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Macrophyte Status of the Rivers Test and Itchen

Hampshire

Summary Report

October 1998

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ACKNOWLEDGEMENTS

Grateful thanks are extended to the many keepers and land owners along both Rivers Test and Itchen and particularly to Jim Glasspool and the Test and Itchen Association for their cooperation and willingness to share their knowledge and experience of the rivers over the last seven years. Owners and keepers are also thanked for readily allowing access to the rivers for the purposes of this study.

This summary report is primarily a distillation of extensive field survey and analytical work on aquatic macrophytes of the Rivers Test and Itchen since 1991. The work has been commissioned by the Hampshire and Isle of Wight Area of the Environment Agency (and formerly by the National Rivers Authority) with kind support from the Test and Itchen Association and Southern Water and has been conducted by the Loughborough Ecologists. In recognition that this is a summary of a commissioned research report it does not necessarily represent the official views of the Environment Agency.

Your comments on any issue in the report or on macrophytes in the Test and Itchen in general would be welcomed. Please write to the address below.

signed .....Lawrence Talks.....

Lawrence Talks
Area Fisheries, Ecology and Recreation Manager
Project Executive

Further copies of this report can be obtained on request from The Environment Agency, Fisheries Ecology and Recreation, Hampshire and Isle of Wight Area, Colvedene Court, Wessex Business Park, Wessex Way, Colden Common, Hampshire, SO21 1WP.

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1. INTRODUCTION

The Rivers Test and Itchen are acknowledged as two of the finest chalk streams in the UK and have subsequently been notified as Riverine Sites of Special Scientific Interest (SSSI) by English Nature. This conservation status is afforded to less than 30 rivers in England and Wales. The River Itchen is also one of only 8 candidate Special Areas of Conservation (cSAC) in formal recognition of its importance at a European level. A key aspect upon which this latter designation rests is the aquatic plant communities, frequently dominated by *Ranunculus* (water crowfoot species), which are typical of this chalk river habitat.

In this light the Environment Agency (EA) are acutely aware of the need to ensure that these rivers are maintained at a favourable conservation status. As national "Contact" for Chalk rivers the Agency is also charged with special responsibility for stimulating action to achieve conservation targets outlined in the UK Biodiversity Action Plan.

A meeting of the River Test forum held in October 1990, expressed concern regarding the apparent decline in the ecological quality and fisheries of the Rivers Test and Itchen. In response to this concern the National Rivers Authority and later, the Environment Agency initiated a programme of research starting in 1991 to:

- establish a database and baseline understanding of macrophyte abundance and distribution: 1991 Longitudinal Survey with extensive coverage of both the Test and the Itchen (but not tributaries thereof) including survey of 164 100m reaches.

- monitor changes in macrophyte abundance and distribution through:

  (a) survey of 9 representative Reference Sites (7 on River Test, 3 on River Itchen) at intervals between 1991 and 1997
  and
  (b) 1997 Longitudinal Survey repeating survey at approximately a third of those river reaches examined in 1991.

- establish possible causes for changes in macrophyte abundance and distribution and assess how particular species or communities respond to a range of physical and chemical environmental parameters.

1.1 Environmental Context

The hydroclimate of the 1990s in southern UK continues to be characterised by above average temperatures and sunshine totals, and below average precipitation amounts. In south-east England there has been a trend towards more anticyclonic airflow patterns in summer which has been reflected in the large decrease in summer precipitation. In south-east Britain the summer of 1996 was the third consecutive very fine summer (ranked 8th since 1947). In addition, the greatest rainfall deficits occurred over eastern and south-eastern England, with only 79% of the 1961-1990 average.

National investigations into climate change using an accepted UK Water Industry (UKWIR) and Environment Agency agreed methodology have shown no definite changes in groundwater, surface water levels and flows across the country. However the preliminary results of a Hampshire Area study of River Test flows between 1958 to the present have shown that the variability of annual flows on the Test have increased in the 1990s when compared with the 1980s, (Graph 1). Extremes in flows however, were also evident in the 1960s and 1970s which highlights that this has been a characteristic of flows in the Test since the late 1950s.

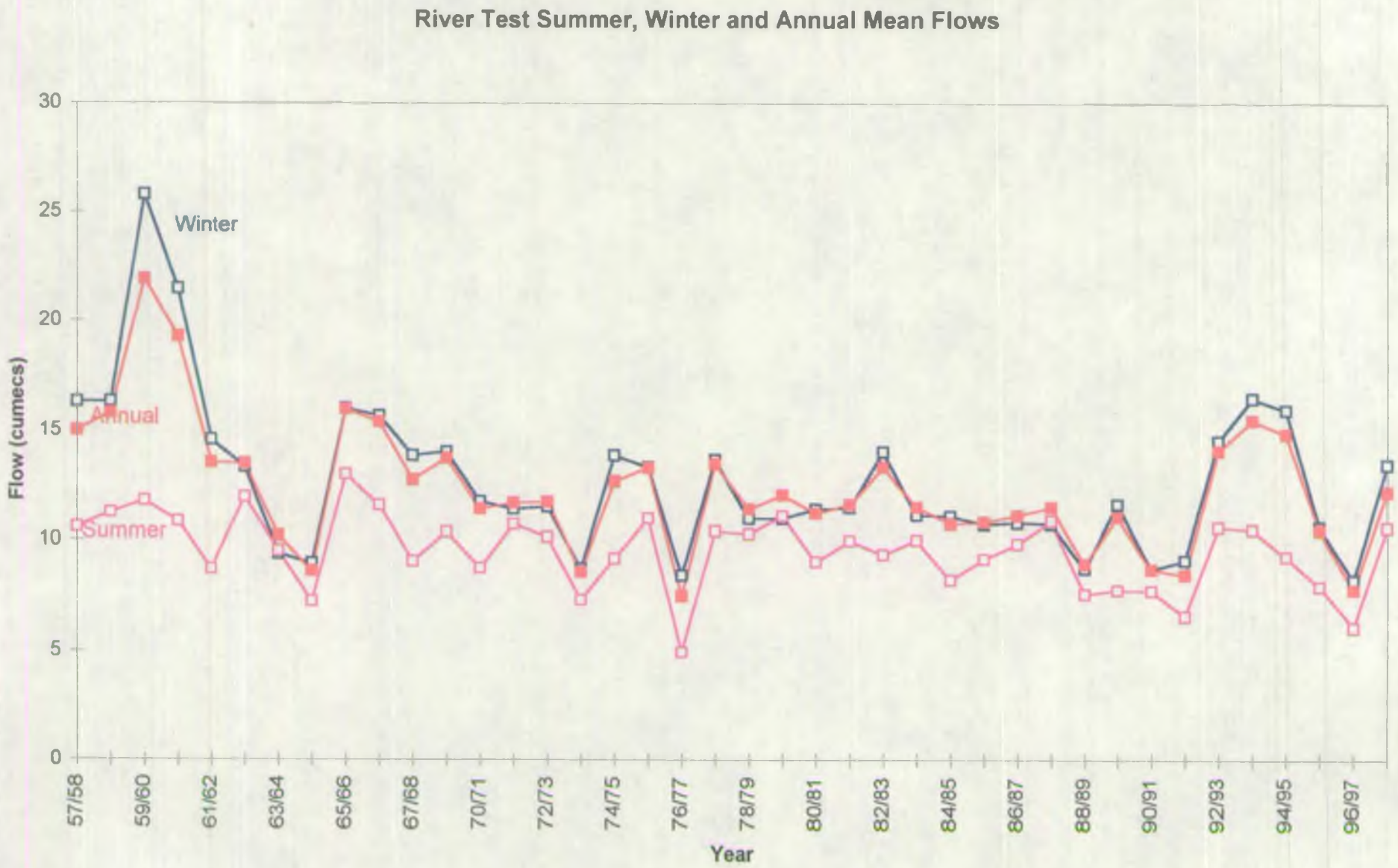
Looking at the rainfall trends in Hampshire between 1960 to the present, there has been a clear decline in summer rainfall, while winter rainfall has increased slightly over the same period (Graph 2). The annual average rainfall has remained steady.

Abstraction on the Test for the period 1983 to 1997 from Public Water Supply (PWS) and all other sources combined are illustrated on Graph 3. Groundwater resources in the catchment are less heavily exploited than in the Itchen and Meon valleys in Hampshire and much of the water for public supply is returned either to the river or to ground. The abstraction amounts have remained reasonably constant over the last 15 years, as can be seen from Graph 3. This suggests that increased variability in climate is responsible for the changing hydrological regime in the Test catchment.

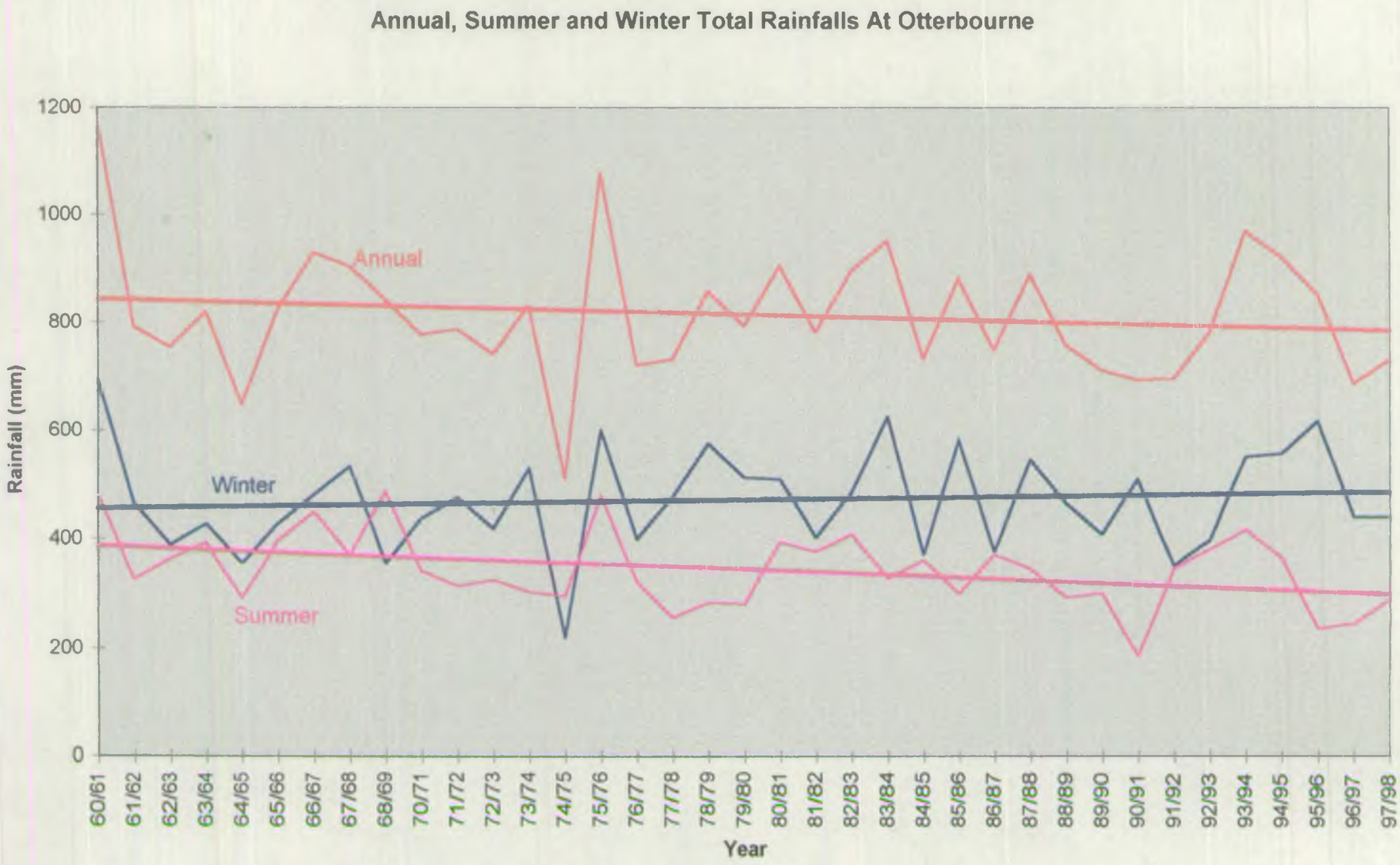
Hydrological processes are known to directly and indirectly affect macrophyte cover. In particular, the incidence of summer 'spates' is thought to impact the longevity and extent of filamentous algae (Blanketweed) growth. The occurrence of rapid (>10%) changes in discharge from one day to the next is significantly correlated with the occurrence of intermediate (>15 mm/day) and heavy (>25 mm/day) rainstorms. Although there have been no statistically significant changes in the frequency of intermediate and heavy daily rainfalls since 1893 in either winter or summer, there has been a significant ($p<0.10$) decline in heavy summer rainfalls since 1958 (i.e. during the last 30-years, coinciding with the river gauging records at Broadlands). This implies that the hydroclimate of most recent decades has resulted in fewer summer 'flushing flows', thereby favouring greater growth and persistence

