative Biomass & Percentage Cover scales see overleaf):

Site Length	0.5 km (500 m)		0.1 km (100 m)		0.01 km (10 m)		
Cover scale	A	B	A	B	A	B	C

	Rel	Cov		Rel	Cov		Rel	Cov
ALGAE:			*Littorella uniflora*			*Elodea canadensis*		
Blue-Green Mats			*Mentha aquatica*			*Elodea nuttallii*		
Batrachospermum sp(p)			*Menyanthes trifoliata*			*Glyceria maxima*		
Hildenbrandia rivularis			*Montia fontana*			*Glyceria other sp(p)*		
Lemanea fluviatilis			*Myosotis sp(p)*			*Groenlandia densa*		
Vaucheria sp(p)			*Myosoton aquaticum*			*Iris pseudacorus*		
Enteromorphia sp(p)			*Myriophyllum alterniflorum*			*Juncus acutiflorus*		
Stigeclonium sp(p)			*Myriophyllum spicatum*			*Juncus articulatus*		
Cladophora sp(p)			*Nasturtium officinale agg.*			*Juncus bulbosus*		
Other filamentous Greens			*Nuphar lutea*			*Juncus effusus*		
Chara sp(p)			*Nymphaea alba*			*Juncus inflexus*		
Nitella sp(p)			*Oenanthe crocata*			*Juncus sp(p)*		
LIVERWORTS:			*Oenanthe fluviatilis*			*Lemna gibba (gibbous)*		
Chiloscyphus polyanthos			*Polygonum amphibium*			*Lemna minor agg*		
Marsupella emarginata			*Potentilla palustris*			*Lemna trisulca*		
Nardia compressa			*Ranunculus aquatilis*			*Phalaris arundinacea*		
Pella endiviifolia			*Ranunculus calcareus*			*Phragmites australis*		
Pellia epiphylla			*Ranunculus circinatus*			*Potamogeton alpinus*		
Scapania undulata			*Ranunculus flammula*			*Potamogeton berchtoldii*		
Solenostoma sp(p)			*Ranunculus fluitans*			*Potamogeton crispus*		
Foliose Liverworts indet			*Ranunculus hederaceus*			*Potamogeton friesii*		
Thalloid Liverworts Indet			*Ranunculus omiophyllus*			*Potamogeton gramineus*		
MOSSES:			*Ranunculus peltatus*			*Potamogeton lucens*		
Amblystegium fluviatile			*Ranunculus penicillatus*			*Potamogeton natans*		
Amblystegium riparium			*Ranunculus trichophyllus*			*Potamogeton pectinatus*		
Cinclidotus fontinaloides			*Ranunculus sceleratus*			*Potamogeton perfoliatus*		
Fontinalis antipyretica			*Ranunculus indet*			*Potamogeton polygonifol*		
Fontinalis squamosa			*Rorippa amphibia*			*Potamogeton praelongus*		
Hygrohypnum luridum			*Rumex hydrolapathum*			*Potamogeton pusillus*		
Hygrohypnum ochraceum			*Solanum dulcamara*			*Potamogeton indet*		
Racomitrium aciculare			*Veronica anagalis-aquatica*			*Potamogeton other sp(p)*		
Rhynchostegium riparioides			*Veronica beccabunga*			*Sagittaria sagittifolia*		
Sphagnum sp(p)			*Veronica catenata*			*Scirpus fluitans*		
Mosses indet			MONOCOTYLEDONS:			*S. lacustris/tabernaemon*		
VASCULAR CRYPTOGAMS:			*Acorus calamus*			*Scirpus maritimus*		
Azolla filiculoides			*Agrostis stolonifera*			*Sparganium angustifolim*		
Equisetum fluviatile			*Alisma lanceolatum*			*Sparganium emersum*		
Equisetum palustre			*Alisma plantago-aquatica*			*Sparganium erectum*		
DICOTYLEDONS:			*Alopecurus geniculatus*			*Spirodela polyrrhiza*		
Apium inundatum			*Butomus umbellatus*			*Typha latifolia*		
Apium nodiflorum			*Carex acuta*			*Zannichellia palustris*		
Berula erecta			*Carex acutiformis*			ADDITIONS:		
Callitriche hamulata			*Carex aquatilis*			1.		
C. hermaphroditica			*Carex elata*			2.		
Callitriche obtusangula			*Carex paniculata*			3.		
Callitriche platycarpa			*Carex riparia*			4.		
Callitriche stagnalis			*Carex rostrata*			5.		
Callitriche indet			*Carex vesicaria*			6.		
Caltha palustris			*Carex indet*			7.		
Ceratophyllum demersum			*Carex other sp(p)*			8.		
Epilobium hirsutum			*Catabrosa aquatica*			9.		

Macrophytes in Watercourses—Habitat Features

RIVER ..... SITE ..... SURVEYOR .....

NGR top ..... NGR bottom ..... Date + time .....

LENGTH SURVEYED (tick) 500 m ☐ 100 m ☐ 10 m ☐

PHYSICAL RECORDS Record 1, 2 or 3 in boxes below, where:

1 = <5% of total, 2 = 5–25% of total, 3 = >25% of total

WIDTH (m)	<1 ☐	1–5 ☐	5–10 ☐	10–20 ☐	>20 ☐
DEPTH (m)	<0.25 ☐	0.25–0.5 ☐	0.5–1.0 ☐	>1.0 ☐	
SUBSTRATES	Bed rock ☐	Boulders ☐	Cobbles ☐	Pebbles ☐	Gravel ☐
	Sand ☐	Silt/mud ☐	Clay ☐	Peat ☐	
HABITATS	Pools ☐	Slacks ☐	Riffles ☐	Fast, deep water ☐	
SHADING Left Bank:	None ☐	Slight ☐	Moderate ☐	Dense ☐	
Right Bank:	None ☐	Slight ☐	Moderate ☐	Dense ☐	

Macrophyte Recording Sheet

Appendix B1

Appendix B2

Aquatic Macrophyte Survey Sites on the Upper Kennet

nb Survey numbers refer to results in Appendix B3

Site No	Site Name	Survey No	Survey Date	NGR
1	Uffcott, d/s roadbridge	1 and 2	23/8 and 3/11	SU125774
2	Winterbourne Bassett, d/s roadbridge	3 and 4	23/8 and 3/11	SU102749
3	Berwick Bassett, u/s roadbridge	5 and 6	23/8 and 3/11	SU100733
4	Winterbourne Monkton, d/s roadbridge	7 and 8	1/9 and 3/11	SU098717
5	Avebury, d/s roadbridge	9 and 10	1/9 and 3/11	SU099014
6	D/S Swallowhead Springs	11	3/11	SU103681
7	West Kennett, d/s roadbridge	12	1/9	SU110681
8	East Kennett, d/s roadbridge	13 and 14	1/9 and 3/11	SU116676
9	West Overton, d/s roadbridge	15 and 16	1/9 and 3/11	SU128682
10	West Overton, Withy Bed	17 and 18	23/8 and 3/11	SU131682
11	West Overton, d/s George Bridge	19	23/8	SU133683
12	Lockeridge, d/s roadbridge	20 and 21	23/8 and 3/11	SU148681
13	D/S Fyfield STW	22 and 23	23/8 and 3/11	SU150683
14	U/S Fyfield Church	24 and 25	23/8 and 3/11	SU149687
15	D/S Fyfield Church	26 and 27	1/9 and 3/11	SU150688
16	Clatford, d/s roadbridge	28 and 29	1/9 and 3/11	SU159688
17	Manton, u/s village	30 and 31	1/9 and 3/11	SU167687
18	Manton, side channel d/s bridge	32 and 33	23/8 and 3/11	SU172688
19	Marlborough, car park	34	1/9	SU188688
20	U/S River Og	35 and 36	1/9 and 4/11	SU196695
21	D/S River Og	37 and 38	2/9 and 4/11	SU197695
22	U/S Marlborough STW	39	4/11	SU200692
23	D/S Marlborough STW	40	4/11	SU201692
24	D/S Elcot Mill	41	4/11	SU204692
25	U/S Mildenhall Fish Farm	42 and 43	2/9 and 4/11	SU200693
26	D/S Mildenhall Footbridge	44 and 45	2/9 and 4/11	SU211693
27	At Sarsen Stones, Mildenhall	46 and 47	2/9 and 4/11	SU212693
28	U/S Hatches, Mildenhall	48 and 49	23/8 and 4/11	SU214694
29	Mildenhall, d/s roadbridge	50	23/8	SU215697
30	Stitchcombe, d/s roadbridge	51 and 52	23/8 and 4/11	SU227696
31	Stone Lane, Axford, d/s bridge	53 and 54	2/9 and 4/11	SU234698
32	Axford, d/s Axford hatches	55 and 56	3/9 and 4/11	SU238699

33	Axford, u/s Rags hatches	57 and 58	3/9 and 4/11	SU243702
34	Axford South Channel, d/s Rags hatches	59 and 60	3/9 and 4/11	SU246702
35	Axford North Channel, d/s Rags hatches	61	4/11	SU246703
36	Ramsbury main channel, d/s Mill Lane	62	9/11	SU270713
37	Ramsbury mill channel, d/s Mill Lane	63	9/11	SU270714
38	Knighton, u/s Knighton Gauging Stn	64 and 65	2/9 and 9/11	SU291711
39	Carrier channel, Elcot	66	4/11	SU205692
40	Back Channel, Mildenhall	67	4/11	SU213695
41	Og u/s roadbridge	68	4/11	SU196695
42	Og u/s Kennet	69 and 70	23/8 and 4/11	SU195696
43	Knighton Loop u/s Aldbourne	71	9/11	SU291712
44	Knighton Loop d/s Aldbourne	72 and 73	2/9 and 9/11	SU293711
45	Albourne at Whittonditch	74	9/11	SU289722
46	Aldbourne u/s Knighton Loop	75 and 76	3/9 and 9/11	SU291713

Results of Macrophyte Survey

The following table displays the percentage cover of each macrophyte recorded at each site surveyed. Values for records of physical variables are also included.

Survey numbers refer to the surveys of the sites listed in Appendix B2.

The full Latin plant names and common names of the abbreviations used are given in Appendix B5.

Any plant present at a site scored a minimum of 0.1% cover.

0 CASE NAME	1 SURVEY1	2 SURVEY2	3 SURVEY3	4 SURVEY4	5 SURVEY5	6 SURVEY6	7 SURVEY7
Batr sp.							
Clad sp.							
Vauc sp.							
Diat slime							
Font anti							
indet moss							
Apiu nodi							10.0
Beru erec							
Call obtu							
Call plat							
Call stag							
Call spp.							10.0
Calt palu							
Epil hirs	30.0	20.0	20.0	10.0	20.0	20.0	15.0
Fili ulma	.1	1.0	2.0	5.0	1.0	1.0	.1
Lyco euro							
Lyth sali							
Ment aqua							
Mimu gutt							
Myos scor							
Myos aqua							
Myri spic							
Nast offi							
Poly hydr							
Ranu aqua							
Ranu pelt							
Ranu pseud							
Ranu spp.							
Rume hydr							
Sola dulc			.1	.1	1.0	3.0	.1
Symp offi							
Vero aqua							
Vero becca							
Vero anag							
Vero cate							
Agro stol							.1
Alop geni							
Care acut							
Care ripa							
Care pani							
Care spp.							
Glyc maxi							
Glyc flui							
Iris pseu							
Junc acut							
Junc effu							
Junc spp.							
Lemn Minor		.1					
Phal arun			.1		.1	.1	5.0
Phra aust							
Scir lacu							
Scro aqua							
Spar erec							
Typh lati							
Zann palu							
Emer cover	30.0	21.0	22.0	15.0	22.0	24.0	40.0
Subm cover							
Tot cover	30.0	21.0	22.0	15.0	22.0	24.0	40.0
Terr grass	50.0	40.0	25.0	15.0	20.0	15.0	15.0
Ave width		.8		1.2		1.2	
Ave depth		20.0		20.0		10.0	
% cobbles							
% gravel							1.0
% sand							
% silt/mud	100.0	100.0	100.0	100.0	100.0	100.0	99.0
% pools		30.0		30.0	50.0	50.0	
% slack		70.0		70.0	50.0	50.0	
% riffle							
% fast/dee							
left	4.0		2.0		2.0		2.0
right	2.0		4.0		2.0		1.0

0 CASE NAME	8 SURVEY8	9 SURVEY9	10 SURVEY10	11 SURVEY11	12 SURVEY12	13 SURVEY13	14 SURVEY14
Batr sp.						.1	
Clad sp.						1.0	5.0
Vauc sp.							
Diat slime							
Font anti				.1		.1	.1
indet moss							
Apiu nodi	30.0	5.0	20.0	70.0	4.0	3.0	20.0
Beru erec							
Call obtu							
Call plat							
Call stag						.1	1.0
Call spp.	30.0	2.0	50.0	10.0			
Calt palu							
Epil hirs	5.0	2.0	.1	.1	.1	.1	.1
Fili ulma	.1	.1	.1	.1			
Lyco euro							
Lyth sali							
Ment aqua			.1	1.0	.1	.1	.1
Mimu gutt							
Myos scor				2.0		.1	5.0
Myos aqua							
Myri spic							
Nast offi		.1	5.0			1.0	10.0
Poly hydr							
Ranu aqua							
Ranu pelt				2.0		.1	5.0
Ranu pseud							
Ranu spp.							
Rume hydr							
Sola dulc	.1	.1	1.0	.1		.1	.1
Symp offi							
Vero aqua						.1	.1
Vero becca					.1		
Vero anag							
Vero cate							
Agro stol	.1					.1	.1
Alop geni							
Care acut							
Care ripa							
Care pani							
Care spp.							
Glyc maxi							
Glyc flui	5.0	55.0	45.0	5.0			
Iris pseu							
Junc acut							
Junc effu							
Junc spp.							
Lemn Minor						.1	
Phal arun	10.0	10.0	15.0	.1		.1	.1
Phra aust							
Scir lacu							
Scro aqua							
Spar erec							
Typh lati							
Zann palu							
Emer cover	80.0	73.0	86.0	79.0	5.0	6.0	42.0
Subm cover		2.0	5.0	12.0		.1	6.0
Tot cover	80.0	75.0	91.0	91.0	5.0	6.0	48.0
Terr grass	5.0	15.0	1.0	1.0	1.0	1.0	.1
Ave width	3.5	2.0	4.0	4.5	2.5	1.5	5.5
Ave depth	30.0	15.0	25.0	30.0	5.0	7.0	30.0
% cobbles				1.0	5.0	10.0	30.0
% gravel	5.0	5.0	30.0	19.0	10.0	40.0	30.0
% sand			5.0			20.0	
% silt/mud	95.0	95.0	65.0	80.0	85.0	50.0	20.0
% pools		50.0		20.0	50.0	20.0	
% slack	100.0	50.0	100.0	80.0	50.0	60.0	80.0
% riffle						20.0	20.0
% fast/dee							
left		1.0		2.0	3.0	3.0	
right		1.0		4.0	3.0	2.0	

