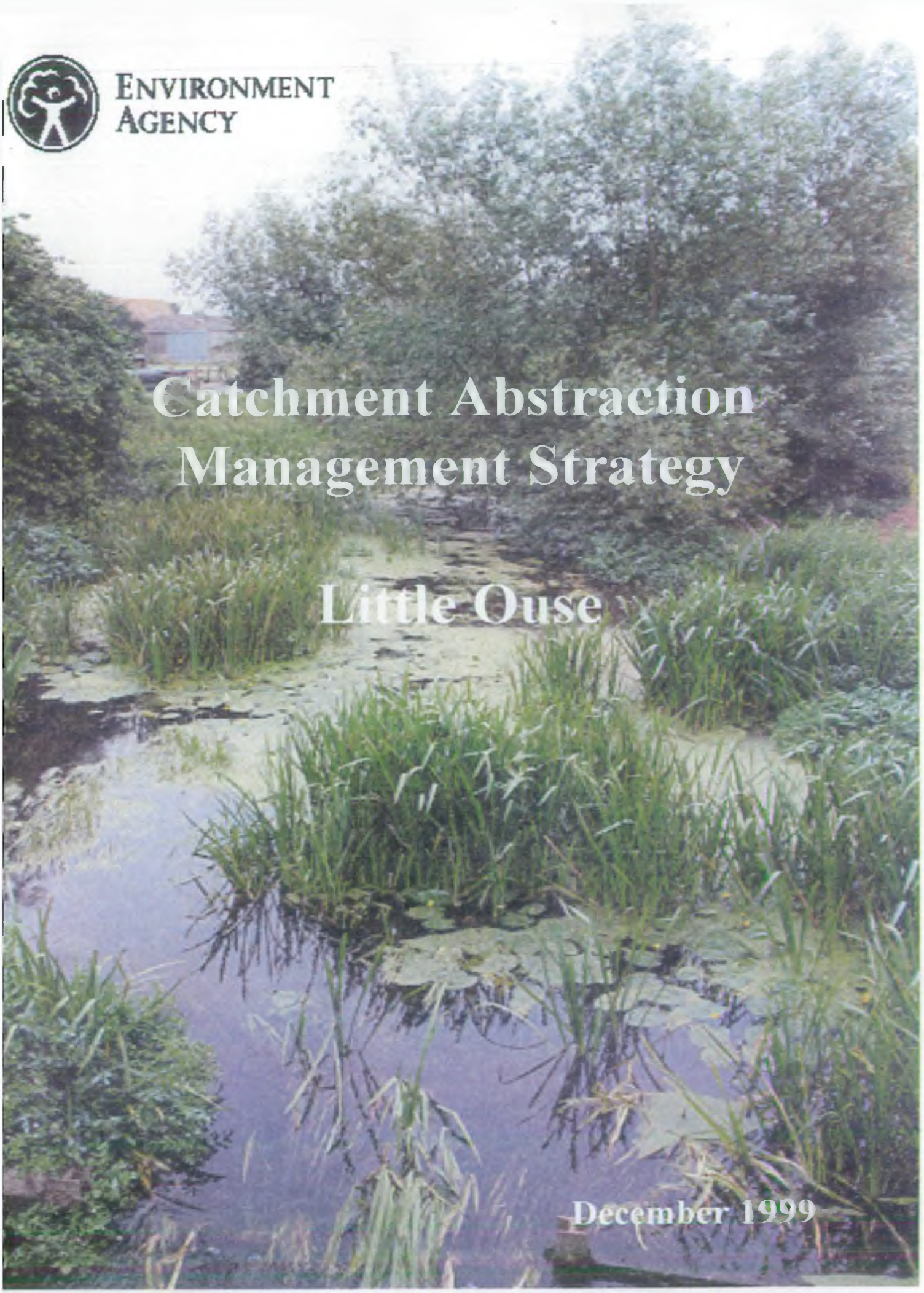
ENVIRONMENT
AGENCY
Catchment Abstraction
Management Strategy
Little Ouse
December 1999

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LITTLE OUSE CATCHMENT ABSTRACTION MANAGEMENT STRATEGY

1. FOREWORD

This Catchment Abstraction Management Strategy (CAMS) for the Little Ouse has been produced as part of the Environment Agency's preparation for the national consultation on the CAMS process, commencing in April 2000.