of filamentous algae. There has been a highly significant decline in the frequency of intermediate (+5%/day increase in discharge from one day to the next) summer flushing events, and a weaker decline in large (+10%/day) summer flushing events.

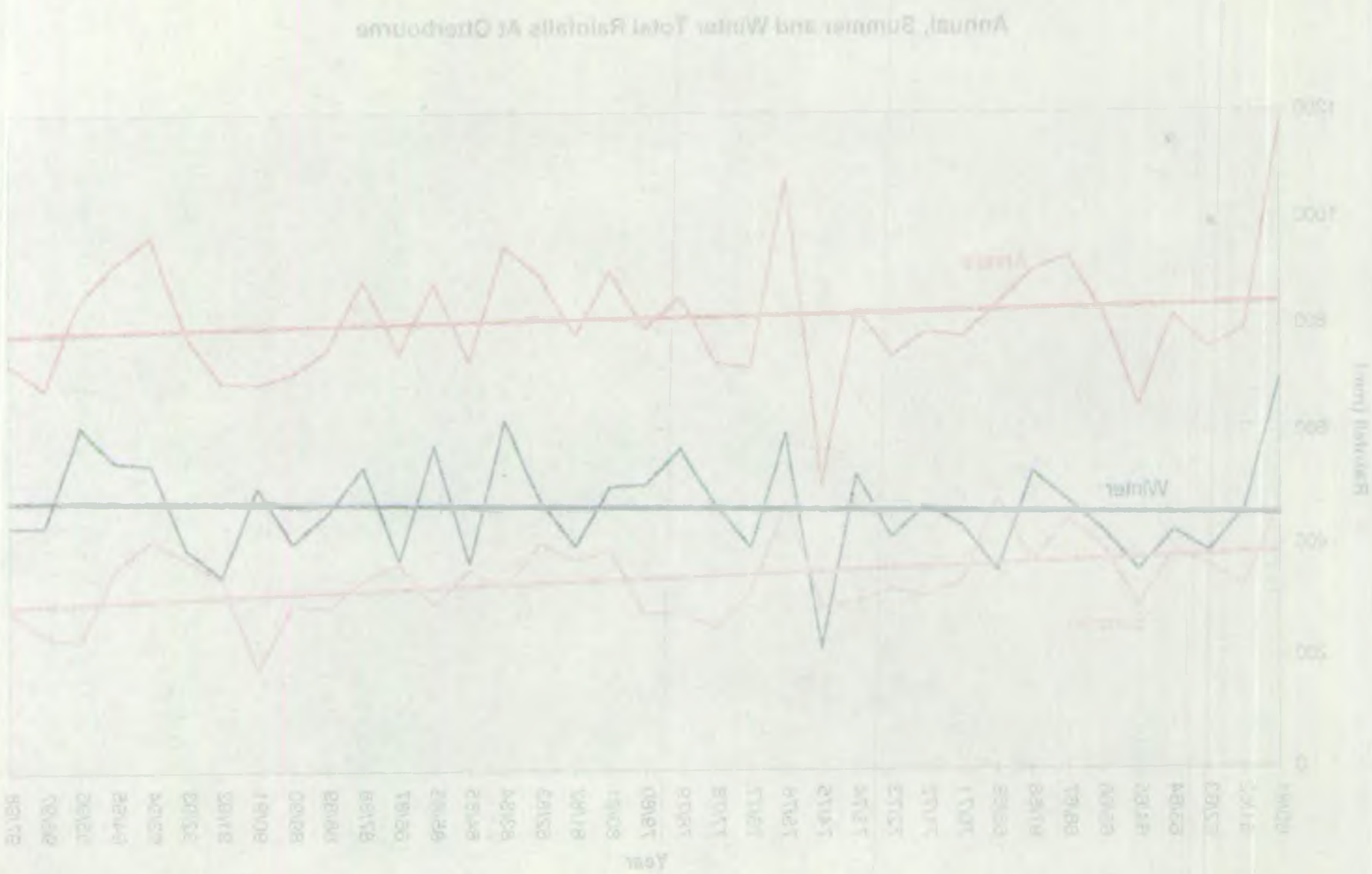
Extreme seasonal fluctuations in the hydrological regime have also had consequences for intermediate and long-term river water quality trends in the Rivers Test and Itchen. Even with improved effluent standards at Waste Water Treatment Works, reduced summer flows and therefore dilution rates, have contributed to higher orthophosphate concentrations at individual sites, e.g. Bere Mill on the River Test (upstream of Test reference site T2). Nitrate concentrations have also continued to increase in both rivers in line with national trends.


River Test Summer, Winter and Annual Mean Flows
Winter
Annual
Summer
Flow (cumecs)
30
25
20
15
10
5
0
57/58
59/60
61/62
63/64
65/66
67/68
70/71
72/73
74/75
76/77
78/79
80/81
82/83
84/85
86/87
88/89
90/91
92/93
94/95
96/97
Year

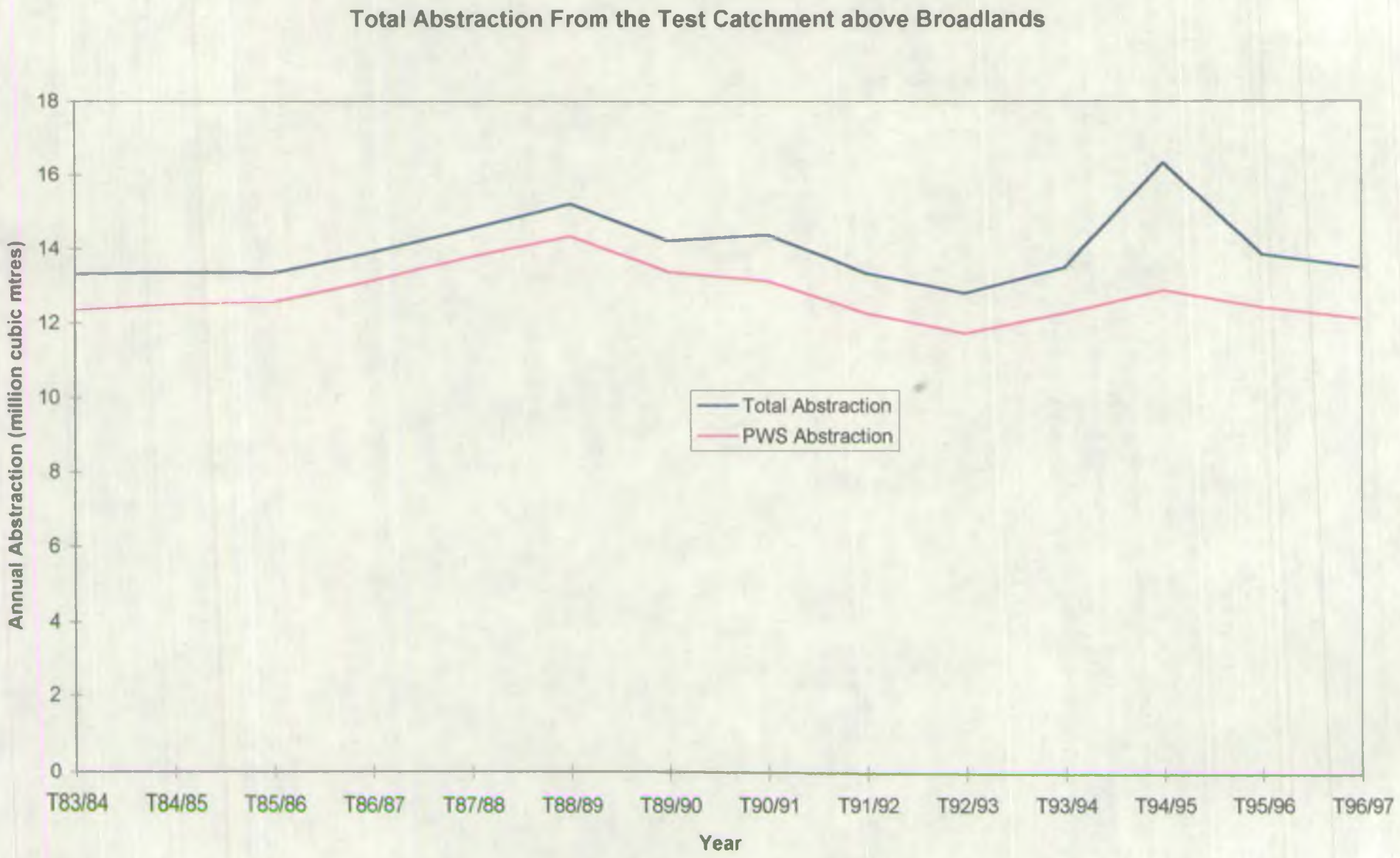
Graph 1


Annual, Summer and Winter Total Rainfalls At Otterbourne
Rainfall (mm)
1200
1000
800
600
400
200
0
Annual
Winter
Summer
60/61
61/62
62/63
63/64
64/65
65/66
66/67
67/68
68/69
70/71
71/72
72/73
73/74
74/75
75/76
76/77
77/78
78/79
79/80
80/81
81/82
82/83
83/84
84/85
85/86
86/87
87/88
88/89
89/90
90/91
91/92
92/93
93/94
94/95
95/96
96/97
97/98
Year

Graph 2


Annual, Summer and Winter Total Rainfalls At Otaihouume
Annual
Winter
Rainfall (mm)
Year

Graph 2


Total Abstraction From the Test Catchment above Broadlands
Annual Abstraction (million cubic mtres)
18
16
14
12
10
8
6
4
2
0
Total Abstraction
PWS Abstraction
T83/84
T84/85
T85/86
T86/87
T87/88
T88/89
T89/90
T90/91
T91/92
T92/93
T93/94
T94/95
T95/96
T96/97
Year

Graph 3

2. METHODOLOGY

2.1 Longitudinal Survey 1991

In July, August and September 1991 a longitudinal baseline survey was undertaken to produce a comprehensive list and distribution pattern of the aquatic macrophytes present (including filamentous algae) in the Rivers Test and Itchen, but not tributaries. Interpretation of the macrophyte distributions was undertaken to obtain an indication of water quality along the two rivers.