0 CASE NAME	15 SURVEY15	16 SURVEY16	17 SURVEY17	18 SURVEY18	19 SURVEY19	20 SURVEY20	21 SURVEY21
Batr sp.							
Clad sp.		3.0					
Vauc sp.							
Diat slime							
Font anti							
indet moss							
Apiu nodi	.1	1.0	.1	15.0	3.0	20.0	20.0
Beru erec							
Call obtu							
Call plat							
Call stag					.1	3.0	1.0
Call spp.			.1	5.0			
Calt palu							
Epil hirs						15.0	10.0
Fili ulma							
Lyco euro							
Lyth sali							
Ment aqua			.1	1.0		2.0	.1
Mimu gutt							
Myos scor	.1	.1		1.0		2.0	.1
Myos aqua	.1						
Myri spic							
Nast offi	.1	2.0		1.0	.1		2.0
Poly hydr							
Ranu aqua							
Ranu pelt	.1	5.0	.1		.1	.1	2.0
Ranu pseud							
Ranu spp.							
Rume hydr							
Sola dulc							
Symp offi						.1	.1
Vero aqua	1.0	3.0		.1	.1	1.0	.1
Vero becca	.1						
Vero anag							
Vero cate							
Agro stol							
Alop geni		2.0		.1			
Care acut							
Care ripa							
Care pani							
Care spp.							
Glyc maxi					.1	5.0	5.0
Glyc flui	2.0	10.0				10.0	10.0
Iris pseu						2.0	1.0
Junc acut							
Junc effu							
Junc spp.							
Lemn Minor	.1						
Phal arun	.1	2.0			.1	20.0	15.0
Phra aust							
Scir lacu							
Scro aqua						.1	
Spar erec						.1	
Typh lati							
Zann palu							
Emer cover	5.0	23.0	2.0	24.0	5.0	77.0	67.0
Subm cover	.1	5.0	.1		.1	3.0	3.0
Tot cover	5.0	28.0	2.0	24.0	5.0	80.0	70.0
Terr grass	.1	3.0	.1	.1	.1	2.0	.1
Ave width	.5	4.5	1.8	4.2	1.0	2.0	4.0
Ave depth	3.0	25.0	10.0	27.0	5.0	8.0	40.0
% cobbles				2.0			30.0
% gravel	1.0	15.0	25.0	30.0	5.0	50.0	15.0
% sand							15.0
% silt/mud	99.0	85.0	75.0	68.0	95.0	50.0	40.0
% pools	50.0		10.0	10.0	20.0	50.0	5.0
% slack	50.0	85.0	90.0	80.0	80.0	50.0	80.0
% riffle		15.0		10.0			15.0
% fast/dee							
left	1.0		3.0		3.0	3.0	
right	1.0		3.0		2.0	2.0	

0 CASE NAME	22 SURVEY22	23 SURVEY23	24 SURVEY24	25 SURVEY25	26 SURVEY26	27 SURVEY27	28 SURVEY28
Batr sp.							
Clad sp.		5.0		1.0	1.0	1.0	.1
Vauc sp.							
Diat slime		10.0	15.0	10.0	5.0	5.0	5.0
Font anti			.1	.1	.1	.1	.1
indet moss							
Apiu nodi	20.0	1.0	5.0	5.0	1.0	2.0	2.0
Beru erec							
Call obtu							
Call plat							
Call stag	2.0	2.0	2.0	2.0	5.0	5.0	
Call spp.							.1
Calt palu							
Epil hirs	1.0	.1	1.0	.1	1.0	.1	.1
Fili ulma							
Lyco euro							
Lyth sali							
Ment aqua		.1	.1	.1	.1	.1	.1
Mimu gutt							
Myos scor	1.0	.1	3.0	3.0	2.0	.1	.1
Myos aqua					.1	.1	
Myri spic							
Nast offi	45.0	.1	3.0	5.0	2.0	2.0	3.0
Poly hydr							
Ranu aqua							
Ranu pelt	.1	.1	1.0	2.0	.1	1.0	
Ranu pseud	5.0	25.0	3.0	2.0	25.0	10.0	30.0
Ranu spp.							.1
Rume hydr							
Sola dulc				.1		.1	
Symp offi				.1	.1	.1	
Vero aqua	2.0	.1	.1	.1	.1	.1	
Vero becca			.1	.1	2.0	1.0	1.0
Vero anag				.1			
Vero cate							
Agro stol							
Alop geni							
Care acut							
Care ripa							
Care pani							
Care spp.							
Glyc maxi							
Glyc flui							
Iris pseu					.1	.1	.1
Junc acut							
Junc effu							
Junc spp.							
Lemn Minor							.1
Phal arun				.1	2.0	1.0	1.0
Phra aust							
Scir lacu							
Scro aqua					.1	.1	
Spar erec							
Typh lati							
Zann palu							
Emer cover	68.0	8.0	14.0	16.0	12.0	9.0	8.0
Subm cover	7.0	27.0	6.0	6.0	30.0	16.0	32.0
Tot cover	75.0	35.0	20.0	22.0	42.0	25.0	40.0
Terr grass	.1	.1	.1	.1	.1	.1	.1
Ave width	3.0	6.0	7.0	10.0	6.0	6.0	10.0
Ave depth	30.0	20.0	12.0	15.0	20.0	18.0	23.0
% cobbles		30.0	30.0	30.0	30.0	25.0	30.0
% gravel	10.0	35.0	30.0	30.0	30.0	30.0	30.0
% sand	5.0	15.0	20.0	25.0	10.0	15.0	20.0
% silt/mud	85.0	20.0	20.0	15.0	30.0	30.0	20.0
% pools		5.0		5.0	5.0		10.0
% slack	95.0	80.0	20.0	20.0	25.0	20.0	20.0
% riffle	5.0	15.0	80.0	75.0	70.0	80.0	70.0
% fast/dee							
left	3.0		2.0		2.0		3.0
right	3.0		2.0		2.0		3.0

0 CASE NAME	29 SURVEY29	30 SURVEY30	31 SURVEY31	32 SURVEY32	33 SURVEY33	34 SURVEY34	35 SURVEY35
Batr sp.							
Clad sp.	1.0					2.0	.1
Vauc sp.							
Diat slime	5.0	5.0	3.0				
Font anti	.1					2.0	
indet moss							
Apiu nodi	2.0	.1	.1	55.0	.1		.1
Beru erec							
Call obtu							
Call plat							
Call stag		5.0	4.0			1.0	3.0
Call spp.	.1						
Calt palu							
Epil hirs	.1			5.0	.1		.1
Fili ulma							
Lyco euro							
Lyth sali							
Ment aqua	.1	1.0	1.0	.1	.1		.1
Mimu gutt							
Myos scor	.1	1.0	1.0		.1		.1
Myos aqua							
Myri spic							1.0
Nast offi	5.0	2.0	2.0	5.0		.1	1.0
Poly hydr							
Ranu aqua							
Ranu pelt							
Ranu pseud	25.0	.1	.1	2.0	3.0		3.0
Ranu spp.							
Rume hydr							.1
Sola dulc							
Symp offi	.1						
Vero aqua		.1					
Vero becca	2.0	.1	.1	10.0	.1		.1
Vero anag							.1
Vero cate							
Agro stol							
Alop geni							
Care acut							.1
Care ripa							
Care pani							
Care spp.							
Glyc maxi				.1	.1		
Glyc flui							
Iris pseu	.1						
Junc acut							
Junc effu							
Junc spp.							
Lemn Minor							
Phal arun	.1	.1					.1
Phra aust							
Scir lacu							
Scro aqua							
Spar erec							
Typh lati							
Zann palu							
Emer cover	11.0	5.0	6.0	76.0	2.0	.1	3.0
Subm cover	25.0	5.0	4.0	2.0	3.0	5.0	7.0
Tot cover	36.0	10.0	10.0	78.0	5.0	5.0	10.0
Terr grass	.1	.1	.1	.1	.1	.1	.1
Ave width	10.0	7.0	7.0	2.0	4.0	10.0	10.0
Ave depth	30.0	65.0	75.0	20.0	20.0	35.0	30.0
% cobbles	30.0	5.0	5.0	25.0	25.0	60.0	
% gravel	30.0	25.0	35.0	45.0	40.0	15.0	40.0
% sand	20.0	5.0	5.0	10.0	10.0	10.0	40.0
% silt/mud	20.0	65.0	55.0	20.0	25.0	15.0	20.0
% pools	5.0	15.0	10.0		5.0		15.0
% slack		85.0	80.0	50.0	45.0	20.0	80.0
% riffle				50.0	50.0	55.0	5.0
% fast/dee	5.0		10.0			25.0	
left		2.0		3.0		4.0	4.0
right		2.0		2.0		4.0	4.0

0 CASE NAME	36 SURVEY36	37 SURVEY37	38 SURVEY38	39 SURVEY39	40 SURVEY40	41 SURVEY41	42 SURVEY42
Batr sp.							
Clad sp.	.1					.1	5.0
Vauc sp.							.1
Diat slime	2.0						
Font anti			.1			.1	
indet moss							
Apiu nodi	.1			.1		.1	5.0
Beru erec							
Call obtu							
Call plat							
Call stag	3.0	10.0	10.0				
Call spp.				10.0	5.0	10.0	5.0
Calt palu							
Epil hirs	.1			.1	.1	.1	.1
Fili ulma							
Lyco euro							
Lyth sali						.1	.1
Ment aqua	.1	.1	.1	.1	.1	.1	.1
Mimu gutt							
Myos scor				.1	2.0	.1	.1
Myos aqua							
Myri spic	1.0	3.0	3.0				
Nast offi	1.0	.1		15.0	10.0	5.0	25.0
Poly hydr							
Ranu aqua							
Ranu pelt							
Ranu pseud	3.0	10.0	10.0	.1	.1	20.0	1.0
Ranu spp.							
Rume hydr	.1						
Sola dulc		.1					
Symp offi							
Vero aqua							.1
Vero becca					.1	.1	.1
Vero anag	.1	.1	.1				
Vero cate							
Agro stol							
Alop geni		.1	.1				
Care acut							
Care ripa							
Care pani							
Care spp.							.1
Glyc maxi							.1
Glyc flui							
Iris pseu							
Junc acut							.1
Junc effu		.1	.1			.1	.1
Junc spp.							
Lemn Minor							
Phal arun	.1	.1	.1	.1	.1		.1
Phra aust				5.0			2.0
Scir lacu							
Scro aqua							
Spar erec							1.0
Typh lati							
Zann palu							
Emer cover	3.0	2.0	2.0	22.0	15.0	7.0	39.0
Subm cover	7.0	23.0	23.0	10.0	5.0	30.0	6.0
Tot cover	10.0	25.0	25.0	32.0	20.0	37.0	45.0
Terr grass	.1	.1	.1	.1	.1	1.0	.1
Ave width	10.0	11.0	12.0	13.0	12.0	15.0	17.0
Ave depth	35.0	35.0	35.0	60.0	60.0	40.0	75.0
% cobbles		30.0	30.0	25.0	25.0	30.0	10.0
% gravel	40.0	30.0	40.0	35.0	30.0	40.0	30.0
% sand	30.0	15.0	15.0			15.0	
% silt/mud	30.0	25.0	15.0	40.0	45.0	15.0	60.0
% pools	15.0	5.0	5.0		15.0	10.0	20.0
% slack	70.0	45.0	40.0	100.0	85.0	25.0	80.0
% riffle	15.0	45.0	50.0			45.0	
% fast/dee		5.0	5.0			30.0	
left		4.0		2.0	3.0	2.0	2.0
right		4.0		2.0	2.0	1.0	2.0