From 2001 CAMS will be public documents, subject to a formal consultation process similar to that undertaken for LEAPS. Each CAMS will describe the water resource and its availability, licensing policies for the allocation of the resource, and future aspirations and strategies.

I would like to thank all those in Thames and Anglian Region of the Environment Agency who contributed to producing this document.

The Vision for the Little Ouse Catchment is that the Water Resources of the area should be used in a sustainable way, which does not harm the aquatic environment. Existing harmful operations should be targeted for change whilst legitimate development of water should be allowed where resources are still available.

Pat Sones
Area Water Resources Manager
December 1999

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2. INTRODUCTION

2.1 Document Structure

The Little Ouse Catchment Abstraction Management Strategy (CAMS) document is comprised of four inter-linking sections. The first section provides a description of the CAMS area, including details of the topography, land-use, rivers etc. The second section provides an account of how the water resource balance of the area has been calculated, and thus how the sustainability status was assigned. Section three explains the existing water resource policies for the area. Section four describes the Agency's aspirations, and how it intends to fulfil them.

2.2 CAMS – NAMS Relationship

The National Abstraction Management Strategy (NAMS) Document is a separate, stand-alone National Document, which supplements each CAMS. The NAMS document contains "national issues" such as the Abstraction Management Strategy (AMS) Vision, the legislative background to AMS, national licensing policy and links with other Environment Agency documents and strategies. In essence the NAMS document prevents duplication, and promotes consistency for each CAMS.

2.3 Description of the Area

The Little Ouse Catchment is situated in East Anglia. Figures 1 and 2 show location maps of the area. Figure 3 shows the surface water catchments for the Rivers Thet, Little Ouse and Sapiston. The rain that falls on these areas will contribute to the flows in these rivers. Plates 1 to 4 show example reaches of the Upper Little Ouse, Lower Little Ouse, Sapiston and the Thet.

Figure 4 shows the area of the Chalk aquifer which contributes to the flows in the rivers Thet, Little Ouse and Sapiston. This area, known as the Little Ouse groundwater unit, is slightly different in extent to the surface water catchments, but is the best basis for determining policy with respect to the licensing of abstraction from Chalk groundwater. Figure 5 shows the relationship between the surface water catchments of the Little Ouse, Thet and Sapiston and the Little Ouse Groundwater Unit.

2.4 Topography

Topographically, the catchment can be divided into 2 distinct areas. The majority of the catchment is comprised of the upland Chalk hills with the highest elevation being around 60 mAOD. This area is drained by a series of rivers and streams which have had a pronounced effect on the topography, forming a series of incised valleys. A small area of the western part of the catchment lies in the lowland fen area known as the South Level. The majority of this area lies at or below sea level, and the drainage has been extensively modified over centuries to provide flood protection.