The selected channel (see Figures 2 to 9) was divided into 0.5km reaches, numbered consecutively downstream. The presence/absence of submerged, floating and emergent aquatic macrophytes and marginal species was recorded. Within each 0.5km reach, a 0.1km section was selected for survey in greater detail. These reaches were selected to represent the whole of the 0.5km reach. Here, the presence/absence of emergent and marginal species was recorded and a semi-quantitative estimate of the percentage cover of submerged and floating aquatic macrophytes was made using the scale below:

Scale	Percentage Cover
1	< 0.1
2	0.1 - 1.0
3	1 - 5
4	5 - 10
5	10 - 25
6	25 - 50
7	50 - 75
8	> 75

Certain taxa were not identified to species due to taxonomic difficulties; most important of these were *Ranunculus* and *Callitriche*. In this report, unless otherwise stated, *Ranunculus* and *Callitriche* species in the Rivers Test and Itchen have been referred to as *Ranunculus* species and *Callitriche* species.

2.2 Reference Site Surveys

From the longitudinal survey a series of reference sites were established to monitor change in macrophyte abundance over time (Figure 1).

Eight of the reference sites comprised a 20m length of river channel; the ninth site (Broadlands, Test 6) was only 15m long due to difficulties with survey in deep water. Each reference site was surveyed in detail by dividing the site into metre squares. The macrophytes,

filamentous algae and substrate present in each square were recorded together with the dominant item in each square. This data was then converted into percentage presence and percentage dominance of macrophytes for the whole reference site.

Following the longitudinal and reference site surveys in summer 1991 additional reference site surveys were carried out in the winter of 1991/2 and the summer of 1992. The opportunity was then taken in 1994 to gather further information at the reference sites following above average rainfall and river discharges in the winter of 1993/94. Surveys were undertaken in April, May, July, August and September 1994, and during the winter of 1995/96.

2.3 Repeat Longitudinal Survey, 1997

Having established from repeat surveys at reference sites, that changes in the macrophyte community were taking place it was decided to confirm whether these changes were occurring in the rivers as a whole. In the summer/autumn of 1997 (July, August, September, October), a repeat longitudinal survey, based on the 1991 survey, was undertaken surveying one reach (100m) in every 1.5km. A total of 34 reaches on the River Test and 25 reaches on the River Itchen were surveyed, including four previously un-surveyed reaches on the upper River Itchen. The nine original reference sites were included in the 1997 survey.

2.4 Environmental data collection and analysis

During survey work in 1995, 1997 and spring 1998 certain physical parameters (e.g. wetted perimeter, width, depth, velocity, substrate size, gradient, land use and percentage shading) were recorded concurrent to macrophyte survey. These parameters, together with water quality data routinely collected by the Environment Agency, were used in the development of statistical models which would help with the interpretation of macrophyte behaviour relative to their environment. Macrophyte modelling also provides a means of exploring future scenarios and likely consequences of management options aimed at mitigating the impacts of undesirable trends. Stepwise linear regression was used to investigate the principle controls responsible for the observed variation in macrophyte cover both spatially and over time since 1991.

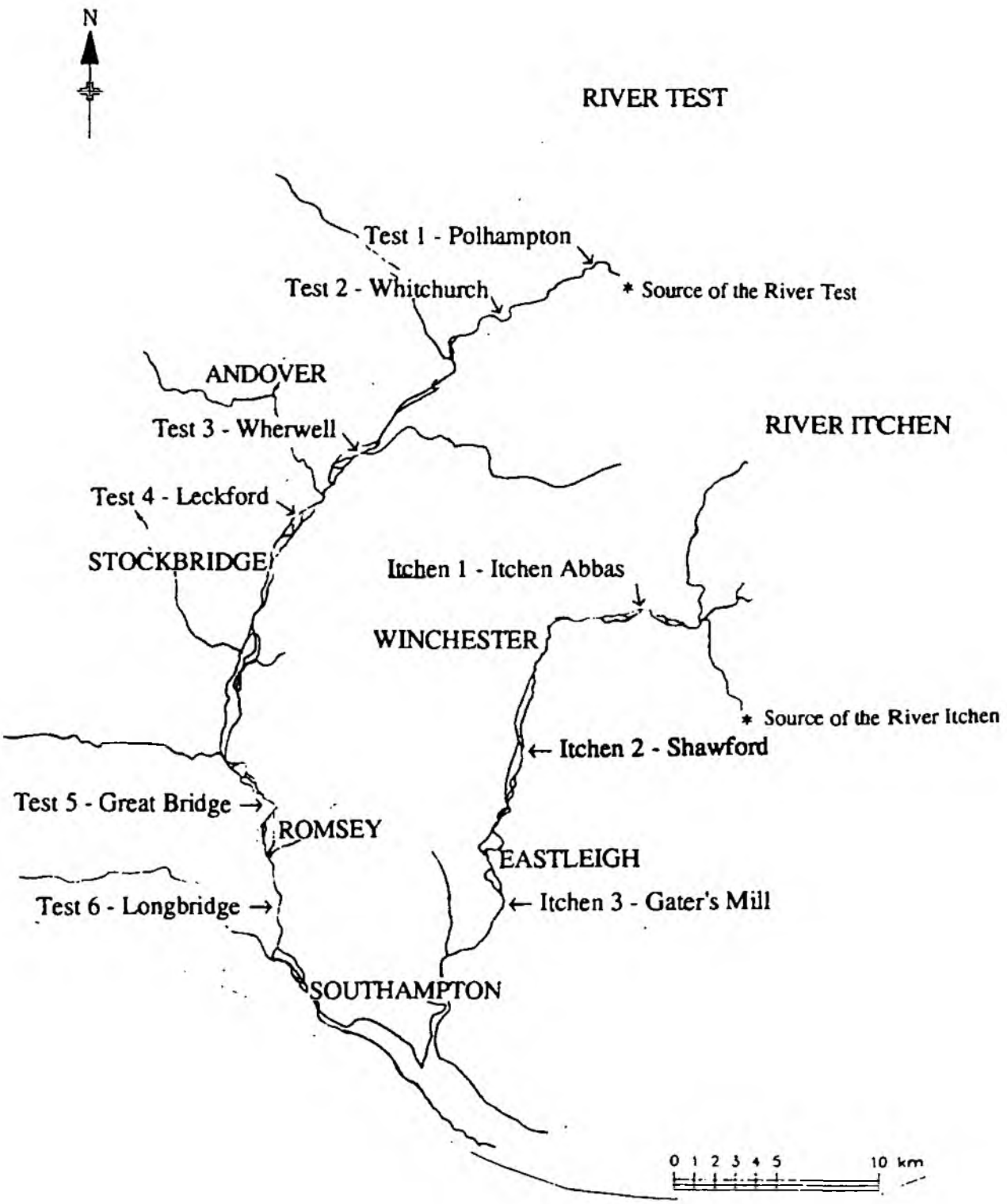
Spatial models employed macrophyte survey data collected in 1997 in conjunction with over a dozen environmental factors which describe the channel geometry, hydraulics, substrate, habitat and shade of each sample location.

Temporal models (exploring relationships between macrophytes and environmental variables over time) incorporated factors describing the monthly hydroclimate, water quality and antecedent environmental conditions (conditions experienced over a previous, given time period).

• *Loughborough Ecologists* •

Location map of the Rivers Test and Itchen, Hampshire showing reference survey sites

Date: 26/3/96	Drawn by: LEC	Ref. no.: Figure 1	Scale: As shown



3. RESULTS OF MACROPHYTE SURVEYS

3.1 1991 and 1997 (Longitudinal Surveys)

Changes in the percentage cover of the key species at the longitudinal survey reaches between 1991 and 1997 are illustrated in Figures 2 - 9. Because only a third of longitudinal reaches were surveyed in both 1991 and 1997, this comparison is only possible for 34 reaches on the River Test and 21 reaches on the River Itchen.

3.1.1 *Ranunculus* species (Water-crowfoot species) - Figure 2

On the River Test *Ranunculus* species has suffered a statistically significant decline in cover as represented by reaches surveyed in 1991 and 1997. This decline on the river as a whole is parallelled by a reduction in percentage cover recorded at most of the reference sites since 1995. The reductions have taken place mainly in the middle to lower reaches of the river.

On the River Itchen the picture is more mixed and much less severe. Both reductions and increases in percentage cover have occurred locally. Reductions have occurred mostly in the lower reaches, whilst increases were observed in the middle to upper reaches. No statistically significant decline has been found to have occurred in the river as a whole between 1991 and 1997. Decreases in *Ranunculus* species cover at some reaches have occurred in conjunction with increases in other species.

3.1.2 Filamentous Algae (Blanketweed) - Figure 3

Although a comparison of 1991 and 1997 data show an overall increase of filamentous algae cover on both rivers this increase was only statistically significant on the River Itchen. Most changes in algal cover for both rivers occurred predominantly in the middle and lower reaches.

3.1.3 *Berula erecta* (Lesser Water-parsnip or Water Celery) - Figure 4

In contrast to *Ranunculus* species, *B. erecta* has shown a considerable increase in both cover and distribution on both rivers comparing surveys in 1991 with 1997. This expansion was statistically significant in both rivers. This increase has also been apparent at the reference sites. On the River Test since 1991 *B. erecta* has appeared in the middle to lower reaches in particular, whilst consolidating its presence elsewhere in the river. On the River Itchen the increases in percentage cover occurred slightly more in the middle and lower reaches.