0 CASE NAME	43 SURVEY43	44 SURVEY44	45 SURVEY45	46 SURVEY46	47 SURVEY47	48 SURVEY48	49 SURVEY49
Batr sp.							
Clad sp.	1.0	4.0	.1	3.0		2.0	.1
Vauc sp.		.1				.1	
Diat slime		3.0					
Font anti		.1		.1			
indet moss							
Apiu nodi	2.0	.1					.1
Beru erec							
Call obtu							
Call plat							
Call stag				20.0	20.0	5.0	
Call spp.	5.0	5.0	5.0				5.0
Calt palu							
Epil hirs	2.0	.1	.1	2.0	2.0	1.0	.1
Fili ulma							
Lyco euro							
Lyth sali							
Ment aqua	.1	.1	.1	.1	.1	.1	.1
Mimu gutt							
Myos scor	.1	.1	.1	2.0	2.0	.1	.1
Myos aqua							
Myri spic	.1						
Nast offi	20.0	6.0	3.0	30.0	25.0	35.0	30.0
Poly hydr							
Ranu aqua							
Ranu pelt							
Ranu pseud	1.0	5.0	5.0	25.0	30.0	1.0	2.0
Ranu spp.							
Rume hydr							
Sola dulc	.1						
Symp offi							
Vero aqua	.1			.1	.1		
Vero becca	.1	.1	.1	.1	.1	.1	.1
Vero anag							
Vero cate							
Agro stol							
Alop geni							
Care acut							
Care ripa							
Care pani							
Care spp.						.1	.1
Glyc maxi	.1	2.0	3.0				
Glyc flui							
Iris pseu							
Junc acut	.1						
Junc effu	.1						
Junc spp.							
Lemn Minor						5.0	2.0
Phal arun	1.0	.1	2.0			.1	
Phra aust	2.0	3.0	3.0				
Scir lacu		8.0	5.0	1.0	.1		
Scro aqua							
Spar erec	1.0			.1	.1	.1	
Typh lati							
Zann palu			.1	.1	.1		
Emer cover	32.0	25.0	20.0	40.0	30.0	44.0	33.0
Subm cover	6.0	10.0	10.0	45.0	50.0	6.0	7.0
Tot cover	38.0	35.0	30.0	85.0	80.0	50.0	40.0
Terr grass	.1	.1	.1	.1	.1	1.0	.1
Ave width	17.0	13.0	12.0	12.0	12.0	16.0	16.0
Ave depth	80.0	35.0	50.0	60.0	65.0	75.0	75.0
% cobbles	15.0	20.0	25.0	30.0	35.0	20.0	15.0
% gravel	25.0	25.0	25.0	30.0	35.0	15.0	15.0
% sand	5.0	20.0	25.0	20.0	15.0	5.0	15.0
% silt/mud	55.0	35.0	25.0	20.0	15.0	60.0	55.0
% pools	20.0	5.0	15.0	5.0	5.0	15.0	15.0
% slack	80.0	80.0	80.0	70.0	60.0	85.0	85.0
% riffle		15.0	5.0	25.0	15.0		
% fast/dee					20.0		
left		1.0		1.0		1.0	
right		3.0		3.0		3.0	

0 CASE NAME	50 SURVEY50	51 SURVEY51	52 SURVEY52	53 SURVEY53	54 SURVEY54	55 SURVEY55	56 SURVEY56
Batr sp.							
Clad sp.				2.0	2.0	.1	
Vauc sp.							
Diat slime		.1		5.0	.1		
Font anti			.1				
indet moss							
Apiu nodi	.1	3.0	2.0	5.0	.1	.1	
Beru erec				.1		.1	.1
Call obtu				.1			
Call plat							
Call stag		20.0	20.0	15.0	15.0	15.0	20.0
Call spp.	3.0						
Calt palu							
Epil hirs	1.0	.1	1.0	2.0	2.0	.1	.1
Fili ulma	.1						
Lyco euro							
Lyth sali				.1	.1		
Ment aqua	.1			.1	.1		.1
Mimu gutt							
Myos scor	.1	.1	.1	.1	.1	.1	.1
Myos aqua							
Myri spic							
Nast offi	1.0	10.0	15.0	20.0	10.0	20.0	10.0
Poly hydr		.1					
Ranu aqua							
Ranu pelt							
Ranu pseud	3.0	25.0	25.0	20.0	20.0	20.0	25.0
Ranu spp.							
Rume hydr							
Sola dulc							
Symp offi	1.0					.1	.1
Vero aqua							
Vero becca			.1		.1	.1	.1
Vero anag						.1	.1
Vero cate							
Agro stol							
Alop geni							
Care acut	.1					5.0	5.0
Care ripa						.1	
Care pani							
Care spp.							1.0
Glyc maxi				.1	1.0	.1	1.0
Glyc flui							
Iris pseu						.1	.1
Junc acut							
Junc effu							
Junc spp.						.1	
Lemn Minor							
Phal arun				.1	1.0	.1	1.0
Phra aust			.1	.1			
Scir lacu		.1	.1				
Scro aqua		.1	.1				
Spar erec				.1	.1	5.0	5.0
Typh lati						.1	.1
Zann palu				5.0	5.0	5.0	5.0
Emer cover	4.0	15.0	20.0	30.0	20.0	35.0	25.0
Subm cover	6.0	45.0	45.0	40.0	40.0	40.0	50.0
Tot cover	10.0	60.0	65.0	70.0	60.0	75.0	75.0
Terr grass	1.0	.1	.1	.1	.1	.1	.1
Ave width	11.0	12.0	12.0	13.5	13.5	11.0	11.5
Ave depth	50.0	50.0	55.0	35.0	40.0	80.0	80.0
% cobbles	25.0	25.0	25.0	30.0	30.0	25.0	30.0
% gravel	35.0	35.0	30.0	45.0	50.0	45.0	40.0
% sand	10.0	5.0	10.0			10.0	10.0
% silt/mud	30.0	35.0	35.0	25.0	20.0	20.0	20.0
% pools		5.0	5.0	5.0		5.0	5.0
% slack		10.0	10.0	15.0	20.0	20.0	20.0
% riffle		35.0	35.0	45.0	45.0	25.0	25.0
% fast/dee		50.0	50.0	35.0	35.0	50.0	50.0
left	2.0	2.0		1.0		1.0	
right	2.0	3.0		3.0		3.0	

0 CASE NAME	57 SURVEY57	58 SURVEY58	59 SURVEY59	60 SURVEY60	61 SURVEY61	62 SURVEY62	63 SURVEY63
Batr sp.							
Clad sp.	5.0	1.0	3.0	1.0		5.0	2.0
Vauc sp.							
Diat slime			1.0			5.0	10.0
Font anti			1.0	1.0		.1	
indet moss							
Apiu nodi							
Beru erec							
Call obtu							
Call plat							
Call stag			15.0	10.0			
Call spp.	5.0	2.0			.1	.1	.1
Calt palu							
Epil hirs	.1	.1	.1		.1	.1	
Fili ulma							
Lyco euro							
Lyth sali							
Ment aqua	.1	.1		.1		.1	
Mimu gutt							
Myos scor	.1	2.0	.1	.1		.1	
Myos aqua							
Myri spic							
Nast offi	2.0	3.0	10.0	10.0	5.0	.1	
Poly hydr							
Ranu aqua							
Ranu pelt							
Ranu pseud			20.0	20.0		.1	
Ranu spp.							
Rume hydr							
Sola dulc							
Symp offi							
Vero aqua	.1						
Vero becca	.1	.1	.1				
Vero anag			.1	.1			
Vero cate							
Agro stol							
Alop geni							
Care acut		.1	.1	2.0		1.0	
Care ripa							
Care pani							
Care spp.	.1		.1	.1	.1	.1	
Glyc maxi	.1	.1	2.0	2.0			
Glyc flui							
Iris pseu							
Junc acut							
Junc effu							
Junc spp.							
Lemn Minor	.1						
Phal arun			.1		.1		
Phra aust						.1	
Scir lacu							
Scro aqua							
Spar erec	.1	.1	2.0	2.0	2.0		
Typh lati							
Zann palu			5.0	7.0			
Emer cover	10.0	8.0	20.0	18.0	7.0	2.0	
Subm cover	5.0	2.0	40.0	37.0		5.0	2.0
Tot cover	15.0	10.0	60.0	55.0	7.0	7.0	2.0
Terr grass	.1	.1	.1	2.0	.1	.1	.1
Ave width	12.5	12.5	12.5	13.0	16.0	11.0	8.0
Ave depth	85.0	95.0	25.0	35.0	90.0	30.0	28.0
% cobbles			45.0	40.0	10.0	30.0	10.0
% gravel	30.0	30.0	30.0	35.0	10.0	30.0	25.0
% sand			5.0	10.0		10.0	
% silt/mud	70.0	70.0	20.0	15.0	80.0	30.0	65.0
% pools				5.0			
% slack	100.0	100.0		5.0	100.0	100.0	100.0
% riffle			85.0	80.0			
% fast/dee			15.0	10.0			
left	4.0		2.0		3.0	2.0	2.0
right	1.0		2.0		2.0	4.0	2.0

0 CASE NAME	64 SURVEY64	65 SURVEY65	66 SURVEY66	67 SURVEY67	68 SURVEY68	69 SURVEY69	70 SURVEY70
Batr sp.							
Clad sp.	10.0	5.0	5.0	2.0		.1	
Vauc sp.							
Diat slime	10.0	5.0					
Font anti					1.0		
indet moss							
Apiu nodi	.1		.1	5.0	1.0	10.0	1.0
Beru erec							
Call obtu							
Call plat							
Call stag	15.0	15.0				10.0	10.0
Call spp.			10.0	30.0	5.0		
Calt palu		.1					
Epil hirs	.1	.1	10.0	2.0			.1
Fili ulma	.1	.1					
Lyco euro							
Lyth sali							
Ment aqua		.1	5.0	.1	.1	.1	1.0
Mimu gutt							
Myos scor	.1	.1	.1	25.0	.1	3.0	5.0
Myos aqua	.1						
Myri spic			20.0	.1			
Nast offi	10.0	5.0	5.0	5.0	35.0	35.0	30.0
Poly hydr							
Ranu aqua			5.0				
Ranu pelt							
Ranu pseud	25.0	20.0			5.0	15.0	15.0
Ranu spp.							
Rume hydr							
Sola dulc	.1	.1					.1
Symp offi	.1	.1					.1
Vero aqua			.1		2.0	.1	.1
Vero becca		.1	3.0	.1	.1		
Vero anag					.1		
Vero cate							
Agro stol							
Alop geni							
Care acut	3.0	3.0	10.0		.1		
Care ripa		.1	10.0				
Care pani							
Care spp.				5.0	.1		
Glyc maxi					.1		
Glyc flui			.1				
Iris pseu	.1	.1					
Junc acut						.1	.1
Junc effu		.1	.1				
Junc spp.							
Lemn Minor	.1		5.0	.1			.1
Phal arun			.1	.1	.1		
Phra aust							
Scir lacu							
Scro aqua		.1	.1				.1
Spar erec			5.0	3.0	.1		
Typh lati			.1				
Zann palu	5.0	7.0					
Emer cover	30.0	10.0	55.0	48.0	40.0	50.0	40.0
Subm cover	55.0	50.0	40.0	32.0	10.0	25.0	25.0
Tot cover	70.0	60.0	95.0	80.0	50.0	75.0	65.0
Terr grass	.1	.1	.1	.1	.1	.1	.1
Ave width	13.0	13.0	4.5	6.0	6.5	7.5	7.5
Ave depth	60.0	65.0	40.0	40.0	20.0	20.0	25.0
% cobbles	20.0	20.0	1.0	5.0	10.0	30.0	30.0
% gravel	55.0	55.0	5.0	5.0	40.0	35.0	30.0
% sand	5.0	5.0		30.0	10.0	10.0	10.0
% silt/mud	20.0	20.0	94.0	60.0	40.0	25.0	30.0
% pools						10.0	
% slack	50.0	50.0	100.0	100.0	50.0	50.0	50.0
% riffle	25.0	25.0			50.0	40.0	50.0
% fast/dee	25.0	25.0					
left	1.0		2.0	2.0	3.0	3.0	
right	3.0		2.0	2.0	2.0	3.0	

0 CASE NAME	71 SURVEY71	72 SURVEY72	73 SURVEY73	74 SURVEY74	75 SURVEY75	76 SURVEY76
Batr sp.						
Clad sp.	.1				2.0	
Vauc sp.						
Diat slime		.1			2.0	
Font anti	5.0				2.0	3.0
indet moss						
Apiu nodi	.1	1.0	.1	20.0	.1	
Beru erec		.1	.1			
Call obtu		.1	.1		5.0	
Call plat					.1	
Call stag		5.0	5.0		15.0	
Call spp.	15.0					20.0
Calt palu						
Epil hirs		5.0	2.0	.1	3.0	5.0
Fili ulma	.1			2.0	.1	.1
Lyco euro		.1				
Lyth sali		.1				
Ment aqua	.1		.1	5.0	.1	.1
Mimu gutt		.1	.1			
Myos scor	.1	2.0	2.0	10.0	.1	.1
Myos aqua						
Myri spic						
Nast offi	10.0	15.0	20.0	10.0	10.0	5.0
Poly hydr						
Ranu aqua						
Ranu pelt						
Ranu pseud			.1		.1	.1
Ranu spp.						
Rume hydr						
Sola dulc	.1	.1	.1	.1		
Symp offi		.1				
Vero aqua		.1	.1			
Vero becca					.1	.1
Vero anag			.1		.1	
Vero cate						
Agro stol				5.0		
Alop geni				5.0		.1
Care acut	2.0	5.0	5.0		5.0	7.0
Care ripa						
Care pani						
Care spp.		2.0	.1			
Glyc maxi						
Glyc flui						
Iris pseu						
Junc acut						
Junc effu	.1				.1	.1
Junc spp.						
Lemn Minor				.1		
Phal arun		.1	1.0		3.0	5.0
Phra aust		.1	.1			
Scir lacu						
Scro aqua			.1			
Spar erec					.1	.1
Typh lati						
Zann palu						
Emer cover	15.0	35.0	35.0	60.0	30.0	25.0
Subm cover	20.0	5.0	5.0		20.0	20.0
Tot cover	35.0	40.0	40.0	60.0	50.0	45.0
Terr grass	.1	.1	.1	30.0	.1	2.0
Ave width	6.0	9.0	9.0	.5	6.0	6.0
Ave depth	25.0	22.0	28.0	5.0	25.0	30.0
% cobbles	30.0	40.0	40.0		10.0	15.0
% gravel	40.0	35.0	35.0		25.0	25.0
% sand	10.0	10.0	10.0		5.0	10.0
% silt/mud	20.0	15.0	15.0	100.0	60.0	50.0
% pools	5.0			100.0	5.0	5.0
% slack	55.0	40.0	40.0		90.0	90.0
% riffle	40.0	60.0	60.0		5.0	5.0
% fast/dee						
left	3.0	2.0		1.0	3.0	
right	3.0	4.0		1.0	2.0	