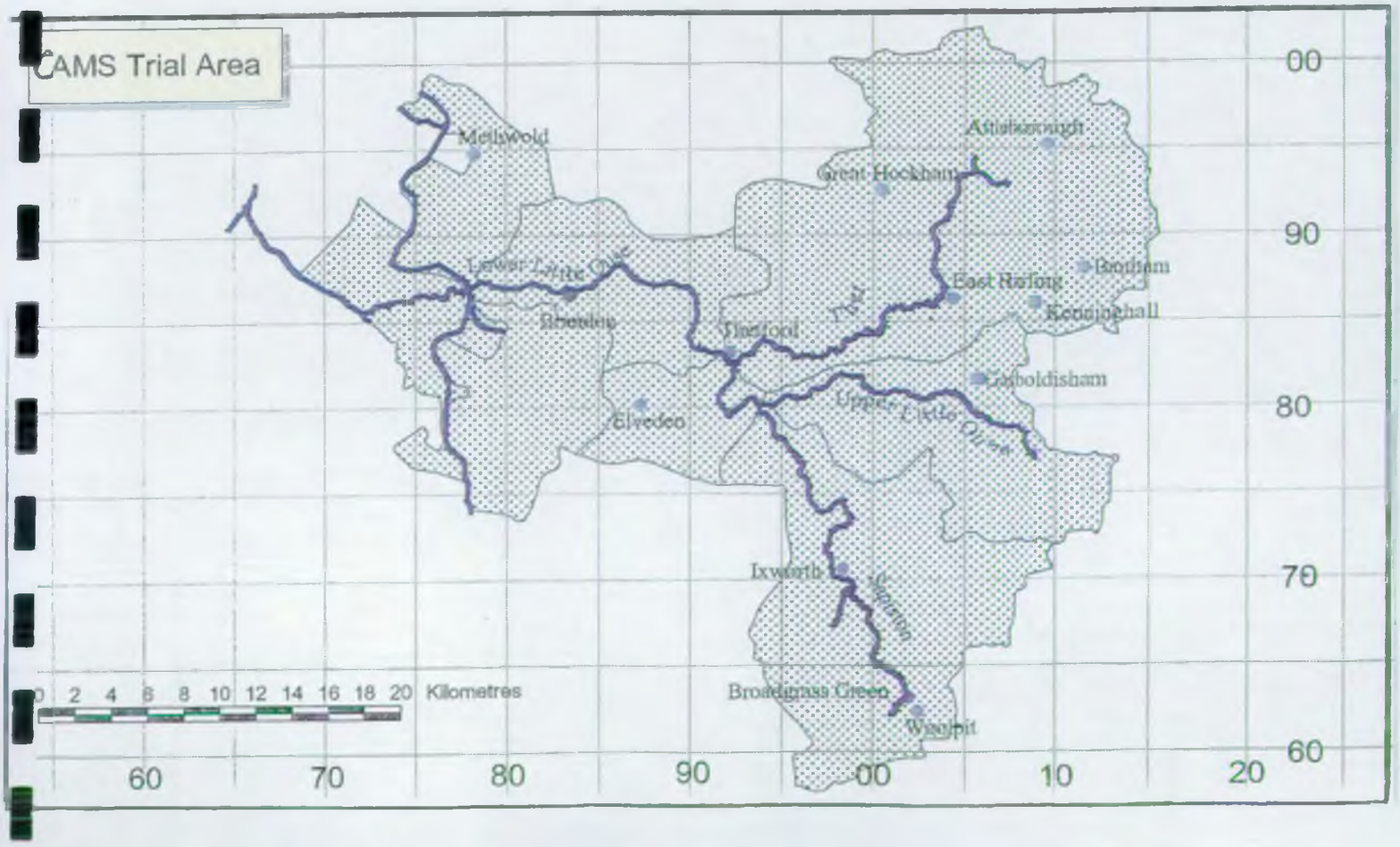
2.5 Land Use

The main population centres within the CAMS area are the towns of Thetford and Brandon, both of which lie within the centre of the catchment. The predominant land use is agriculture, with areas of woodland (Thetford Forest) and urbanisation. The agricultural grade of the land ranges from Grade 4 (lowest grade) in the centre of the catchment, to the highest quality land, Grade 1, in the fenland. The agricultural land grades are determined by MAFF, and relate to the suitability of the land for agriculture.

2.6 Abstractions of Water

Water is abstracted from rivers (surface water) and the groundwater (groundwater) and used for several purposes. These purposes include public water supply, private water supply, agriculture, industry and raw water transfer. Further details on water resources usage can be seen in Appendix A.9.