3.1.4 *Callitriche* species (Water-starwort) - Figure 5

Callitriche species was not found to have significantly increased or decreased on either river between the two survey years. Although a decrease in cover has occurred in the middle and lower reaches of the River Test an increase has been observed in the middle to upper reaches. The overall pattern of distribution and abundance has not changed on the River Itchen between 1991 and 1997.

3.1.5 *Zannichellia palustris* (Horned Pondweed or Silky Pondweed) - Figure 6

Between 1991 and 1997 most reaches on the River Test where *Z. palustris* was recorded have seen a dramatic decline, especially in the lower reaches. Half of these sites no longer have any *Z. palustris* present, recording losses, in some cases, of 10 - 25% cover. On the River Itchen the decline was not so great but involved reaches predominately in the upper and middle river. Analysis of the whole river data shows that the decline in *Z. palustris* on the River Test was statistically significant, but not so on the River Itchen. The reasons for this decline are as yet unknown but there are indications that the survival of *Z. palustris* may depend on the severity of the preceding winter discharges. If cover of *Z. palustris* is traced since 1991 at the reference sites, expansion appears to coincide with average or below average discharges in the previous winter. After the higher discharges of winter 1993/94 and 1994/95 *Z. palustris* cover was reduced. The severe decline that was observed between 1991 and 1997 may be a reaction to these changes in winter discharges.

3.1.6 *Schoenoplectus lacustris* (Common Club-rush or Bulrush or Ribbonweed) - Figure 7

S. lacustris, a species typical of the middle and lower reaches of both rivers has declined slightly since 1991. Reductions in the cover of *S. lacustris* may be accounted for by direct management. Ribbonweed or Rubbishweed are names given to *S. lacustris* and probably to *S. emersum*, by keepers who dislike this plant and actively manage its control. It is the opinion of keepers that Ribbonweed has increased in the last decade, particularly in the lower River Test (J. Dennis pers. comm. 1998).

3.1.7 *Sparganium emersum* (Unbranched Bur reed or Ribbonweed) - Figure 8

Since 1991 *S. emersum* has become a more significant component of the macrophyte community in the middle and lower reaches of both rivers. It was also found further upstream in 1997 than *Schoenoplectus lacustris* or *S. emersum* records. *S. emersum* was recorded in the middle to upper reaches of the River Itchen in the 1920s. Its status in the 1990s may be a reflection of its historical distribution.

3.1.8 *Oenanthe fluviatilis* (River Water-dropwort) - Figure 9

O. fluviatilis is a scarce plant in Britain and has a high nature conservation value. It occurs predominately in the middle and lower reaches of the two rivers. On the River Test cover has remained low but losses, particularly in the middle reaches, have been complimented by recording at 'new' sites, particularly in the lower reaches. On the River Itchen 3 'new' sites were recorded in 1997 but overall there has been a worrying decline, principally in the lower reaches.

3.1.9 *Hippuris vulgaris* (Mare's tail)

Recorded at a relatively small number of sites *H. vulgaris* has maintained its presence on the River Test being lost at some sites and appearing at others. On the River Itchen the losses have been greater with no 'new' sites being recorded in 1997. However, this is not a statistically significant decline.

3.2 1991 - 1997 (Reference Site Surveys)

3.2.1 *Ranunculus* species (Water-crowfoot spp)

The site at Polhampton (T1) on the River Test has maintained its almost 100% cover of *Ranunculus* species since surveying started in 1991. This is despite the annual occurrence of diatomaceous algae which thickly coats the upper surfaces of the plant. The site at Whitchurch (T2) has seen a drop from cover category 6 to 5 in 1994 but this has not fallen further since. The macrophytes at this site are cut every month (F. Kemp pers. comm. 1998). In the middle and lower reaches of the river there has been a distinct decline since 1995, a decline clearly evident in the results from the survey of the longitudinal reaches. At Wherwell (T3) previously known for its large stands of *Ranunculus* species, the rapid decline recorded in 1996 was confirmed in 1997. A site that once had more than 75% cover of *Ranunculus* species now has 1-5%. The traditional cutting of *Ranunculus* species did not take place here in 1997 because there was so little to cut. It was thought best to leave what little there was to flower and seed (M. Perry pers. comm. 1998). The site at Leckford (T4) has seen a similar reduction in *Ranunculus* species cover. This decline has been attributed to swans that heavily grazed the site in the spring 1997. The site was cut as usual in the autumn to encourage growth of *Ranunculus* species (G. Robinson pers. comm. 1998). Once a major component of the floral community at Great Bridge (T5), *Ranunculus* species was only just present in 1997 (0.1-1% cover). *Ranunculus* species was not cut in 1997 (Manager for C. Saunders-Davies pers. comm. 1998). At Longbridge (T6), *Ranunculus* species cover had, by 1997, declined from a previous high of category 5/6 to category 3. It was stated that until 1990 this site had little *Callitriche* species, filamentous algae or Ribbonweed. In the last seven years these plants had increased at the site to the detriment of the *Ranunculus* species (J. Dennis

pers. comm. 1998).

On the River Itchen reference sites the changes have been mixed. At Itchen Abbas (I1), *Ranunculus* species reached a peak of cover category 6 in 1994 which was maintained in the following two years, but by 1997 this had dropped to cover category 4. By contrast the site at Shawford (I2) had large beds of *Ranunculus* species in 1991, which by 1996, had reduced to a maximum of cover category 4 and in 1997 *Ranunculus* species was barely present. No cutting was carried out in 1997 at this site but *Ranunculus* species was planted downstream. During the winter of 1997 a large flock of swans (27 birds) virtually eliminated the young plants and then moved on (M. Murrell pers. comm. 1998). *Ranunculus* species has always maintained a high percentage cover at the Gater's Mill site in the lower River Itchen (I3).

The site (I3) has not been cut since surveying started in 1991. Following the heavier winter discharges of 1993/4 the site has become more gravely with stronger currents (D. Houghton pers. comm. 1998). The repositioning and deposition of gravels on the site allied with a stronger current may well be the reason why *Ranunculus* species has retained its high cover value.

3.2.2 Filamentous algae (Blanketweed)

During the low flow years of the early 1990s reference sites on the River Test saw a steady increase in the amount of filamentous algae with the exception of T1. Filamentous algae has never been recorded at this site. After the higher winter discharges of 1993/94 there was an overall decrease of cover category 4/5 to cover category 2/3 at the reference sites. Since then the cover of filamentous algae has increased again at T2 from category 3 in 1995 to category 4 in 1997. At T4 cover remained at 3 in 1995/6 but increased to category 5 in 1997. Despite the loss of *Ranunculus* species at T3 filamentous algae cover has not increased since 1994 and has remained at category 3 in 1997. Over the last three years filamentous algae cover at T5 and T6 has remained static at an average of 3 to 4.

Percentage cover at I1 on the River Itchen has, over the last six years, shown a tendency to remain at cover category 3/4. However, the sites at I2 and I3 have gradually increased their percentage cover of filamentous algae from 3/4 to 6 and 5 respectively in 1996/7. In September 1997 filamentous algae cover at Shawford (I2) was high at cover category 6 and may be related to the loss of *Ranunculus* species at this site. Attempts to physically clear filamentous algae from the vicinity of this site by the keeper resulted in a reprieve of only four days. After that time it returned in similar quantities (M. Murrell pers. comm. 1998). The site at Gater's Mill (I3), sustains a high level of filamentous algae cover as well as a high cover of *Ranunculus* species at a site where there is high velocity. The proximity of the Eastleigh Sewage Treatment Works upstream of this site may account for the algal presence but the high velocity appears to limit the cover of filamentous algae while maintaining conditions

suitable for a substantial cover of *Ranunculus* species.

3.2.3 *Berula erecta* (Lesser Water-Parsnip or Water celery)

Increased cover of *B. erecta* at the reference sites has mirrored the increase observed in both rivers as a whole. Site T2 reached cover category 6 in 1992 from 4 in 1991. This cover was maintained over the next three years dropping to category 5 in 1997. *B. erecta* has been recorded as having a small presence (most frequently cover category 1 or 2) at site T3 from 1991 to 1995. In 1996 and 1997 this stabilised at the higher level of cover category 3. Sites T4, T5 and T6 all recorded cover categories of 2/3 in 1991, increasing steadily to cover category 5 in 1997, a trend similar to that observed at site T2 from 1992 onwards.

On the River Itchen at site I1 the average cover category of 3/4 from 1991 to 1995 reached category 5 in 1996 but fell to 3 in 1997. The site at I2 had *B. erecta* cover category 5 in 1991, 6 in 1996 and 5 again in 1997. *B. erecta* was not recorded at site I3 in 1996/7 and has barely been present at this site in the past.

3.2.4 *Callitriche* species. (Water Starwort species)

Callitriche species cover has generally increased or remained stable at the reference sites on the River Test since 1991. At the uppermost site T1, the cover category has remained at 2/3 and at the lowest site T6, cover has consistently been recorded at category 6 since 1991. Having remained consistently at a cover category of 3 from 1991 to 1994 at site T3 *Callitriche* species increased to category 6 in 1996 and then to 7 in 1997. This macrophyte is now the dominant member of a community that was, until two years ago, dominated by *Ranunculus* species. Site T2 has seen a similar change from category 3/4 from 1991 to 1995 to cover category 6 in 1997. The cover of *Callitriche* species at T5 has varied over the years from category 5 in 1992, category 2 in 1995 increasing to category 5 in 1996 and down to category 4 in 1997.

On the River Itchen the picture is equally varied. At I1 the cover of *Callitriche* species went from category 5 in 1991 with slight variations to category 3 in 1996 but increased dramatically to category 6 in 1997. At Shawford, I2, there was a slight drop from category 5 in 1996 to cover category 4 in 1997. *Callitriche* species has maintained a constant but very low presence at I3 during the last six years.

3.2.5 *Zannichellia palustris* (Horned Pondweed or Silky Pondweed)

In line with trends throughout the River Test, *Z. palustris* has drastically decreased at the majority of the reference sites. *Z. palustris* was not recorded at site T3 in 1997 having merely been present in the past. At T4, T5 and T6 percentage cover also dropped from 5 in 1991,

falling to 2/3 in 1994, appeared to recover to category 4 in 1996, finally falling to a mere presence in 1997. By contrast at T2 *Z. palustris* has generally had a small presence reaching the highest cover category 3 in 1994 and 1997.

On the River Itchen *Z. palustris* has only been recorded at sites I1 and I3. Having reached cover category 6 in the past (1991, 1992 and 1994) at site I1 *Z. palustris* was barely present in August 1997 at this site. A similar pattern was observed at I3. In the summer surveys of 1991, 1992 and 1994 the cover of *Z. palustris* was most frequently present at cover category 5 or 6, by 1996 this had fallen to 4/3 and in 1997 was 3.

3.2.6 *Hippuris vulgaris* (Mare's Tail)

H. vulgaris has been consistently recorded at a high cover percentage at T5 since 1991. The cover category of 6 recorded in 1997 was representative of the cover in all years since 1991. At I1 *H. vulgaris* has only just been present in the years 1991 to early 1996. From then until 1997 it was not observed.