Results of N Holmes' Upper Kennet Macrophyte Survey, 1992-1993

Percentage cover of Macrophytes at seven sites on the Upper Kennet

Site	U/S Br Winterbourne Bassett				U/S Br Berwick Bassett				D/S Br Avebury				U/S Br West Kennett				D/S Br East Kennett				D/S Overton Br				D/S Br Clatford			
Year	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93
Season	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au
Month	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10
Aplu nodi										0.5	2	10	35	55	75	25	20	35	70	25	35	30	35	20	2	3	5	5
Ment aqua													0.1	1	0.5	1	10	3	3	2	0.1	0.1	0.1	0.1	0.1	1	2	1
Myos scor													45	3	2	5	25	10	5	2	0.1	0.1	0.1	0.1	5	1	2	2
Nast offi										0.1	0.5	5	5	2	5	10		1	1	10		0.1	0.1	1	5	1	10	5
Terrest herb	20	15	10	25	15	5	5	5	75	10	10	2	10	1	1	0.1	10	2	1	0.1	0.1	2	0.5	0.1	1	0.2	0.1	
Terrest gras	5	5	5	5	5	5	5	2	10	5	2	0.1	5	5	0.5	0.1	10	10	3	0.1	10	3	2	1	0.1	0.1	0.1	0.1
Vauc spp.										20				5	0.1			0.1										
Clad glom						2				2				0.1	0.1			5				0.1						
Fila alga						10				3	0.1			0.1	0.1			0.1	0.1			0.1	0.1			0.1		
Ambl fluv																									0.1	0.1	0.1	0.1
Ambl ripa					0.1	0.2	0.2	0.5					0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Brac rutu	0.1	0.1	0.1	0.1	0.1	0.5	0.5	1																				
Cinc font																	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Font anti													0.1	0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ange sylv																									0.1	0.1	0.1	0.1

Continued overleaf

Appendix B4
cont

Site	U/S Br Winterbourne Bassett				U/S Br Berwick Bassett				D/S Br Avebury				U/S Br West Kennett				D/S Br East Kennett				D/S Overton Br				D/S Br Clatford			
Year	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93	92	93	93	93
Season	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au	au	sp	su	au
Month	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10	10	4	7	10
Epil hirs	20	10	15	20	15	20	40	40	2	0.1	1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1					0.1	2	2	0.1
Fili ulma	7	2	3	5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	1	1	0.1								
Ranu pseu																									70	90	50	30
Ranu pelt														2	2	0.1	7	30	10	0.1	5	10	20	5				
Sola dulc	2	2	1	1	2	10	5	2	2	2	5	3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1					0.1	0.1	0.1	0.1
Symp offi																									0.1	0.1	0.1	0.1
Vero becc																									2	0.1	2	2
Vero anag											0.5	0.1		0.2	0.5	0.1	0.1	0.2	1	0.1	0.1	0.2	0.5	0.5		0.1	1	0.1
Alop geni																					2	35	5	2				
Cata aqua																						0.1	10	0.1				
Glyc flui									10	50	70	60					1	10	2	0.1	5	20	5	10				
Glyc xped																					40	55	25	5				
Iris pseu																									0.1	0.1	0.1	0.1
Junc acut																									0.1	0.1	0.1	0.1
Lemn mino						0.1																0.1	0.1	0.1				
Phal arun									10	10	10	20	0.1	0.5	0.5	0.1	2	0.5	3	1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1

NB: Full latin names and common names, for the abbreviations in this table appear in Appendix B5

Appendix B5

Results of N Holmes' Kennet Macrophyte Survey 1981

River Macrophyte Database.
Report for KENNETT generated on 01 FEB 1994

River KENNETT Database code = 486

OS sheets: ? River length: ? No of sites: 8

Comments:
From original survey by Nigel Holmes.

Recommendations:
None entered on database.

The following three items were recorded during surveys in the late 1970s and early 1980s only.

Water authority: THAMES
Height of river at source: 168 metres
Highest point: 294 metres

Basic river information ENDS
Site information FOLLOWS.....
****

Macrophyte sampling sites:

River Macrophyte Database.
Report for KENNETT generated on 01 FEB 1994

Site no: 1 River: KENNETT 1992/3/4 SSc (3)

Grid reference: SU100696 (Refer to Point in km below for location of grid reference within sample.)

Altitude: 152 metres

The following four items were recorded during early surveys only.

Point in km: 0.0
Size class: 1
Slope: 8.8
Geology: Chalk

Note: Point in km indicates the point within the sample where the grid reference was taken, with 0.0 being the uppermost point and 0.99 being the lowermost.
Size class is on a scale of 1-10 indicating the flow rate in cubic metres per second, as follows:

1 = <0.31
2 = 0.31 - 0.62
3 = 0.62 - 1.25
4 = 1.25 - 2.5
5 = 2.5 - 5.0
6 = 5 - 10
7 = 10 - 20
8 = 20 - 40
9 = 40 - 80
10 = >80

Slope is the number of kilometres per 15 metres drop in height

Macrophyte data
Surveyed on 18 JUN 1981 by HOLMES, N

Typed as: 4 = DITCH!

Sample length: 0.5 km

Code	Species	Sample 1 R A	Sample 1 R %	Sample 1 B A	Sample 1 B %	Sample 2 R A	Sample 2 R %	Sample 2 B A	Sample 2 B %
4	Vaucheria sessilis agg.	1	1						
9	Cladophora glomerata agg.					3	2		
10	Filamentous greens	2	2			2	1		
28	Amblystegium riparium	1	1	1	1	1	1	1	1
35	Cinclidotus fontinaloides							1	1
39	Fontinalis antipyretica	1	1			1	1	1	1
47	Rhynchostegium riparioides					1	1	1	1

60	Apium nodiflorum	2	2			2	2	2	1
67	Callitriche platycarpa	1	1			2	1		
68	Callitriche stagnalis	2	2			2	2		
66	Callitriche obtusangula	1	1			2	1		
73	Epilobium hirsutum			1	1				
88	Mentha aquatica	1	1	1	1	1	1	1	1
96	Myosotis scorpoides	1	1	1	1	1	1	1	1
122	Rorippa nasturtium-aquaticum a					1	1	1	1
116	Ranunculus peltatus	1	1			3	2		
130	Solanum dulcamara	1	1	1	1	1	1	1	1
135	Veronica anagallis-aquatica	2	1			1	1		
140	Salix sp(p.)	2	1	2	2	2	1	2	2
141	Other tree genera					2	1	2	2
143	Agrostis stolonifera	1	1	2	2	1	1	2	2
146	Alopecurus geniculatus	1	1	1	1	1	1	1	1
179	Glyceria fluitans	3	3	3	3	3	2	3	2
197	Phalaris arundinacea	3	3	3	3	1	1	3	3
229	Phormidium sp(p.)	1	1						
303	Cratoneuron filicinum			1	1				
347	Pohlia carnea			1	1			1	1
413	Rumex sp(p.), other			1	1			1	1
425	Other dicotyledons	1	1	3	3	1	1	2	2
444	Other monocotyledons	1	1	2	2	1	1	3	3

Note: R = River data
B = Bank data
A = relative Abundance on scale 0-3 where:
1 = rare
2 = frequent/occasional
3 = dominant
% = %cover where:
1 = <0.1%
2 = 0.1-5%
3 = >5%

Line across table is division between species on standard card, and additional species.

Physical attributes	Sample 1	Sample 2
Depth		
<0.25M	6	7
0.25-0.5M	4	2
Width		
<5M	9	9
5-10M	1	1
Substrates		

GRAVEL	3	5
SILT/MUD	1	4
CLAY	5	
Habitats		
RUN	1	
SLACK	9	
Margins		
Total veg area (%)		
No data on database		

Note: rivers with database codes higher than 900 use a 0-4 scheme for physical data, as follows:
1 = >5%
2 = 5-25%
3 = 25-50%
4 = >50%
but those with lower numbers use a 0-9 scheme as follows:
1 = 1-10%
2 = 11-20%
3 = 21-30%
etc

Additional physical information given below was collected during early surveys only.

Physical attributes	Sample 1	Sample 2
Estimated stability	9	9
Velocity		
SLOW	3	2
MODERATE	7	8
Bank slope		
<30 degrees	2	4
30-60 degrees	8	2
60-90 degrees		2
±90 degrees		2
Bank type		
EARTH	9	7
Land use		
PERMANENT GRASS	5	5
ROTATION GRASS	5	5

Management		
DREDGING	7	1
SHADE	1	

Note: Estimated stability is a field estimate of the proportion of river bed that would remain in place during a flood.
Velocities were defined as follows:

Negligible:	Water barely moving.
Slow:	Water obviously moving, water surface calm, and trailing plant parts still.
Moderate:	Water surface somewhat disturbed and swirling, trailing parts moving.
Fast:	Water surface disturbed, trailing plant parts moving vigorously.
Rapid:	Water surface broken by boulders or stones, much swirling and disturbance.

Information for site no 1 ENDS
****

River Macrophyte Database.
Report for KENNETT generated on 01 FEB 1994

Site no: 2 River: KENNETT = CLATFORD - between 1992/3/4 Sites 7+8

Grid reference: SU156688 (Refer to Point in km below for location of grid reference within sample.)

Altitude: 137 metres

The following four items were recorded during early surveys only.

Point in km: 0.5
Size class: 2
Slope: 7.7
Geology: Chalk

Note: Point in km indicates the point within the sample where the grid reference was taken, with 0.0 being the uppermost point and 0.99 being the lowermost.
Size class is on a scale of 1-10 indicating the flow rate in cubic metres per second, as follows:

1 = <0.31
2 = 0.31 - 0.62
3 = 0.62 - 1.25
4 = 1.25 - 2.5
5 = 2.5 - 5.0
6 = 5 - 10
7 = 10 - 20
8 = 20 - 40
9 = 40 - 80
10 = >80

Slope is the number of kilometres per 15 metres drop in height

Macrophyte data
Surveyed on 18 JUN 1981 by HOLMES, N

Typed as: (4)

Sample length: 0.5 km

Code	Species	Sample 1 R A	Sample 1 R %	Sample 1 B A	Sample 1 B %	Sample 2 R A	Sample 2 R %	Sample 2 B A	Sample 2 B %
9	Cladophora glomerata agg.	1	1			1	1		
10	Filamentous greens	2	2			1	1		
28	Amblystegium riparium	1	1	1	1				
39	Fontinalis antipyretica	1	1	1	1				
47	Rhynchostegium riparioides	1	1	1	1				
53	Equisetum arvense			1	1				
58	Angelica sylvestris					1	1		

60	Apium nodiflorum	1	1	1	1	1	1	2	1
67	Callitriche platycarpa	1	1			1	1		
68	Callitriche stagnalis	1	1	1	1	1	1		
66	Callitriche obtusangula	1	1			1	1		
69	Caltha palustre			1	1				
72	Dipsacus fullonum			1	1				
73	Epilobium hirsutum	1	1	2	2	1	1	3	2
75	Filipendula ulmaria	1	1	2	1				
88	Mentha aquatica	1	1	2	2	1	1	2	2
96	Myosotis scorpoides	1	1	2	1	1	1	2	1
102	Oenanthe crocata					1	1	2	1
104	Petasites hybridus	1	1	2	2	1	1	1	1
105	Polygonum amphibia	1	1	1	1	1	1	1	1
110	Ranunculus penicillatus var ca	3	3			3	3		
122	Rorippa nasturtium-aquaticum a	2	2	3	2	2	2	3	2
127	Scrophularia auriculata			1	1			1	1
130	Solanum dulcamara	1	1	1	1			1	1
133	Symphytum officinale	1	1	2	2	1	1	2	1
135	Veronica anagallis-aquatica	2	1	2	2	1	1	1	1
136	Veronica beccabunga					1	1	2	1
140	Salix sp(p.)	1	1	1	1	1	1	1	1
141	Other tree genera	1	1	1	1	1	1	1	1
143	Agrostis stolonifera	1	1	2	1	1	1	2	1
146	Alopecurus geniculatus	1	1	1	1	1	1	1	1
179	Glyceria fluitans	1	1	1	1	1	1	1	1
183	Iris pseudacorus	1	1	1	1	1	1	1	1
184	Juncus acutiflorus			1	1				
187	Juncus effusus			1	1				
188	Juncus inflexus			1	1			1	1
191	Lemna minor	1	1			1	1		
197	Phalaris arundinacea	2	1	3	3	2	2	3	3
221	Sparganium erectum	1	1	1	1				
413	Rumex sp(p.), other	1	1	2	1	1	1	2	1
425	Other dicotyledons	1	1	3	3	1	1	2	1
444	Other monocotyledons	1	1	3	2	1	1	2	2

Note: R = River data
B = Bank data
A = relative Abundance on scale 0-3 where:
1 = rare
2 = frequent/occasional
3 = dominant
% = %cover where:
1 = <0.1%
2 = 0.1-5%
3 = >5%

Line across table is division between species on standard card, and additional species.

Physical attributes	Sample 1	Sample 2
Depth		
<0.25M	8	8
0.25-0.5M	2	2
Width		
<5M	6	6
5-10M	4	4
Substrates		
GRAVEL	9	9
Habitats		
RUN	6	6
SLACK	3	4
POOL	1	
Margins		
Total veg area (%) No data on database		

Note: rivers with database codes higher than 900 use a 0-4 scheme for physical data, as follows:
1 = >5%
2 = 5-25%
3 = 25-50%
4 = >50%
but those with lower numbers use a 0-9 scheme as follows:
1 = 1-10%
2 = 11-20%
3 = 21-30%
etc

Additional physical information given below was collected during early surveys only.

Physical attributes	Sample 1	Sample 2
Estimated stability	8	8
Velocity		
SLOW	2	2
MODERATE	8	8
Bank slope		

<30 degrees	4	4
30-60 degrees	2	2
60-90 degrees	4	4
Bank type		
EARTH	9	9
MUD	1	1
Land use		
PERMANENT GRASS	9	8
SCRUB	1	1
DECIDUOUS WOOD		1
Management		
CUTTING	9	9

Note: Estimated stability is a field estimate of the proportion of river bed that would remain in place during a flood.
Velocities were defined as follows:

Negligible: Water barely moving.
Slow: Water obviously moving, water surface calm, and trailing plant parts still.
Moderate: Water surface somewhat disturbed and swirling, trailing parts moving.
Fast: Water surface disturbed, trailing plant parts moving vigorously.
Rapid: Water surface broken by boulders or stones, much swirling and disturbance.

Information for site no 2 ENDS
****

Site no: 3 River: KENNETT = Mildenhall

Grid reference: SU215697 (Refer to Point in km below for location of grid reference within sample.)

Altitude: 137 metres

The following four items were recorded during early surveys only.

Point in km: 0.99
Size class: 4
Slope: 7.7
Geology: Chalk

Note: Point in km indicates the point within the sample where the grid reference was taken, with 0.0 being the uppermost point and 0.99 being the lowermost.
Size class is on a scale of 1-10 indicating the flow rate in cubic metres per second, as follows:

1 = <0.31
2 = 0.31 - 0.62
3 = 0.62 - 1.25
4 = 1.25 - 2.5
5 = 2.5 - 5.0
6 = 5 - 10
7 = 10 - 20
8 = 20 - 40
9 = 40 - 80
10 = >80

Slope is the number of kilometres per 15 metres drop in height

Macrophyte data
Surveyed on 18 JUN 1981 by HOLMES, N

Typed as: (3) Typed as CHALK STREAM.

Sample length: 0.5 km

Code	Species	Sample 1 R A	Sample 1 R %	Sample 1 B A	Sample 1 B %	Sample 2 R A	Sample 2 R %	Sample 2 B A	Sample 2 B %
2	Hildenbrandia rivularis	1	1			2	2		
4	Vaucheria sessilis agg.	1	1						
9	Cladophora glomerata agg.	1	1			2	2		
16	Verrucaria spp., other	1	1			1	1		
28	Amblystegium riparium	1	1	1	1	1	1	1	1
32	Brachythecium rutabulum							1	1
39	Fontinalis antipyretica	1	1			1	1		

58	Angelica sylvestris			1	1				1	1	
60	Apium nodiflorum	1	1	1	1	1	1	1	1		
61	Berula erecta					1	1				
67	Callitriche platycarpa	2	1			2	1	2	1		
68	Callitriche stagnalis	3	2			3	2	2	1		
66	Callitriche obtusangula					1	1				
72	Dipsacus fullonum			1	1						
73	Epilobium hirsutum	1	1	3	3	1	1	2	2		
75	Filipendula ulmaria	1	1	3	3	1	1	2	2		
76	Galium palustre	1	1	2	1	1	1	1	1		
88	Mentha aquatica	1	1	2	1	1	1	2	1		
96	Myosotis scorpoides	1	1	2	1	1	1	2	1		
104	Petasites hybridus			1	1	1	1	2	1		
105	Polygonum amphibia	1	1	1	1	1	1	1	1		
110	Ranunculus penicillatus var ca	3	2			3	3				
122	Rorippa nasturtium-aquaticum a	1	1	1	1	1	1	2	2		
127	Scrophularia auriculata	1	1	2	2	1	1	2	2		
130	Solanum dulcamara	1	1	1	1	1	1	1	1		
133	Symphytum officinale	1	1	2	1	1	1	2	1		
135	Veronica anagallis-aquatica	1	1	1	1						
136	Veronica beccabunga			2	1	1	1	2	2		
140	Salix sp(p.)	1	1	1	1	1	1	1	1		
141	Other tree genera			1	1	1	1	1	1		
143	Agrostis stolonifera	1	1	2	1	1	1	2	1		
146	Alopecurus geniculatus	1	1	1	1						
150	Carex acutiformis	1	1	2	2	2	2	3	3		
169	Carex riparia	2	1	3	3	2	2	3	3		
176	Elodea canadensis	2	1			2	1				
179	Glyceria fluitans					1	1	1	1		
180	Glyceria maxima	1	1	2	2	2	2	3	3		
187	Juncus effusus	1	1	1	1			1	1		
188	Juncus inflexus	1	1	2	2	1	1	2	1		
191	Lemna minor	1	1			1	1				
197	Phalaris arundinacea	2	1	3	3	2	1	3	3		
198	Phragmites australis	2	1	2	1	2	1	2	2		
216	Scirpus lacustris	3	2			3	2				
220	Sparganium emersum	3	2			3	2				
221	Sparganium erectum	2	2	1	1	2	2	1	1		
222	Typha latifolia					1	1	1	1		
383	Epilobium sp(p.), other			1	1			2	1		
408	Polygonum sp(p.), other			1	1			1	1		
413	Rumex sp(p.), other			1	1			1	1		
422	Veronica catenata x veronica a					1	1	2	1		
425	Other dicotyledons	1	1	2	2	1	1	2	2		
444	Other monocotyledons	1	1	3	3	1	1	2	2		

Note: R = River data
B = Bank data
A = relative Abundance on scale 0-3 where:

1 = rare
2 = frequent/occasional
3 = dominant

% = %cover where:
1 = <0.1%
2 = 0.1-5%
3 = >5%

Line across table is division between species on standard card, and additional species.

Physical attributes	Sample 1	Sample 2
Depth		
<0.25M	2	4
0.25-0.5M	2	3
0.5-1.0M	2	1
>1.0M	2	
Width		
5-10M	9	8
10-20M		2
Substrates		
PEBBLES		1
GRAVEL	3	8
SILT/MUD	6	
CLAY		
Habitats		
RUN		6
SLACK	9	4
Margins		
Total veg area (%) No data on database		

Note: rivers with database codes higher than 900 use a 0-4 scheme for physical data, as follows:
1 = >5%
2 = 5-25%
3 = 25-50%
4 = >50%
but those with lower numbers use a 0-9 scheme as follows:
1 = 1-10%
2 = 11-20%
3 = 21-30%
etc

Additional physical information given below was collected during early surveys only.

Physical attributes	Sample 1	Sample 2
Estimated stability	9	9
Velocity		
SLOW	6	1
MODERATE	4	7
FAST		2
Bank slope		
<30 degrees		4
30-60 degrees	9	5
Bank type		
EARTH	9	9
Land use		
PERMANENT GRASS	7	8
SCRUB	3	1
URBAN		1
DECIDUOUS WOOD		
Management		
CUTTING	9	9

Note: Estimated stability is a field estimate of the proportion of river bed that would remain in place during a flood.
Velocities were defined as follows:

Negligible:	Water barely moving.
Slow:	Water obviously moving, water surface calm, and trailing plant parts still.
Moderate:	Water surface somewhat disturbed and swirling, trailing parts moving.
Fast:	Water surface disturbed, trailing plant parts moving vigorously.
Rapid:	Water surface broken by boulders or stones, much swirling and disturbance.

Information for site no 3 ENDS
****

River Macrophyte Database.
Report for KENNETT generated on 01 FEB 1994

Site no: 4 River: KENNETT = RMSBo.24

Grid reference: SU278716 (Refer to Point in km below for location of grid reference within sample.)

Altitude: 122 metres

The following four items were recorded during early surveys only.

Point in Km: 0.99
Size class: 4
Slope: 9.1
Geology: Chalk

Note: Point in km indicates the point within the sample where the grid reference was taken, with 0.0 being the uppermost point and 0.99 being the lowermost.
Size class is on a scale of 1-10 indicating the flow rate in cubic metres per second, as follows:

1 = <0.31
2 = 0.31 - 0.62
3 = 0.62 - 1.25
4 = 1.25 - 2.5
5 = 2.5 - 5.0
6 = 5 - 10
7 = 10 - 20
8 = 20 - 40
9 = 40 - 80
10 = >80

Slope is the number of kilometres per 15 metres drop in height

Macrophyte data
Surveyed on 13 JUN 1981 by HOLMES, N

Typed as: 3

Sample length: 0.5 km

Code	Species	Sample 1 R A	Sample 1 R %	Sample 1 B A	Sample 1 B %	Sample 2 R A	Sample 2 R %	Sample 2 B A	Sample 2 B %
2	Hildenbrandia rivularis					1	1		
4	Vaucheria sessilis agg.	1	1			1	1		
9	Cladophora glomerata agg.	1	1			1	1		
10	Filamentous greens					1	1		
16	Verrucaria spp., other					1	1		
28	Amblystegium riparium	1	1	1	1	1	1	1	1
32	Brachythecium rutabulum			1	1			1	1

39	Fontinalis antipyretica					1	1		
47	Rhynchostegium riparioides					1	1		
53	Equisetum arvense			1	1			1	1
58	Angelica sylvestris			1	1			1	1
60	Apium nodiflorum	1	1	1	1	1	1	1	1
61	Berula erecta	1	1			2	2		
67	Callitriche platycarpa	3	3	1	1	3	3		
68	Callitriche stagnalis	3	3	1	1	2	2	1	1
66	Callitriche obtusangula	2	1			1	1		
69	Caltha palustre	1	1	1	1	1	1	1	1
72	Dipsacus fullonum			1	1			1	1
73	Epilobium hirsutum	1	1	2	2	1	1	3	3
74	Eupatorium cannabinum	1	1	1	1	1	1	2	2
75	Filipendula ulmaria	1	1	2	1			2	1
76	Galium palustre			1	1	1	1	1	1
85	Lycopus europeaus	1	1	1	1				
87	Lythrum salicaria	1	1	2	1	1	1	2	1
88	Mentha aquatica	1	1	2	2	1	1	2	2
96	Myosotis scorpoides	1	1	2	1	1	1	2	1
99	Myriophyllum spicatum	1	1			1	1		
102	Oenanthe crocata					1	1	2	1
105	Polygonum amphibia	1	1	2	1	1	1	2	1
108	Pulicaria dysenterica			1	1			1	1
110	Ranunculus penicillatus var ca	3	3			3	3		
122	Rorippa nasturtium-aquaticum a	2	1	2	1	1	1	2	1
125	Rumex hydrolapathum	1	1	1	1				
126	Sagina procumbens			1	1			1	1
127	Scrophularia auriculata	1	1	2	1	1	1	2	1
129	Senecio aquaticus			1	1			1	1
130	Solanum dulcamara	1	1	1	1	1	1	1	1
133	Symphytum officinale	1	1	2	2	1	1	2	1
136	Veronica beccabunga	1	1	2	1	1	1	2	1
143	Agrostis stolonifera	1	1	2	2	1	1	2	1
145	Alisma plantago-aquatica	1	1					1	1
150	Carex acutiformis	2	2	3	2	1	1	3	2
140	Salix sp(p.)	1	1	1	1	2	2	3	3
141	Other tree genera			1	1	1	1	2	1
169	Carex riparia	2	2	3	3	2	1	3	2
175	Eleocharis palustris	1	1	1	1				
176	Elodea canadensis	1	1			1	1		
180	Glyceria maxima	2	1	2	1	2	1	2	2
183	Iris pseudacorus	1	1	2	1	1	1	2	1
184	Juncus acutiflorus			1	1			1	1
187	Juncus effusus			1	1			1	1
188	Juncus inflexus			1	1				
191	Lemna minor	1	1			1	1		
197	Phalaris arundinacea	2	1	2	2	2	1	3	3
198	Phragmites australis	1	1	1	1	1	1	1	1
216	Scirpus lacustris	3	3			3	3		
220	Sparganium emersum	2	2			2	2		
221	Sparganium erectum	1	1	1	1	1	1	1	1

317	Fissidens crassipes					1	1	1	1
383	Epilobium spp.) other			1	1	1	1	2	1
390	Typhia flos-cuculi			1	1				
391	Lysimachia nemorum			1	1			1	1
413	Rumex spp.) other			1	1			1	1
421	Valeriana dioica\officinalis			1	1			1	1
422	Veronica catenata v veronica a	2	1	2	1	1	1	1	1
425	Other dicotyledons	1	1	1	1	1	1	2	2
444	Other monocotyledons	1	1	2	1	1	1	2	1

Note: R = River data
B = Bank data
A = relative Abundance on scale 0-3 where:
1 = rare
2 = frequent/occasional
3 = dominant
% = %cover where:
1 = <0.1%
2 = 0.1-5%
3 = >5%

Time arrows table is division between species on standard card. And additional species

Physical attributes	Sample 1	Sample 2
Depth		
<0.25M	1	4
0.25-0.5M	2	2
0.5-1.0M	2	1
>1.0M	3	1
Width		
5-10M	0	8
10-20M	1	2
Substrates		
GRAVEL	2	6
STLT/MUD	4	2
CLAY	4	2
Habitats		
RUN		4
SLACK	8	4
Margins		
Total Veg Area (%)		

Common Names and Abbreviations of Macrophytes

Latin Name	Common Name	Abbreviation
Algae		
Batrachospermum sp.	Frogspawn algae	Batr sp.
Cladophora sp.	Blanket weed	Clad sp.
Vaucheria sp.		Vauc sp.
Diatom slime		
Mosses		
Fontinalis antipyretica	Willow Moss	Font anti
Dicotyledons		
Apium nodiflorum	Fool's Water-cress	Apiu nodi
Berula erecta	Lesser Water-parsnip	Beru erec
Callitriche obtusangula	Blunt-fruited Water Starwort	Call obtu
Callitriche platycarpa	Various-leaved Water Starwort	Call plat
Callitriche stagnalis	Common Water Starwort	Call stag
Callitriche spp indet	Water Starwort	Calli spp
Caltha palustris	Marsh-marigold	Calt palu
Epilobium hirsutum	Great Willowherb	Epil hirs
Filipendula ulmaria	Meadowsweet	Fili ulma
Lycopus europaeus	Gipsywort	Lyco euro
Lythrum salicaria	Purple-loosestrife	Lyth sali
Mentha aquatica	Water-mint	Ment aqua
Mimulus guttatus	Monkey flower	Mimu gutt
Myositis scorpiodes	Water Forget-me-not	Myos scor
Myosoton aquaticum	Water Chickweed	Myos aqua
Myriophyllum spicatum	Spiked Water-milfoil	Myri spic
Nasturtium officinale	Water-cress	Nast offi
Polygonum hydropiper	Water-pepper	Poly hydr
Ranunculus aquatilis	Common Water-crowfoot	Ranu aqua
Ranunculus peltatus	Pond Water-crowfoot	Ranu pelt
Ranunculus pen subsp pseud	Brook Water-crowfoot	Ranu pseu