3.2.7 *Schoenoplectus lacustris* (Common Club-rush, Bulrush, Ribbonweed)

S. lacustris has only been a major part of the macrophyte community at T6, and has remained so since 1991. This species has been virtually absent from all other reference sites.

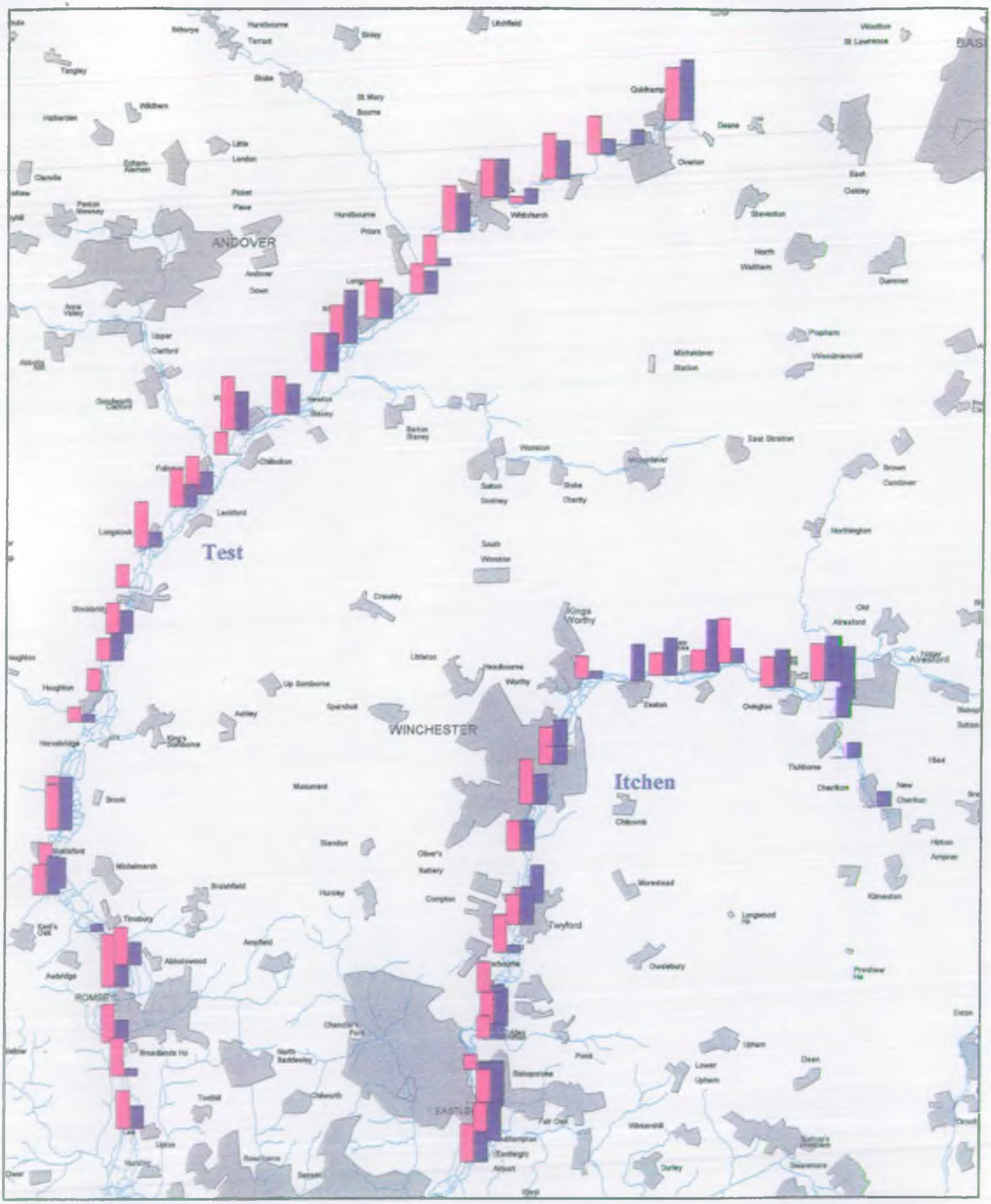


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Figure 2

% cover scale 8 4 0

1991 1997

***Ranunculus* spp.**
(Water Crowfoot)

Legend:

SCALE 1:331200
metres : metres

NORTH

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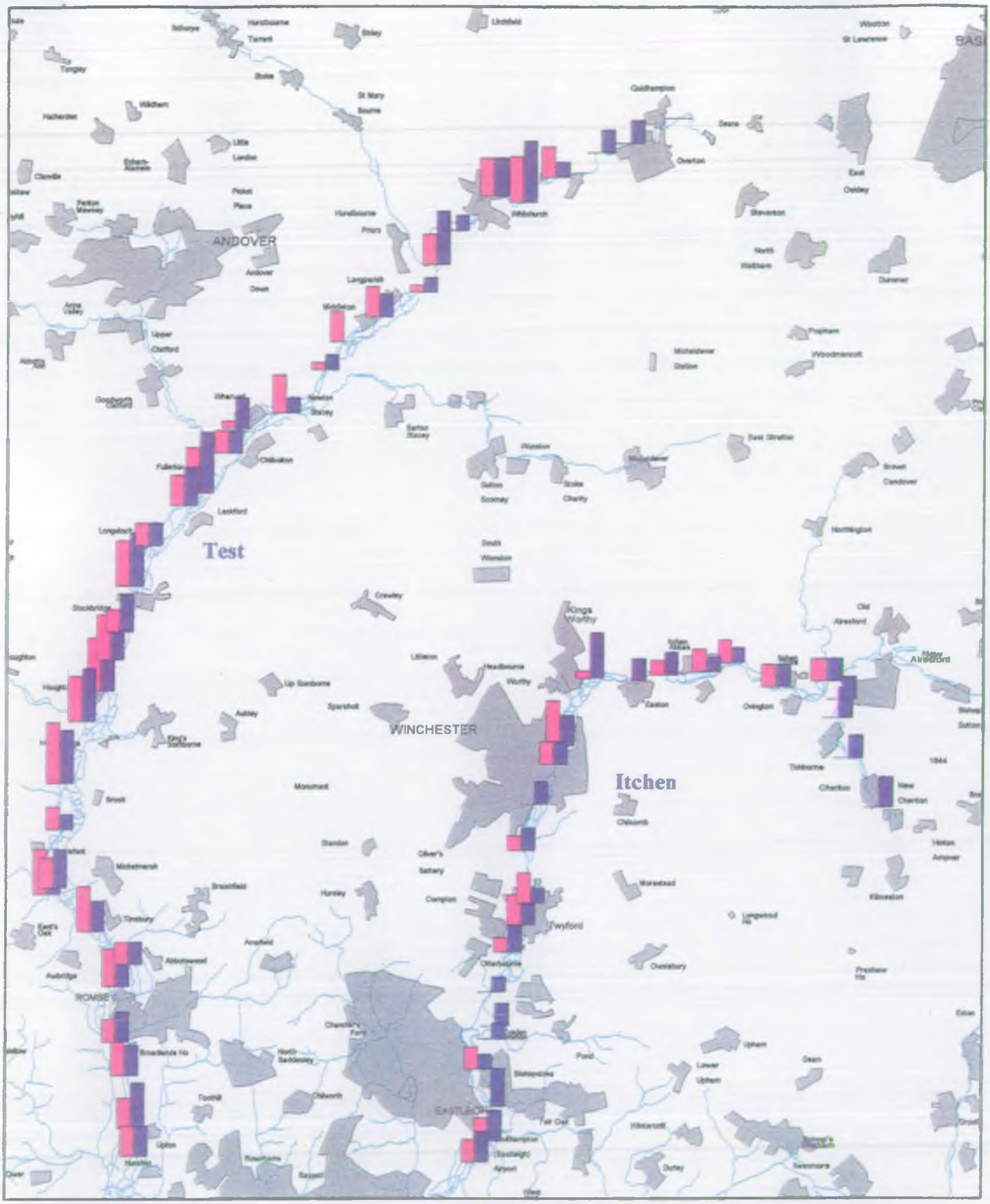

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Figure 3

% cover scale 8 4 0

1991 1997

Filamentous Algae

Legend:

SCALE 1:331200
metres : metres

NORTH

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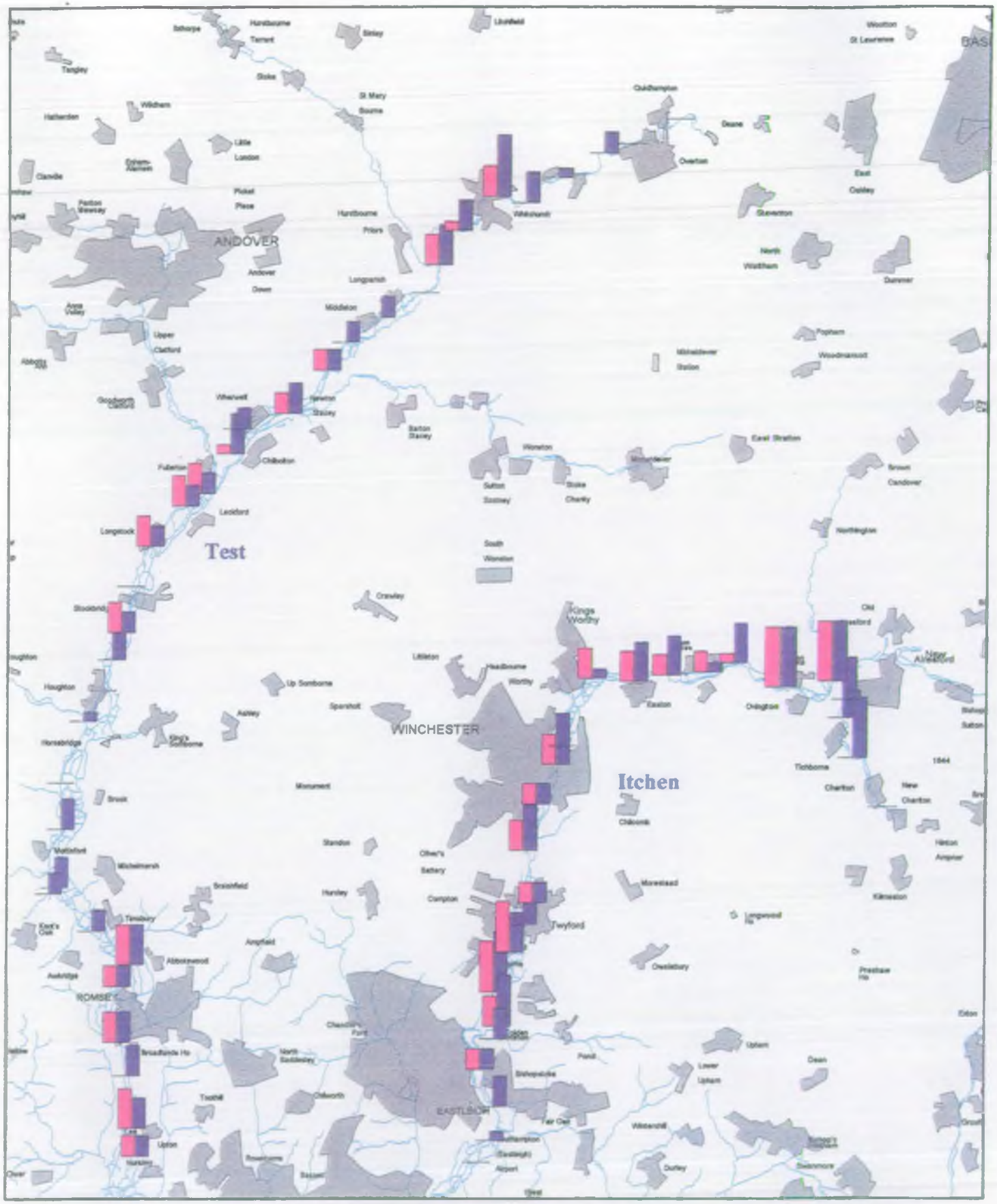