Latin Name	Common Name	Abbreviation
Ranunculus spp. indet	Water-crowfoot	Ranu spp.
Rumex hydrolapathum	Water Dock	Rume hydro
Solanum dulcamara	Bittersweet	Sola dulc
Symphytum officinale	Common comfrey	Symp offi
Veronica anagalis-aquat	Blue Water-speedwell	Vero aqua
Veronica beccabunga	Brooklime	Vero becc
Veronica catenata x anag	Hybrid Water-speedwell	Vero anag
Veronica catenata	Pink Water-speedwell	Vero cate
Monocotyledons		
Agrostis stolonifera	Creeping Bent	Agro stol
Alopecurus geniculatus	Marsh Foxtail	Alope geni
Carex acutiformis	Lesser Pond-sedge	Care acut
Carex riparia	Greater Pond-sedge	Care ripa
Carex paniculata	Greater Tussock-sedge	Care pani
Carex spp. indet	Sedge	Care spp.
Glyceria maxima	Reed Sweet-grass	Glyc maxi
Glyceria fluitans	Floating Sweet-grass	Glyc flui
Iris pseudacorus	Yellow Iris	Iris pseu
Juncus acutiflorus	Sharp-flowered Rush	Junc acut
Juncus effusus	Soft-rush	Junc effu
Juncus spp. indet	Rush	Junc spp.
Lemna minor	Common Duckweed	Lemn mino
Phalaris arundinacea	Reed Canary-grass	Phal arun
Phragmites australis	Common Reed	Phro aust
Scirpus lacustris	Common Club-rush	Scir lacu
Scrophularia aquatica	Water Figwort	Scro aqua
Sparganium erectum	Branched Bur-reed	Spar erec
Typha latifolia	Reed-mace	Typh lati
Zannichelia palustris	Horned Pondweed	Zann palu

Review of Management Practices

1 Weed Control

Aquatic weeds are managed for many reasons, principally relating to the control of water levels, the provision of suitable habitats for fish and freshwater invertebrates and maintenance of bank stability. Aquatic weed is also important to the visual appearance of a watercourse and the public perception of a healthy river.

Traditionally weeds have been managed by hand and in some cases, particularly where the waters are valuable for fishing, as on much of the Kennet, these methods are still used. A river keeper is often employed to manage and maintain the fishing interest. Weed management for other reasons such as flood control is often carried out using machinery, aquatic herbicides and less frequently biological and environmental means. A review of different weed control methods is given below.

a) Traditional Hand-cutting

The traditional methods used in the control of weed growth are very selective and are ideal for encouraging the growth of desirable species such as Water-crowfoot through trimming, and the removal of less desirable species such as Mare's-tail (*Hippuris* spp.) and Water-cress by pulling-up or raking-out. These methods are however very labour-intensive.

Traditional weed-cutting methods are discussed extensively in Behrendt (1977), Seymour (1970), Seagrave (1988) and BTCV (1981) and the ecology of weed management has been reviewed by Ham et al (1982), Westlake and Dawson (1982, 1986 and 1988) and Dawson (1989).

The weeds which are desirable in a fishery may be cut into shape using hand scythes or river knives, the most common patterns of cut being the 'cut and bar' and 'checkerboard' which are shown in Figure 5. In deeper waters where wading is impossible the weeds can be cut using a scythe blade on a long pole from a boat, or a chain scythe operated from each bank. The 'cut and bar' pattern involves trimming the weed in transverse bands, of approximately 10m, across the watercourse in rotation so that the weed forms different heights in longitudinal section. This has the advantage in smaller streams of holding-up water levels behind each band of weed which acts as a small weir. The 'checkerboard' pattern leaves patches of weed at the side of the stream where lateral erosion is likely, for example on the outside of a bend. Occasional bars of weed are left across the watercourse downstream of the bend. This method helps to keep the stream or river on course and limit the formation of ox-bows.

The aim of this cutting is to maintain a plant-cover to open-water ratio of approximately 60:40 (Seymour 1970) for good angling. The weeds provide shelter and food for fish and freshwater invertebrates, and the clear patches provide spawning and feeding areas. In the autumn the areas between weed are often raked to oxygenate the gravels and remove silty deposits. Clean gravels encourage the spawning of salmonids.

The weed, once cut, has to be removed from the watercourse as it rots quite quickly and can cause localised reductions in oxygen. It is an offence under the Rivers (Prevention of Pollution) Act to leave cut weed in a river. The cut weed is usually removed by floating the weed downstream where it is collected on weed-racks or booms and then pulled onto the banks with pitchforks or rakes. It may be deflected into weed-lagoons via booms and hatches and left to rot.

The timing of weed-cutting has to take the fishing season into account, for example:

- in spring, before the fishing season opens, the patterns desired are established with a light trim, the bankside vegetation is trimmed and, in over-widened areas, weed is encouraged to narrow the channel;

- the second cuts are usually made in mid-summer when the weeds break the surface of the water and growth is at a peak. The bank-side vegetation is also cut to allow access to the river and room for casting for anglers. These summer cuts are often made on designated days to reduce the disturbance to anglers;

- the final cut of weed is generally carried out in autumn after the fishing season has closed. The gravels may be raked in preparation for spawning and the weeds are often removed from the centre of the channels, leaving strips of vegetation along the margins, to aid the passing of flood waters.

In many rivers it has recently become common to undertake close autumn cutting of Water-crowfoot in order to prevent the need for more extensive and damaging cutting in the spring, when flooding may otherwise occur (Westlake and Dawson 1986). Although this pre-emetine autumn cutting appears to successfully reduce the standing crop at the time of the normal spring cut the wider ecological effects (eg changes in community structure, growth modes etc) are still poorly understood (Westlake and Dawson 1988).

In the early part of the growing season the process of cutting weed stimulates vegetative growth and in itself promotes the need for further cutting. The amount of cutting is critical; the value of the habitat to fish and freshwater invertebrates can easily be adversely affected. For example, if the weed is cut too severely or if too great

an area is cut at one time, the fish may migrate to another stretch. Studies (Dawson et al 1991) have shown that cut weed, especially Water-crowfoot, harbours large numbers of invertebrates which would otherwise provide potential food for fish. In order to minimise disturbance to fish and invertebrates it is particularly important in deeper waters, where silt and muds are likely to have built-up, to allow a settling period before working on adjacent reaches. Seymour (1970) suggests carrying out cutting during or after heavy rainfall to reduce the impact of silt in the water.

Trees can have significant impact upon watercourses by affecting the amount of light reaching the water surface, the bank stability and, in some cases, the currents and quantities of water within the channel. Certain trees, such as Alder and Crack Willow, can cause problems if they are permitted to reach maturity, They are prone to falling and can cause channel constrictions flood hazards. Overhanging branches are often removed to stop debris being caught up during floods and subsequently affecting currents and erosion patterns. Conversely the shading out of aquatic plants may reduce the need for in-stream weed management.

b) Machinery

The most commonly used machines are weed-cutting boats and hydraulic excavators or tractors fitted with weed buckets (Newbold et al 1989; BTCV 1981; Seagrave 1988). Boats are usually employed in large waterbodies or in deep water, particularly in the Fens. The use of this machinery is much quicker and cheaper in terms of labour costs than the more traditional methods of cutting. In addition the machines can be used for other jobs. Disadvantages include the high initial capital outlay, possible access problems and lack of environmental sensitivity and selectivity. For this reason hand cutting is still prevalent in chalk streams with high quality fisheries.

Dredging may also be used as a method of weed control, although such severe action results in changes to the channel shape and loss of bankside as well as aquatic vegetation. The invasion of vigorous plant species, on the resultant silty bed may then be encouraged. Dredging other than the removal of localised silt/sand accumulation is rarely performed due to the environmental damage which often results.

c) Herbicides

There is a range of well tried aquatic herbicides which include selective and non-selective forms. The number of chemicals approved for use is however limited and products are required to comply with the Food and Environment Protection Act (1984 - Control of Pesticides Regulations). Products available include Roundup (Glyphosate), Midstream (Diquat) and Clarosan

(Terbutryne) (Seagrave 1988). The chemical chosen depends upon the particular circumstances, for example the timing, water velocity and species of weed to be controlled. Although problem weed species may be eradicated and/or controlled, new problems may result with other species (often Blanket Weed) becoming more abundant with the removal of competition.

The use of aquatic herbicides requires care and the manufacturers' recommendations must be followed. MAFF (1985) have produced a set of guidelines for the use of herbicides in or near watercourses.

d) Biological Control

Although rarely used, biological methods for the control of aquatic weed growth are available (Newbold et al 1989; BTCV 1981; Seagrave 1988). The most common include the use of carp species or crayfish to graze weeds. Little work has been done regarding the effectiveness of using grazing to control weed growth, although it is attractive in that little physical labour is required and toxic chemicals are not used. Birds such as geese and swan can also be used to graze weed although this activity is more often seen as destructive. Biological methods often involve the introduction of alien species; a practice which is generally considered undesirable, especially in highly prized salmonid fisheries.

e) Environmental Control

Control measures within this category include the reduction of light available for plant growth through the spreading of black polythene sheeting or similar material on the stream/lake bed, or the shading of the water by trees (Dawson and Kern-Hansen 1979; Dawson and Haslam 1983; and Dawson and Hallows 1983). Other controls include the manipulation of water levels, the changing of substrate (for instance the removal of silt), and the manipulation of nutrients until the required aquatic weed species decline. These methods, other than the limited control which can be achieved by provision of bankside shade, are undesirable or impractical in most natural situations.

2 Hatch Operation

Hatch and sluice systems are a relic of historic management regimes and were particularly associated with water meadows and water mills. Hatches have in many instances been maintained for regulation of water levels in the chalk streams of lowland Britain, although the original reasons for their existence have generally long since gone. Water meadows are however being re-introduced in some places under The Countryside Stewardship Scheme and other management schemes as described in Section 4 (Appendix B7) and Section 3 of the main report.

The hatches traditionally consist of a set of gates which can be raised or lowered with a ratchet or peg holding the gate at the required level. When natural levels are to be maintained, or when water levels are high the hatch is raised, and water is drawn underneath the gate. When water levels need to be raised the hatch is lowered. Sets of hatches often consist of several gates together, allowing a finer adjustment of flow, and some have an adjacent spillway or overflow adjacent to take excess flows when the watercourse is in flood. Hatches and spillways are often associated with the numerous cuts and leats which have arisen alongside natural chalk stream channels.

The primary use of hatches (Plates 26, 31 and 34) today is in fisheries management. They allow water levels to be maintained at a suitable depth during the summer and during periods of low flow. In some instances where fishing is of less importance hatches have been replaced with boards which allow water to spill over when levels rise, but hold-up water when natural levels are low. This can cause silt and other material to build-up behind the boards which may inhibit the growth of desirable weed species such as Water-crowfoot. In some instances large quantities of Common Duck Week (*Lemna minor*) can build up behind the hatches and the growth of water-cress and Fool's-cress may be encouraged.

Where fisheries are of high importance the hatches are often checked on a daily basis and adjusted according to seasonal or daily requirements. In many cases the hatches are left untouched during the winter months unless flood flows are predicted. In the spring, at the start of the game fishing season, there may be a conflict between the need to encourage Water-crowfoot growth (through keeping water velocity high and water levels low) and the need to raise water levels in order to improve angling.

3 Channel Modification

Many of the modifications made to channels are undertaken to improve the fishing or flood control potential of the watercourses. Changes can be made to the bankside vegetation, to the channel bed and to the banks themselves. More recently channel enhancements have been carried out on a significant scale in an attempt to restore those rivers and streams which have been adversely affected by historical land drainage and flood defence works.

The vegetation which grows along the edge of a river is of great importance to the stability of the banks and river margins. Species of reed and sedge are particularly important in limiting the erosion of banks, although they can cause problems with encroachment into the channel, and as a result may require careful management. In many cases the cut vegetative material can be used to build-up the banks where erosion is taking place.

Trees can also play a role in bank stability and need to be managed to prevent them uprooting and falling into the channel. Fallen trees can destabilise the banks, and can lead to changes in the flow regime of the

river. In certain river landscapes trees are traditionally pollarded along watercourses. In the situation where flood defence and fisheries are not important fallen trees can add to immensely the habitat diversity and ecological interest of a watercourse.

The principal reasons for altering the channel itself are for enhancement and restoration of a more natural riverine environment, to increase suitability for fishing and fisheries or to increase the potential for flood control. The main changes include those made to the course, the longitudinal section, and the capacity of a river.

Minor alterations to the course of a river can be achieved through the installation of groynes, half-weirs, rocks/stones and islands. Greater using excavators to create a desired shape and by importing appropriate materials to maintain it. Meanders and other naturally occurring channel movements can be restricted, where necessary, through inserting groynes or strengthening of banks at appropriate places. Bank strengthening can be achieved using hard materials such as concrete or sheet piling, or more 'environmentally friendly' materials such as geotextiles (eg nicospan), wooden stakes or willow hurdles.

Changing the longitudinal section of a watercourse can enhance both habitat and fishing quality by increasing aeration, raising or reducing water levels and increasing water velocity. The most frequently used method of achieving such changes in bed level is the construction of weirs, whether in a hard-engineering form (eg a concrete sill) or in a more natural form (eg large stones).

Changes to channel capacity are more commonly achieved through narrowing, widening and dredging. Often problems apparently due to low flows can be mitigated, to some extent, by narrowing over-widened channels. This may increase water level and velocity. Similar methods to those for improving bank stability can be used, with piles or stakes marking the new bank margin and various materials being used to infill. In other situations aquatic weeds such as Water-cress can be encouraged or left un-cut so narrowing the channel. However when this dies back and up-roots it may cause a flood defence problem by blocking hatches.

Dredging and widening increase the capacity of watercourses and are generally carried out for flood defence purposes rather than for improving the environmental or fishery potential. The waste dredgings are often disposed of on the banks. Very little dredging work is now undertaken by the NRA due to the adverse environmental consequences.

4 Water Meadows

Traditional water meadows date from the farming systems, such as the sheep/corn method, which were prevalent in the 17th Century in lowland England. The agricultural economy at this time was dominated by corn production, and to maximise the crops sheep manure was necessary as a

fertiliser. The systems worked by grazing sheep on the downlands during the day and putting them onto the arable land over night, after harvest and prior to the sowing of the next crop (Cowan 1982).

To maximise the grass available for sheep grazing, a complicated system of drainage and irrigation channels were established on the land adjacent to watercourses, to create water meadows. During the winter months when grass was least available, the water was brought onto the land via a main carrier from the watercourse. The water was then encouraged to flow in a thin film across the land from a series of smaller channels running along the tops of ridges down to a set of drains in the furrows. The water supplied additional nutrients to the meadows which encouraged grass growth (Sheail 1971) and the thin film of continuously moving water also offered frost protection to the young grass shoots.

The flooding of the water meadows was managed through a series of hatches many of which still exist, although the carriers have long since been filled. The meadows were traditionally flooded in early November and drained again at the beginning of March (Mr A Barrett, pers. comm.).

The demise of the water meadows has removed much storage capacity and therefore increased the need to undertake flood defence works.

The Countryside Commission is now offering grant aid for the re-establishment of historic water meadows through the Countryside Stewardship scheme policy P5 (Countryside Commission 1993). This scheme targets numerous 'waterside landscapes' including those which "are of archaeological and historical interest, and that need active measures to conserve them, including the restoration of disused irrigation systems on historic water meadows".

Appendix C
CONSULTATIONS

HALCROW

Appendix C

CONSULTATIONS

C1.	List of Consultees	
C2.	Meeting with Terry Lambourne	(NRA, Flood Defence)
C3.	Meeting with John Hounslow	(River Keeper, Crown Estates)
C4.	Meeting with Toby Lewington	(River Keeper, Axford Estate)
C5.	Meeting with Archie Barrett	(River Keeper, Ramsbury Estate)
C6.	Meeting with Tony Barrett	(River Keeper, Martyn Arbib)
C7.	Meeting with Peter Woolnough	(River Keeper, Wills Estate)
C8.	Meeting with Jack Oliver	(Wiltshire Botanical Society)
C9.	Meeting with Neville Mutter	(Action for the River Kennet)
C10.	Letter from Martyn Arbib	(Riparian Owner)
C11.	Letter from John Gale	(Riparian Owner)
C12.	Letter from English Nature	
C13.	Conversation with Mr J Burrows	(Riparian Owner)
C14.	Conversation with Lady Fermoy	(Riparian Owner)

Appendix C1

List of Consultees

Riparian Owners

Mr K Carter
Manton Grange
Manton

Crown Estates
Burbage Wharf
Burbage

Mr Gale
Church Farm
Mildenhall

Mr Bull
2 Poulton House Cottages
Poulton

Dr A Ward
Marlborough Surgery
George Lane
Marlborough

The Bursar
Marlborough College
Marlborough

Mr R K McMahon
Harbrook House
Ramsbury

Mr H J Hyams
Ramsbury Manor Estate
Ramsbury

The Estate Manager
Axford Estate
Axford

Lady Fermoy
Axford House
Axford

Mr J Burrows
Coombe Farm
Stitchcombe

Sir Seton Wills
Eastridge House
Knighton

Mr M Arbib
Howe Mill
Ramsbury

Mrs A H Ball
The Old Mill
Ramsbury

Mr Naess
Moons Mill
Mill Lane
Ramsbury

Other Organisations

Mr N Mutter
Action for the River Kennet
5 The Square
Ramsbury

Mr A Service
Action for the River Kennet
Swan House
Avebury

Mr R DeVere
Action for the River Kennet
Durnsford Mill
Mildenhall

The Water Research Officer
Wiltshire Trust for Nature Conservation
18-19 High Street
Devizes

Mr S Smith-Wyndhams
British Trust for Conservation
Volunteers
St Joseph's Place
Devizes

Dr J Oliver
'Highview'
Lockeridge

Mr J Waldon
Conservation Officer
Royal Society for the
Protection of Birds
10 Richmond Road
Exeter

Mr R Wright
Conservation Officer
English Nature
Hambleton Avenue
Devizes

Mr C W Poupard
Salmon and Trout Association
Fishmongers' Hall
London Bridge
London

Mrs P Palmes
Countryside Commission
Bridge House
Sion Place
Bristol

Mr T Lambourne
National Rivers Authority
Osney Yard
Oxford

Appendix C2

Meeting with Terry Lambourne (NRA, Flood Defence)

Date:	15 November 1993
Present:	Terry Lambourne (NRA, Flood Defence)
	Richard Ashby-Crane (Halcrow)
Venue:	Osney Yard Oxford
Purpose :	To discuss weed management and flood defence on the Upper Kennet

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No work carried out downstream of Marlborough in 1992/93. River keepers are left to their own devices and this costs the NRA nothing.

1993 works were undertaken between West Kennett and Manton. September/October weed cut to prevent frosting and subsequent drifting of cress. TL says this is all cut by hand and the *Ranunculus* is left.

Man hours:	3 men crew NRA crew	8 hour day	
U/S Winterbourne Monkton	1,650m	102 hrs	(Reach 21)
Silbury Hill to East Kennett	2,250m	294 hrs	(Reach 18)
East Kennett to Overton Bridge	1,600m	98 hrs	(Reach 17)
Overton Bridge to Lockeridge	2,456m	201 hrs	(Reach 16)
Lockeridge to Clatford	1,650m	347 hrs	(Reach 15)

Hours are those budgeted for. Before the drought the work was much greater.

In the winterbourne section most work is trimming of banks and bed in response to Parish Council pressure (annual trim).

On the River Og a small cut (cress) early in the year was undertaken at public/council request. Weed is left to rot unless it is burnable. In some places it is broken up with a flail mower.

Enhancement works have also been carried out over the years, generally in conjunction with river keepers:

- narrowing between bridges at Axford;
- narrowing at Mildenhall.

Increased flow velocity generally means decreased maintenance due to reduced cress growth.

Aldbourne is overgrown at bottom end and is holding up STW discharge flow; used to cut here every year.

Most work in past in upper catchment is to prevent summer flooding problems - during the drought this has not occurred resulting in reduced work load.

Appendix C3

Meeting with John Hounslow (River Keeper, Crown Estate)

Date:	13 October 1993	
Present:	Richard Ashby-Crane	(Halcrow)
	John Hounslow	(River Keeper Crown Estate, Mildenhall)
Venue:	The Bothy Mildenhall	(JH's house)
Purpose:	To discuss river keeping/management of the River Kennet, weed growth and flow regime	

JH is keeper for the Crown Estate waters which run from Elcot Mill (just d/s Marlborough) to Stitchcombe (approximately 300m d/s sluices). He also works or has worked on the sections downstream of Ramsbury Manor House lake (Mr McMahons Countryside Stewardship) and downstream of Axford Bridge (Stone Lane).

JH suggested that before the recent drought weed was still reducing (ie did not coincide with drought) approximately 7-8 years ago.

Over dredging has also been a problem in many reaches eg d/s Mildenhall Bridge to Durnsford Mill; often the most natural river bed and banks are adjacent to bridges where dredging was not allowed (induces instability in the bridge).

JH gave an appreciation of weed growth and flow/habitat related problems reach by reach:

Marlborough to Railway Bridge (d/s Og):

There used to be good *Ranunculus* and *Callitriche* growth through the town; this has now largely disappeared. Ponding due to weir construction and riverside developments in the town may be partly responsible. There is some Ran/Call above the Og confluence but very little downstream. STW discharges just above railway bridge. The section of river above the railway bridge is quite deep dredged. Section between Stonebridge Lane and the railway bridge is owned by Mr Bull and managed by the Trustees of Mr Hill.

Railway Bridge to Footbridge d/s Trout Farm (Mildenhall):

Majority of this section (except for good *Callitriche* growth for 200 m d/s Elcot Mill sluices) shows poor growth of submerged weed, although encroaching water cress banks are prolific. The upper section is largely overwide and overdredged in the past. Large boulders have been added to a 100-200 m section d/s Elcot Mill, but this has met with limited success.

The section opposite Mildenhall Nursery is largely natural and until approximately 1988 the weed growth was acceptable. Submerged weeds have since disappeared.

Footbridge to Mildenhall Mill Pond:

JH has done much work in this section to raise water velocities and promote *Ranunculus* growth. 2-3 years ago a number of sarsen stone groynes and half weirs were emplaced with some success. Bank narrowing using nicospan and backfilling with chalk has also been undertaken. 200-300 m has good (60-70%) growth of *Ranunculus*, *Callitriche* and *Scirpus* but impoundment behind hatches reduces velocities and final 200 m is not so good. This section has very extensive marginal cress beds; up to 5 m on one bank on occasions.

Mildenhall Sluices to Durnsford Mill:

Generally this section is deep and wide with poor growth of submerged weed. 100 m of good growth occurs where bed height is greater and velocities are higher at Mildenhall bridge and Weir. The rest of the section is overdredged and canalised. Some *Zannichellia* (blind *Ranunculus* as JH calls it) present here.

Durnsford Mill to Stitchcombe:

Weed growth through this section is reasonably acceptable although too much *Scirpus* and not enough *Ranunculus* for fishermen. The short section between Stitchcombe Mill and Mr Burrows' section has only been subjected to a slight dredge and there is reasonably good weed growth.

Stitchcombe to Axford:

Mr Burrows' and Lady Fermoy's sections; weed growth is poor; Mr Burrows has carried out narrowing works which brought him into conflict with the NRA who accused him of dredging, although none was undertaken.

Axford to Ramsbury Manor Lake:

JH has worked on this section in the past; now run by Toby Lewington. It had been very overdredged and overwidened but he carried out narrowing works (Nicospan and backfill) to the wider reaches to increase velocities. Similar works have now been carried out on other sections of this reach.

Ramsbury Manor Lake to Ramsbury:

JH has worked here with owner Mr MacMahon who is entering into a Countryside Stewardship agreement to restore water meadows and traditional management regime. The bed is largely covered in moss and there is no submerged weed growth. There are many sets of hatches requiring repair. Some *Myosotis* (submerged version) here and a little starwort. The original bed has been covered with leaves and silt from the lake upstream. Last Autumn it was horse harrowed and this restored the

hard bed but the gravels are accreted with calcium carbonate and provide poor trout spawning habitat, but there is now a reasonable head of wild fish. Ten bags of *Ranunculus* planted last year but none grew, most was eaten by swans and geese (there are many on the lake).

General Practice

All JH's hatches are kept in good working order. JH tries to keep them open during late autumn, winter and early spring - good velocities encourage spring *Ranunculus* growth. Some water is held up for the stew ponds. Regular flushing through the hatches moves silt out of the gravels. Hatches are generally closed to hold back water for the fishermen (better fish lies) from April/May. (May generally with JH, April often elsewhere).

Appendix C4

Meeting with Toby Lewington (River Keeper, Axford Estate)

Date:	14 October 1993	
Present:	Toby Lewington	(River Keeper for Axford Estate)
	Vaughan Lewis Nigel Hawkes	(NRA - Thames)
	Alison Newell	(Halcrow)
Venue:	The Red Lion and the river at Axford	
Purpose:	To discuss river keeping/management of the River Kennet, weed growth, flow regime and PHABSIM	

TL also controls hatches between Lady Fermoy's and Mr Burrows' stretches, has kept them open all summer.

TL checks the hatches every day during fishing season (1st May - end of September) and when water levels are rising. All the hatches have overflows so that it is not so important to check hatches regarding flooding. Rags hatches are operated most frequently as these control flows into Hyam's stretch.

The weed growth has been generally good the last few years. TL does operate the hatches to promote ranunculus growth, but does close them prior to the start of the fishing season.

The weeds have been cut twice this year, when they start to take over. TL cuts in traditional 'bar' method if the growth is not too excessive. No cuts were made last year. The cut weed is washed into a lagoon. The watercress growth has been particularly good this year. In the past TL has tied plants to small rocks and put them into the river to encourage weed growth.

Several improvements have been made, including the construction of six weirs, mainly of sarsen stones and/or boards. At one point TL has put in metal bar (railway sleeper). Weed growth has increased downstream of these weirs due to increased aeration and cleaning of gravels.

Nicospan has been used to reinforce the banks at two places (downstream of Stone Lane bridge and downstream of Rags hatches) to narrow the channel at the former, and to prevent flooding onto adjacent land and increase bank stability at the latter. TL has also planted quite a lot of willow and plans to plant more.

TL has not done any dredging recently, although he does relocate the gravels below Rags hatches back upstream. He has no more plans for improvements other than tree planting.

The flows in the River Kennet have been much lower over the past few years.

TL manages the river as a fishery, for about 25 rods. He stocks the river in April, June and August.

The straighter, deeper stretch east of Axford has noticeably less weed growth.

Appendix C5

Meeting with Archie Barrett (River Keeper, Ramsbury Estate)

Date:	28 October 1993	
Present:	Archie Barrett	(River Keeper for Mrs Ball and Mr Hyams)
	Alison Newell	(Halcrow)
Venue:	82 High Street Ramsbury and River	(AB's house)
Purpose:	To discuss river keeping/management of the River Kennet, weed growth and flow regime	

AB has worked on River Kennet all his life.

Mrs Ball's stretch is not 'true' River Kennet, but mill stream. Neither Mrs Ball's or Mr Hyam's stretches are fished on a regular basis, and are therefore not managed for fisheries, but rather to maintain 'natural' flows.

Traditionally, the flows in the river were managed with the water meadows in mind, for example the meadows would have been allowed to flood on 1st November then drained on 1st March to allow the cattle onto the meadows. The use of water meadows was stopped in the area in 1938.

Weed-cutting was traditionally carried out in April by a 'saw gang' from the village under supervision of the River Keeper. Using chain and hand scythes, the weed would be cut into the 'bar' pattern, then the cut weed trapped at racks and pulled out and left on the banks. There used to be six weed racks between Mildenhall and Axford Farm, and four racks at Ramsbury Manor.