ENVIRONMENT AGENCY

Figure 4

% cover scale

8
4
0

1991 1997

Legend:

Berula erecta
(Lesser Water Parsnip)

SCALE 1:331200
metres : metres

NORTH

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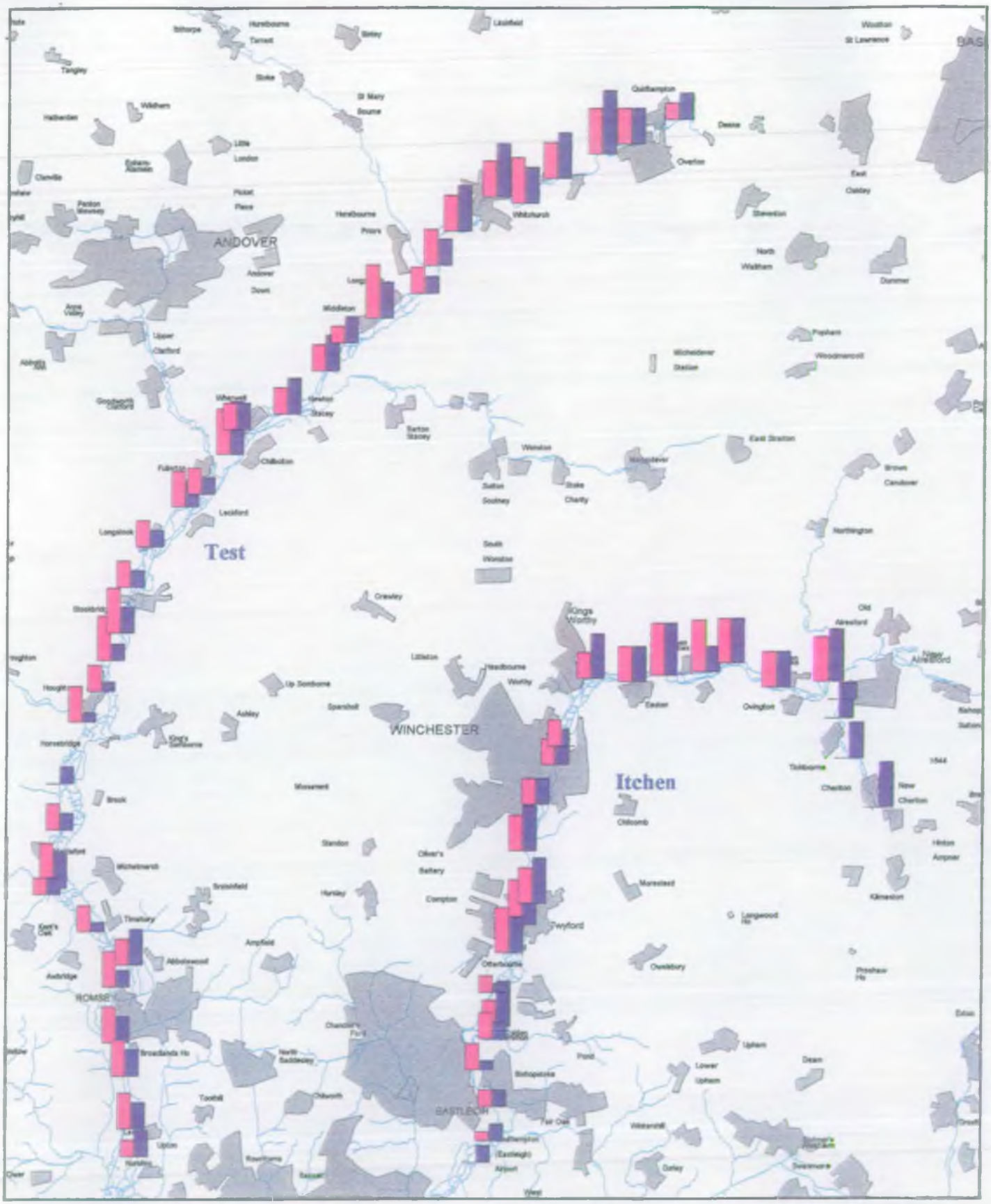

ENVIRONMENT AGENCY

Figure 5

% cover scale 8 4 0

1991 1997

Legend:

Callitriche spp.
(Starwort)

SCALE 1:331200
metres : metres

NORTH

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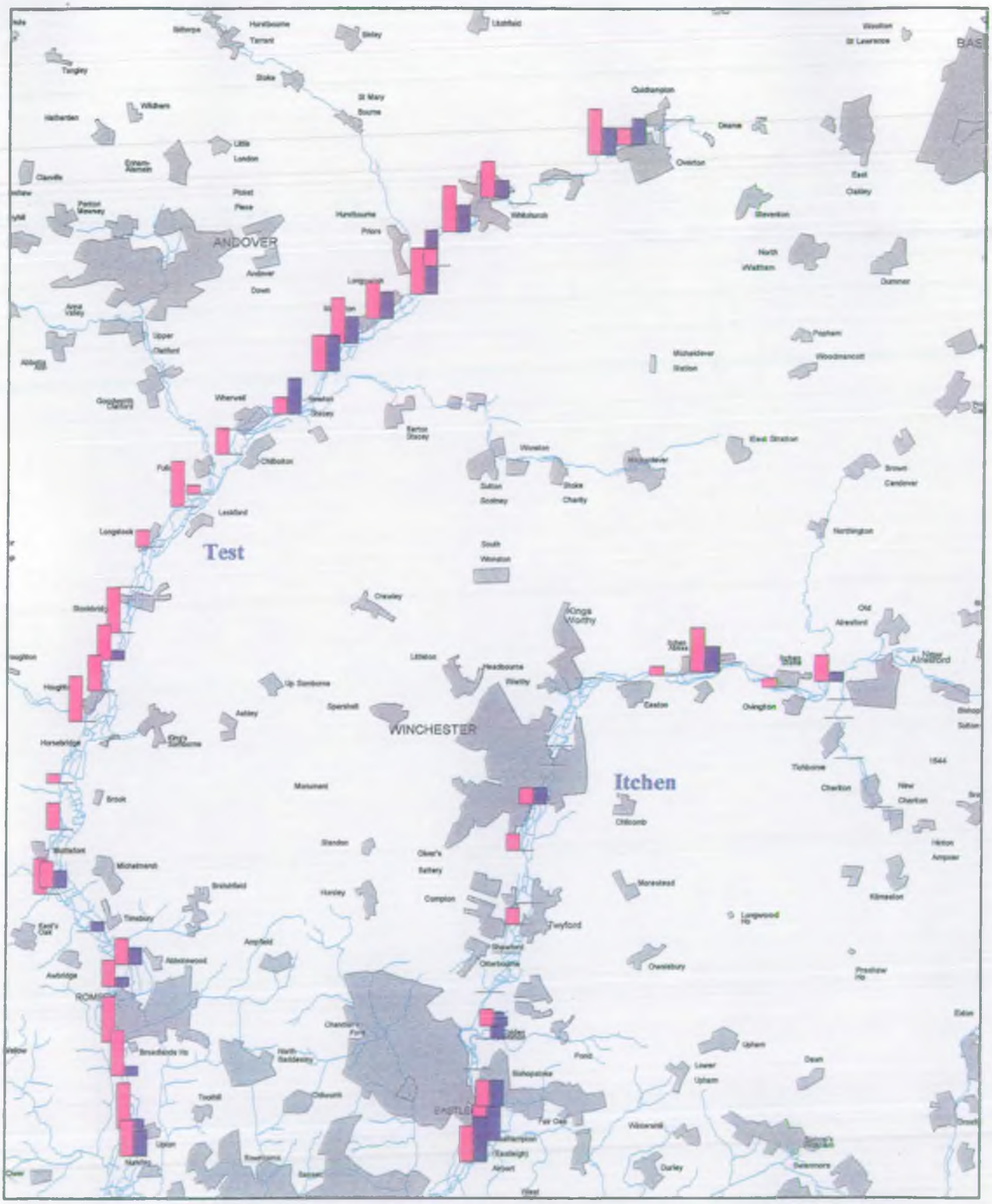

ENVIRONMENT AGENCY

Figure 6

% cover scale

8
4
0

1991 1997

Zannichellia palustris

(Horned Pondweed)

Legend:

SCALE 1:331200
metres : metres

NORTH

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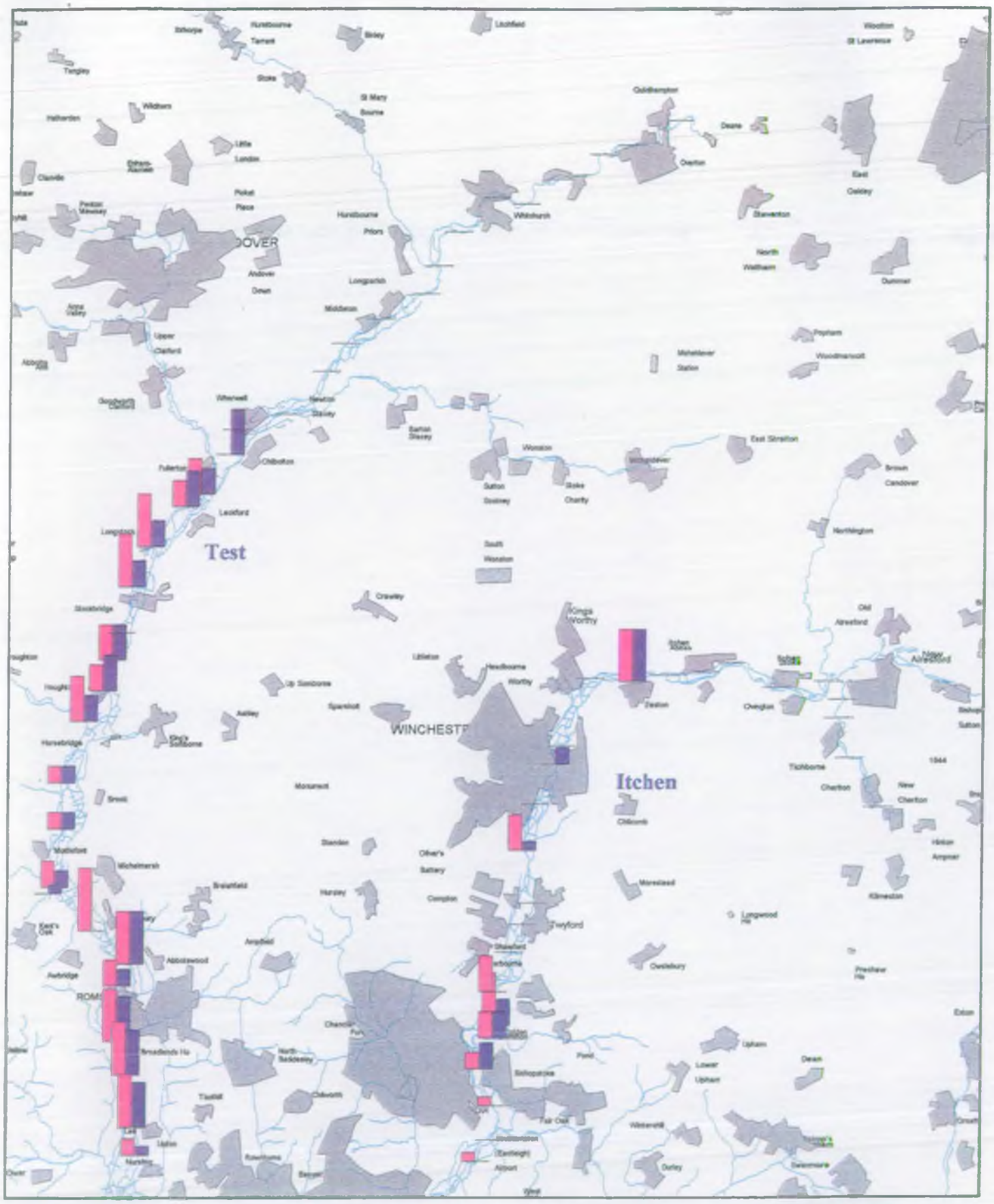

ENVIRONMENT AGENCY

Figure 7

% cover scale

8
4
0

1991 1997

Legend:

Schoenoplectus lacustris
(Common Club-rush)

SCALE 1:331200
metres : metres

NORTH

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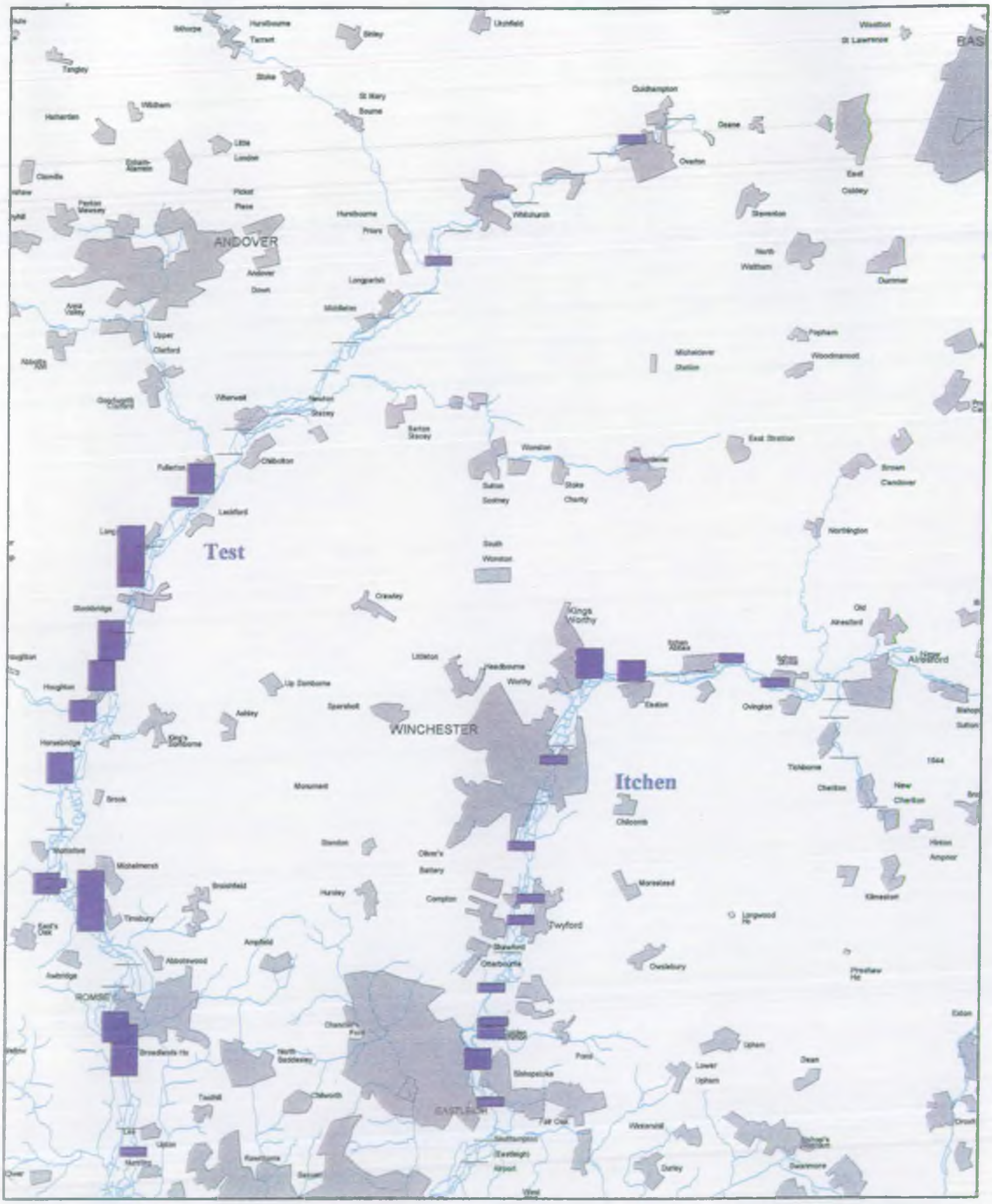

Figure 8

ENVIRONMENT AGENCY

Legend:

% cover scale

Sparganium emersum

SCALE 1:331200

metres : metres

NORTH

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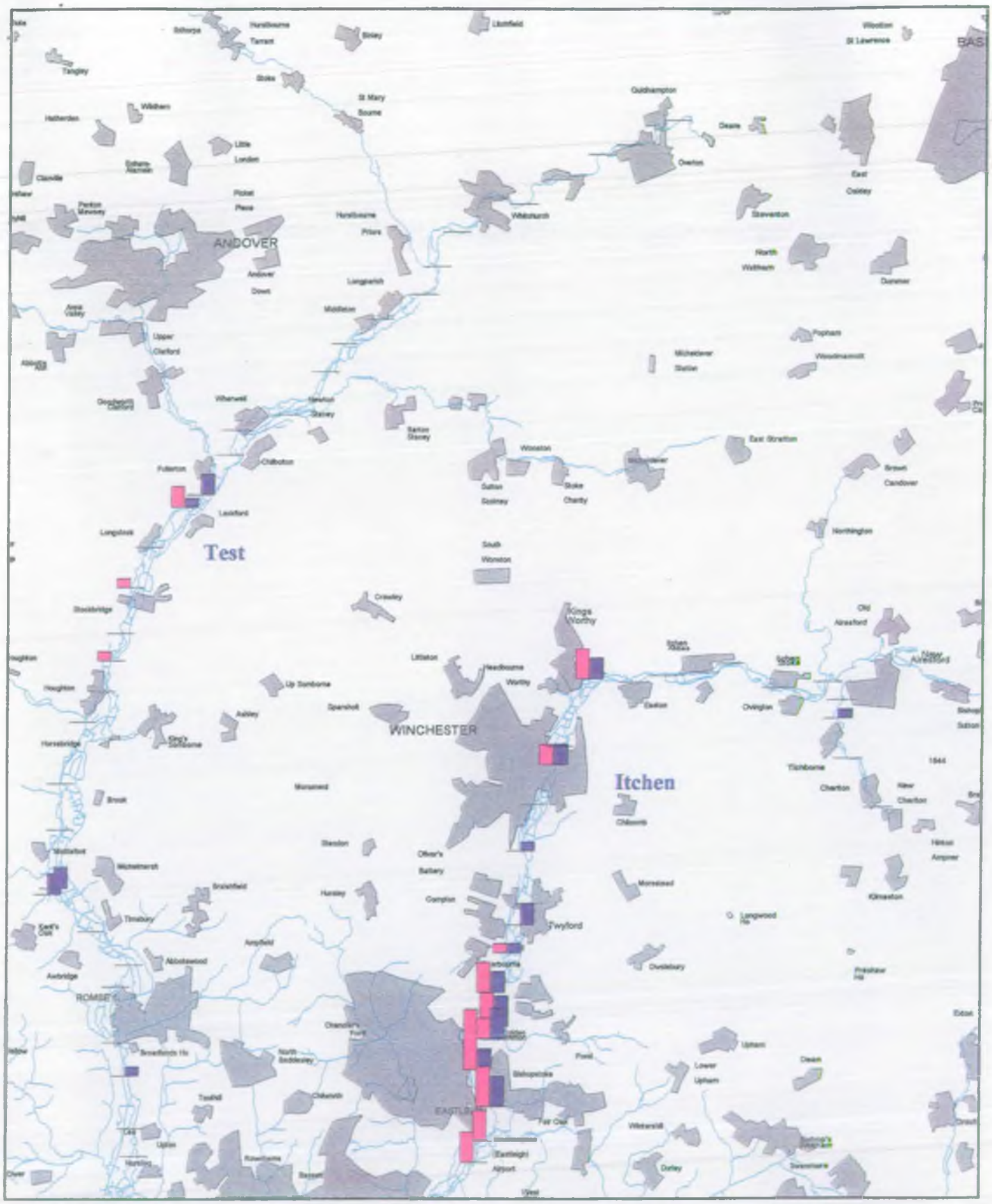

ENVIRONMENT AGENCY

Figure 9

% cover scale

8
4
0

🟥 1991 🟪 1997

Oeananthe fluviatilis

(River Water Dropwort)

Legend:

SCALE 1:331200
metres : metres

NORTH

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4. CONCLUSIONS

Literature reviews carried out as part of this long term study, longitudinal and reference site survey data, and statistical modelling analyses support the following general conclusions regarding macrophyte cover and distribution within the Rivers Test and Itchen:

4.1 State of the Environment

This report summarises the current status of macrophytes in the Rivers Test and Itchen together with trends experienced in their abundance and distribution since 1991. The survey data on which it is based represents an invaluable database against which future changes can be assessed. Further, this base of information should play a key role in the development of strategic management plans aimed at maintaining the special wildlife and fisheries interests of these rivers.