AB still uses chain scythes but cuts in June/July, primarily because there is not enough weed to cut/no need up until this point. Only one cut is made per year. AB used to cut using the 'bar method' but there is not enough weed to do this now. At Ramsbury Manor grazing by geese in particular removes the need to cut the weed.

AB made the weed lagoons at Axford (now used by Toby Lewington) about 20 years ago. Thames Water dug them, along with one at Harbrook and one at Mr Arbib's stretch.

AB checks the hatches every day. He has replaced the traditional hatches with boards and keeps the top board just below the water surface level, so that the water spills over the top rather than underneath.

AB has made no changes to the channel morphology at either of the stretches he currently looks after. He has no plans to do so.

AB commented that the flows this year have been the best for about the last 10 years.

AB also commented that the *Ranunculus* present in the Kennet here, but it grows 'blind' - ie starts to grow then stops and does not flower (might be *Zannichellia* - RAC).

AB did not think that abstraction at Axford had anything to do with the recent low flows.

Appendix C6

Meeting with Tony Barrett (River Keeper, Mr Arbib)

Date:	1 November 1993	
Present:	Alison Newell	(Halcrow)
	Tony Barrett	(River Keeper for Mr Arbib)
Venue:	Howe Mill Ramsbury	
Purpose:	To discuss river keeping/management of the River Kennet, weed growth and flow regime	

TB has not cut weed for last three years. Prior to this he cut twice a year at Whitsun and again in September. The weed is cut by hand with scythes in the Traditional 'bar' pattern. The cut weed is caught in a weed lagoon which was put in 7-8 years ago. Thames Water cut weed about 8 years ago. The *Ranunculus* has declined over recent years with increases in blanket weed and starwort. The blanket weed was particularly vigorous during the past two years. TB commented that the *Ranunculus* has been growing 'blind', ie begins to grow then stops and does not flower.

TB operates the hatches by boards rather than gates, but puts a baton below the lowest board to allow water to draw underneath as well as spill over the top.

Quite a lot of work has been done to improve the flows and water quality. A weir was built in 1982/83 which is a concrete sill with posts into which boards can be inserted when levels drop. Sarsen stones have been put in several places. The channel has been narrowed by about three feet downstream of the footbridge at Howe Mill. Thames Water did the last major bank works. A large fallen willow has been left to narrow the channel along the narrowed stretch too. Small bank repairs have been carried out.

Horses were used in 1992 to rake the gravels upstream of the footbridge, although as yet no benefits from this have been noticed in terms of weed growth. The silt levels have dropped however. No more dredging is planned.

Crayfish have not been seen in the stretch for about 8 years. Mayfly disappeared in the 1950's which coincided with the sealing-off of side carriers and the introduction of mechanical dredging.

There are 12 nesting pairs of Canada geese and a pair of swan which graze the weed significantly. TB stocks the river at least once a year with mostly brown trout and sometimes rainbow.

TB did not think that abstraction had a great deal of impact upon flows in the Kennet.

TB has on occasion planted weed, by tying roots onto pebbles and placing them on the channel bed.

Appendix C7

Meeting with Peter Woolnough (River Keeper, Sir Seton Wills)

Date:	28 October 1993	
Present:	Peter Woolnough	(River Keeper for Sir Seton Wills)
	Alison Newell	(Halcrow)
Venue:	Knighton Cottage and River Kennet	
Purpose:	To discuss river keeping/management of the River Kennet, weed growth and flow regime	

PW commented that he believed that abstraction at Axford was the principal cause of low flows, and that he could tell when, particularly during periods of low flow, pumping was being carried out at Axford.

The stretch of River Kennet which PW is responsible for runs from the sluices at West Lodge downstream for approximately 5-6 km although only 600 m falls within the study area.

PW manages the river as a fishery, has 27 rods to look after. He has fish ponds at Littlecote. The management he undertakes reflects this.

PW undertakes four major cuts in an average year. These he does manually, using a scythe and a link scythe to cut ribbon weed in the deeper stretches. The cuts are roughly of 10m width bands across the river, done in rotation, leaving 20 m in cut each time, ie so that after third cut all the weed has been cut once.

This gives a variety of weed habitat for the fish and invertebrates.

PW commented that the weed growth has been much less in the last 6-8 years, particularly 1989-92, because of the drought during the winters.

PW rakes the gravels in October/November to clean the gravels for spawning.

PW has six hatches which he operates - each consisting of four gates/hatches which are open at the bottom - allowing water to be drawn through underneath rather than spilling over the top. PW feels this is very important in preventing the build-up of silt and other materials on the channel bed. He leaves the hatches alternately closed and open. The hatches are checked every day. He does have problems with entrained materials, particularly garden waste, being washed down and blocking the hatches.

PW has made no permanent changes to the channel morphology - but does put boulders in during periods of low flow and removes them when water levels rise, to help oxygenate the water.

PW said that there always used to be a chalky film on the water surface when the springs broke - that is when in spate - but that this has not happened for the last 15 years.

PW is also responsible for managing the area under Countryside Stewardship Scheme as water meadow. So far the grants have been used to replace hatches. Since the reinstatement of the water meadows the small blue butterfly has returned this year, plus four pair of breeding snipe and one pair of redshank.

Appendix C8

Meeting with Dr Jack Oliver (Wilts Botanical Soc)

Date:	12 October 1993
Present:	Dr J Oliver Richard Ashby-Crane (Halcrow)
Venue:	Sir William Halcrow & Partners Burderop Park Swindon
Purpose:	To discuss the plant communities of the River Kennet and Dr Oliver's survey data

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Dr Oliver expressed his concern over migration downstream of the winterbourne and over increasing numbers and abundance of terrestrial plant species in the channel.

He described the survey work which he had been undertaking for the last 2 years.

In the following weeks Dr Oliver sent RAC large numbers of plant records, these have not be reproduced here, but it is hoped that they can be analysed and published in some way in the future.

Appendix C9

Meeting with Neville Mutter (ARK)

Date:	7 October 1993
Present:	Mr N Mutter (Action for River Kennet) Richard Ashby-Crane (Halcrow) Alison Newell
Venue:	5 The Square Ramsbury
Purpose:	To discuss the River Kennet and the concerns of ARK

Comments were made as to the more flashier nature of the Kennet and especially the winterbourne than previously. Comment was also made that the river above Preshute and up to Fyfield is very different, being affected by the springs, pumping station and sewage works.

John Hounslow is also the keeper for Ronnie McMahon.

NM gave RAC several articles which he thought would be of interest:

British Wildlife magazine article on chalk streams (RAC to return to NM)

Geology map Sheet 266 IGS 1:50,000

NRA draft internal report on groundwater modelling of the River Og at Axford

"Passing of a River", 1947, Maurice

Discussed hatches and their operating regimes.

A Barret is the keeper for Ramsbury Manor (Mr Hyam).

NM expressed his concern about the pumping stations at Yatesbury, Cherhill and Shepherd's Shaw and the effects that these are having on Horslip Stream running into the Kennet above Avebury.

Comments were made as to the numerous feeder streams/channels which are not the actual river which were used historically to supply mills, the iron works, water meadows and houses.

The Kennet Catchment Management Plan was discussed, particularly aspects of work outlined in the Action Plan.

The importance of the Countryside Stewardship scheme re: the re-establishment of water meadows was discussed. Both Wills and McMahon have pilot schemes in operation with the Countryside Commission at the moment. CoCo contact is Pru Palmes. The effects of water meadow uses on water quality and flows historically were discussed.

RAC to discuss channel reshaping with Toby Lewington and John Hounslow.

The use of remote sensing as data source was discussed. Contacts at National Remote Sensing Centre, Farnborough: Deborah Hindley & Peter Bonham (prepared report on evaluation of remote sensing to determine catchment parameters for Kennet).

Howe Mill
Ramsbury
Wiltshire

Your Ref: WE/UKW/10/015

Sir William Halcrow and Partners Ltd
Burderop Park
SWINDON
Wiltshire SN4 0QD

12th October 1993

Dear Sirs,

I write in reply to your letter dated 24th September, which has reference to your weed growth investigation of the Upper Kennet.

I share public concern over the prolonged low flows affecting many chalk streams in the South of England. My own stretch of the Kennet has suffered immensely.

I attach notes prepared by Mr Peter Drake, my fishery manager. They have reference to the years 1989 to 1993. From these you will see how the low flow - caused by abstraction on top of rain shortage - has gravely affected the river. This deprivation of the flow has led to an almost complete disappearance of ranunculus and starwort. Instead there is an abundance of silt and long stretches of the river bottom are now covered by blanket weed.

Furthermore, the shortage of water has made fishing in the side streams impossible. To keep a sufficient head of water in the main river all the carriers have had to be starved of it.

In answer to the further points you raised - there are eight hatches and stocking of rainbow and brown trout is done at appropriate intervals.

Peter Drake would be pleased to answer any other questions and his address is Woottons, Ramsbury (0672-20441).

Yours faithfully,

MARTYN ARBIB

NOTES BY PETER DRAKE, FISHERY MANAGER

1989 - River flowing well and a luxurious growth of all types of weed. A heavy weed cut necessary in June and a lighter cut in August.

1990 - Water level a little lower due to a fairly dry winter. Not quite so much weed. Had to cut once.

1990/91 - Winter very dry.

1991 - A very dry and hot summer. River very low and a marked decrease in the amount of weed. A NRA chap came and checked the oxygen content of the water which he reported was 'satisfactory'. A lot of blanket weed and silt. No weed cutting necessary.

1992 - Very dry winter followed by a dry summer. No river weed growing. River very low. Had to keep hatches nearly closed to hold back sufficient water for fishing. Blanket weed and silt very bad indeed. In October, two shire horses harrowed the stretch of the water and the river bottom improved for a while.

Heavy rain in late summer and a wet winter.

1993 - Early on river level held up fairly well due to a comparatively wet summer. River weed started to grow behind weirs that were built but elsewhere blanket weed has almost completely covered the bottom of most of the stretch.

JOHN GALE
CHURCH FARM
MILDENHALL
MARLBOROUGH
WILTSHIRE
SN8 2LU

Tel. 0672-513159.

26.9.93.

Dear Mr Lawson,

Thank you for your letter dated 24.9.93 ref WE/UKW/10/004 regarding the Upper Kennet.

Like others I am also very concerned about the low level and low flows and lack of weed in the Kennet,

I have lived here all my life (54 ½ years) and during the last 4 years I have noticed the rapid deteriation of the river.

We had a very attractive stream running through our garden

but about 4 years ago it dried up and with the exception of a few short spells during the winter months, it hasn't run since. Even during the supposedly worst drought of the century in 1976 the stream kept running.

This is terribly sad and I feel something should be done to stop the over abstraction of the water from our valley, which in my opinion is the cause of the lack of river level and flows, and weed growth. Although as I understand it the N.R.A and Thames Water don't share my opinion. Mr John Hannan of The Bothy, Werg, Mildenhall, looks after my stretch of the River.

Yours sincerely,

ENGLISH NATURE

Wiltshire Office
Prince Maurice Court
Hambleton Avenue
Devizes SN10 2RT

Telephone: (0380) 726344
Fax: (0380) 721411

Mr J D Lawson
Sir William Halcrow and Partners Ltd
Burderop Park
SWINDON
Wiltshire
SN4 0QD

Our Ref SU 26.3

Your Ref WE/UKW/11/039

7 December 1993

Dear Mr Lawson

RIVER KENNET PROPOSED SITE OF SPECIAL SCIENTIFIC INTEREST
WEED GROWTH INVESTIGATION OF THE UPPER KENNET

Thank you for your letter of 24 September 1993 regarding Halcrow's investigation of weed growth in the upper Kennet. I must apologise for my delayed response but I felt it necessary to seek advice from our specialists in Peterborough over this issue.

The River Kennet is an important river having been selected as one of a national series of rivers to be designated as a Site of Special Scientific Interest. English Nature welcomes the proposal to address the problems associated with the river with the aim of safeguarding the important macrophyte communities present.

Our analysis of the available data on the River Kennet indicates that excessive plant growth could be related to the high levels of nutrients in the main river and its tributaries which may be attributed primarily to point sources. English Nature has already made recommendations to both the NRA and DOE in relation to the development of new statutory water quality objectives. We maintain that reductions in phosphate levels are necessary to safeguard the special interest. Unfortunately nutrient enrichment was not highlighted as a problem in the catchment management plan.

This issue therefore needs to be addressed and incorporated into the plan as a whole.

In order to take discussions further I would be more than happy to arrange a meeting with you at our offices in Devizes. Dr Mary Gibson, our freshwater pollution specialist, has agreed that it could be useful for her to attend.

I hope that this response is within your deadline and that you will be able to make use of further discussions.

Yours sincerely

Peter McSweeney

PETER McSWEENEY
Assistant Conservation Officer
North Wiltshire

S1528.PM

Appendix C13

Conversation with Mr Burrows

Record of Telephone Conversations:

29 September 1993

Mr J Burrows (Stitchcombe)

Richard Ashby-Crane (Halcrow)

John Hounslow is the Keeper responsible for the hatches upstream of here and those owned by Lady Fermoy. JH gives advice on river management.

No weed-cutting has been done for the past three years. The cut weed was collected in the weed lagoon at Ramsbury Estate.

Mr Burrows has rebuilt poached banks under JH's instruction. He had plans to build a pond but would first like advice on conservation.

There are large numbers of swans and Canada Geese on the Kennet here, which graze the weed.

The NRA were to pollard and trim the willows along this stretch and put in some sarsen stones about two years ago but they did not.

Appendix C14

Conversation with Lady Fermoy

Record of Telephone Conversations:

29 September 1993

Lady Fermoy

Richard Ashby-Crane (Halcrow)

Lady Fermoy owns ¼ mile of the River Kennet which is fished mainly for trout. No weed-cutting has taken place for 2-3 years, although there is currently good weed growth. She is, however, alarmed at the lack of water in the Kennet.