4.2 Principal changes in macrophyte cover

- The greatest changes to macrophyte communities since the start of the survey work in 1991 have occurred on the River Test. Of these changes the most notable has been the decline of *Ranunculus* species since 1995. This decline is, with exceptions, as true for the reference sites as for the longitudinal reaches. On the River Test there was a reduction in cover at 24 out of the 34 reaches surveyed. This included complete loss at four reaches in the middle Test. On the River Itchen there was a decline in cover in 9 out of the 21 reaches surveyed. These losses occurred fairly equally along the length of the river. However, these losses in cover were accompanied by an increase in cover at a similar number of reaches, particularly in the middle to upper River Itchen. Indeed, there was found to be no statistically significant decline in *Ranunculus* species cover on the River Itchen as a whole.

- Filamentous algae showed a statistically significant increase on the River Itchen and whilst increasing also on the Test this trend was not statistically significant. Increases in filamentous algae cover in the upper reaches of the River Test are balanced by marked decreases in the lower reaches. The increases in filamentous algae cover on the River Itchen are fairly widespread, with exceptions in the uppermost reaches. It should also be noted that the average cover of filamentous algae on the River Test still exceeds that on the River Itchen.

- *B. erecta* has increased significantly on the River Test and on the River Itchen since 1991. The increases are widespread with the exception of a group of reaches in the middle River Test which experienced a decline.

- *Callitriche* species has maintained a stable presence at most of the reference sites on both rivers but with notable increases in cover categories on the middle Test (T3 and T4). By contrast, at the longitudinal reaches there have been increases in percentage cover in the upper Test but losses in the middle to lower reaches. Since 1991 the overall pattern at the reaches on the River Itchen has seen little change.

- A significant decline in the cover and distribution of *Z. palustris* has taken place. Of the 29 reaches recording *Z. palustris* on the River Test in 1991 41% no longer contained any *Z. palustris*. The majority of the remainder, a further 45%, experienced reductions in cover. Despite being more sparsely distributed on the River Itchen *Z. palustris* had declined at 58% of reaches between 1991 and 1997.

- There is evidence which suggests that the macrophyte community found in the lower reaches (and to a lesser extent the mid - upper reaches) of the Test , are moving away from a *Ranunculus* species dominated community to one with a greater percentage cover of *B. erecta*, *Callitriche* species and filamentous algae. In the absence of any change in the predicted hydroclimatic regime, current impacts and existing management practices, more reaches of the river may experience similar changes in the future.

4.3 Key variables and macrophyte behaviour

- As expected, many environmental variables were observed to co-vary such that all macrophyte-environment correlations must be interpreted with care. This highlights the extremely complex nature of the dynamic river environment.

- The most important physical parameter arising from the spacial modelling analysis was the local, in-channel flow velocity.

- Flow-related parameters were found to be direct determinants of temporal cover for a number of species, most notably filamentous algae, *B. erecta* and *Callitriche* species. For *Ranunculus* species cover the strongest (negative) correlation out of all the variables studied was with *Callitriche* species, *B. erecta* and filamentous algae.

- The temporal models were dominated by, antecedent (previous) macrophyte covers, temperature regimes and water quality (most notably nitrite and pH).

- A statistically significant decline in the frequency of heavy (>25mm/day) rainfalls in the summers since the 1960s means that the hydroclimate of most recent decades has contributed fewer flushing events, thereby favouring the growth of low-flow species such as filamentous algae or *Callitriche* species. This is thought to have had an

adverse affect on *Ranunculus* species.

4.4 Swan damage

- During the course of collecting the data used in this report it has become clear that swans are perceived to have a major adverse impact on *Ranunculus* species although that impact may be restricted to specific stretches of the two rivers. The River Test is thought to suffer the greatest impact.

5. RECOMMENDATIONS

A significant element to the nature conservation, fisheries and aesthetic value of these rivers rests with the luxuriant and diverse beds of submerged and floating aquatic macrophytes. Water-crowfoot (*Ranunculus* species) is typically a dominant component of these plant communities and is frequently referred to for its pivotal role in chalk stream ecology and as a species with which to measure the overall "health" of the river.

In the absence of a return to "normal" hydrological conditions, e.g. comparable to those witnessed in the 1960s, it is unlikely that we will see aquatic plant communities return to, and be maintained at, a favourable status. In such an event, the management afforded to the river by man becomes increasingly important.

The following recommendations are based on the findings within this report. It is vitally important that, where appropriate, changes in management are monitored and refinements made to ensure that best practice is always applied.

5.1 Promoting Macrophyte Growth by Changing Flow Characteristics

"Velocity" remains, perhaps, the single most critical environmental parameter influencing the presence and abundance of key macrophyte species on the Test and Itchen. It is particularly important for promoting growth of *Ranunculus* species and enabling this species to maintain a competitive advantage over other macrophyte species. Many unfavourable changes observed are the result of a reduction in water velocity across the river bed. All river reaches will be indirectly affected to some extent through reduced flows. However, the areas which are likely to be most severely impacted and suffer greatest reductions in velocity, are those in which the channel has undergone some enlargement - widening, deepening, or both. Enlargement and deepening of carriers can lead to a reduction in water velocities across the valley as can the opening and closing of sluices.

Traditional management has, for many years, recognised the importance of velocity as a key variable for in-stream ecology by the installation of pinch-points or deflectors. These structures do increase velocity, but the effects tend to be very localised.

The same effect can be achieved on a larger scale by reducing the size of the whole channel - through narrowing, bed raising, or both. This technique has been tried and tested at numerous locations on the Test and Itchen and is often followed by dramatic recovery of *Ranunculus* species. By introducing structural diversity into an enhancement scheme it is possible to create a variety of flow characteristics more conducive to the establishment and maintenance of a balanced macrophyte community.

The Environment Agency welcomes this approach as being a realistic means of maintaining chalk stream macrophyte communities in the light of long term climate change. However, each scheme needs to be treated on its own merits with water resource, flood defence, fisheries and conservation considerations all taken into account. The Agency's expertise in measuring, modelling and predicting velocities may also prove invaluable when designing schemes to the best effect.

5.2 Weed Cutting Options to Promote Growth of *Ranunculus*

Timing of the weed cut is known to greatly influence the growth behaviour of *Ranunculus* species. A review of existing research together with results from this study would suggest:

- *Ranunculus* species responds well to an early spring cut. This promotes growth and may be considered even if the plants look too small to really need it. In such cases, it may be worth trying a very light cut - to induce the growth response.

- The extent to which *Ranunculus* species propagates from seed is not well understood. It is possible that the importance of this means of establishing new plants has been overlooked. Where bed conditions and/or flow dynamics have been improved e.g. through gravel cleaning, channel narrowing etc., it may be worth leaving *Ranunculus* species plants uncut (in areas upstream and / or in adjacent carriers) prior to flowering and seeding. This may give plants a chance to re-establish via this means.

- A strong relationship has been found between the cover of *Ranunculus* species in the spring / summer and *Ranunculus species* cover left in place the previous autumn. This would suggest that abstaining from the autumn cut will promote better growth the following year. However, this should be tempered by the need to help the river flush silt downstream and the importance of cleaning spawning gravels for trout and salmon.

In accordance with traditional weed cutting practice it is recommended that a chequerboard or patchwork weed cutting regime is carried out.

Where weed cutting boats are employed it is recommended that whole river channel clear cutting is avoided leaving a patchwork (or bars) of weed in situ. This has the added advantage of maintaining sufficient cover for resident fish and invertebrate populations.

5.3 Weed Cutting Options to Control Growth of *Ranunculus*

Control of over-luxuriant beds of *Ranunculus* species, is as important in some areas as promoting growth is in others. Reducing growth can be achieved by (1) cutting heavily in the autumn and (2) not cutting in spring / summer. However, it has also been shown that complete cessation of cutting will, over a period of four years, reduce the biomass of *Ranunculus* by around 50 %.

5.4 Selective Removal and Control of Macrophytes

The relative abundance of each macrophyte species is a response to environmental parameters, other macrophyte species and management. All species recorded during this survey work have a legitimate place in the chalk stream plant community - including filamentous algae. It is the relative abundance of each that is of prime importance. *Ranunculus* species is well established as a key species which generally ,but, by no means always, assumes dominance. Indeed, an abundance of species such as *Berula erecta*, *Schoenoplectus lacustris*, *Sparganium emersum* and *Callitriche* species, may be perfectly natural in certain parts of the river.

Where a species (e.g. *Berula erecta*) is known to have replaced e.g. *Ranunculus* species, it may be appropriate to selectively remove areas of the former in order to encourage re-establishment of the latter. However, removing one species in favour of another is akin to treating the symptoms of a problem rather than the cause. This is likely to be met with limited success without first treating other factors responsible for the initial change, from one species to another. Furthermore, there is a risk of damaging other important chalk stream macrophytes such as *Oenanthe fluviatilis* (River water dropwort) which is a nationally scarce species of considerable conservation importance in chalk rivers. Any decline in this species is of as much concern as reductions in *Ranunculus* species and selective removal serves only to impoverish the overall plant community and place this species under greater pressure nationally.

A key area where river managers have an opportunity to treat the causes which may have influenced a change in macrophytes, is through appropriate river engineering, such as shallowing and narrowing as referred to earlier.

6. RECOMMENDATIONS FOR FURTHER RESEARCH

- Integrate the 1998 spring survey data into existing models.

- Initiate further research on the complex interrelationship between macrophytes, water quality and flow.

- Investigation into the causes and impact of diatomaceous or epiphytic algae on *Ranunculus* species.

- Baseline survey of macrophyte status on the tributaries of the Test and Itchen.

- Consideration should be given to the principle of 5 yearly whole catchment status survey for macrophytes on the Test and Itchen.

  NOTE: The economies of time and resources afforded by the adoption of the percentage cover methodology present the opportunity in future to add to the number of reference sites surveyed. The data is now available to add sites which have followed recent trends e.g. suffered a decline of *Ranunculus* species, or gone against a trend and maintained or increased the cover of *Ranunculus* species.

- Further develop methods for enhancing flow characteristics of river channels to compliment techniques already established.

- In view of the conservation status of *O. fluviatilis* (River Water Dropwort) consideration should be given to investigating the reasons for its decline (particularly in the lower River Itchen) and devising a strategy to secure its future in the floristic community of both rivers.

- In the light of research to be conducted in South West Region of the EA on the impact of swans on macrophytes, formulate, with the assistance of MAFF, English Nature and the RSPB/WWT appropriate management guidance. Meanwhile, draw up a list of sites or river stretches where swans are known to heavily graze macrophytes and include those sites/stretches as part of a future macrophyte monitoring programme.