Figure 1 : General Location of CAMS Trial Area



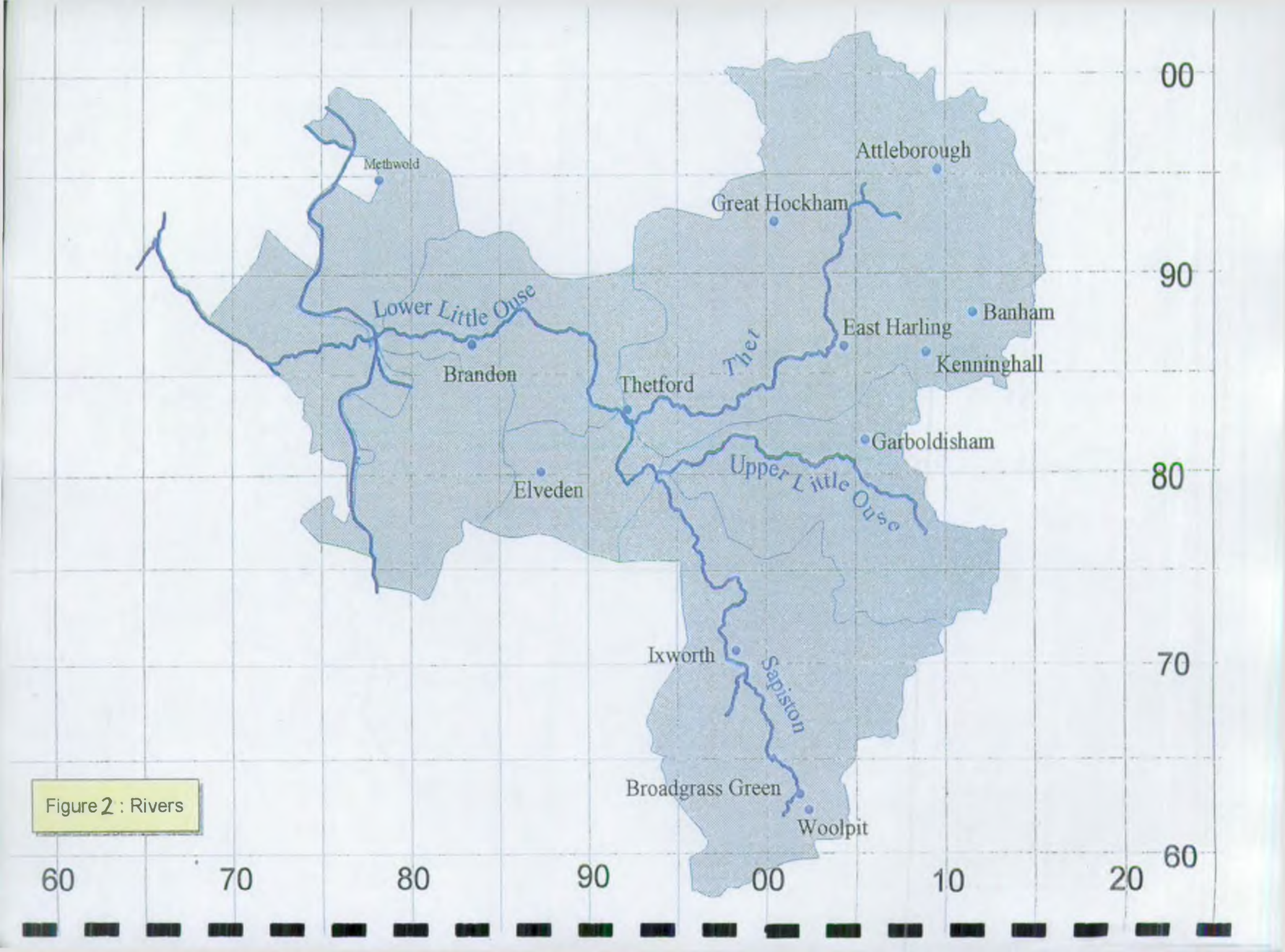


Figure 2 : Rivers

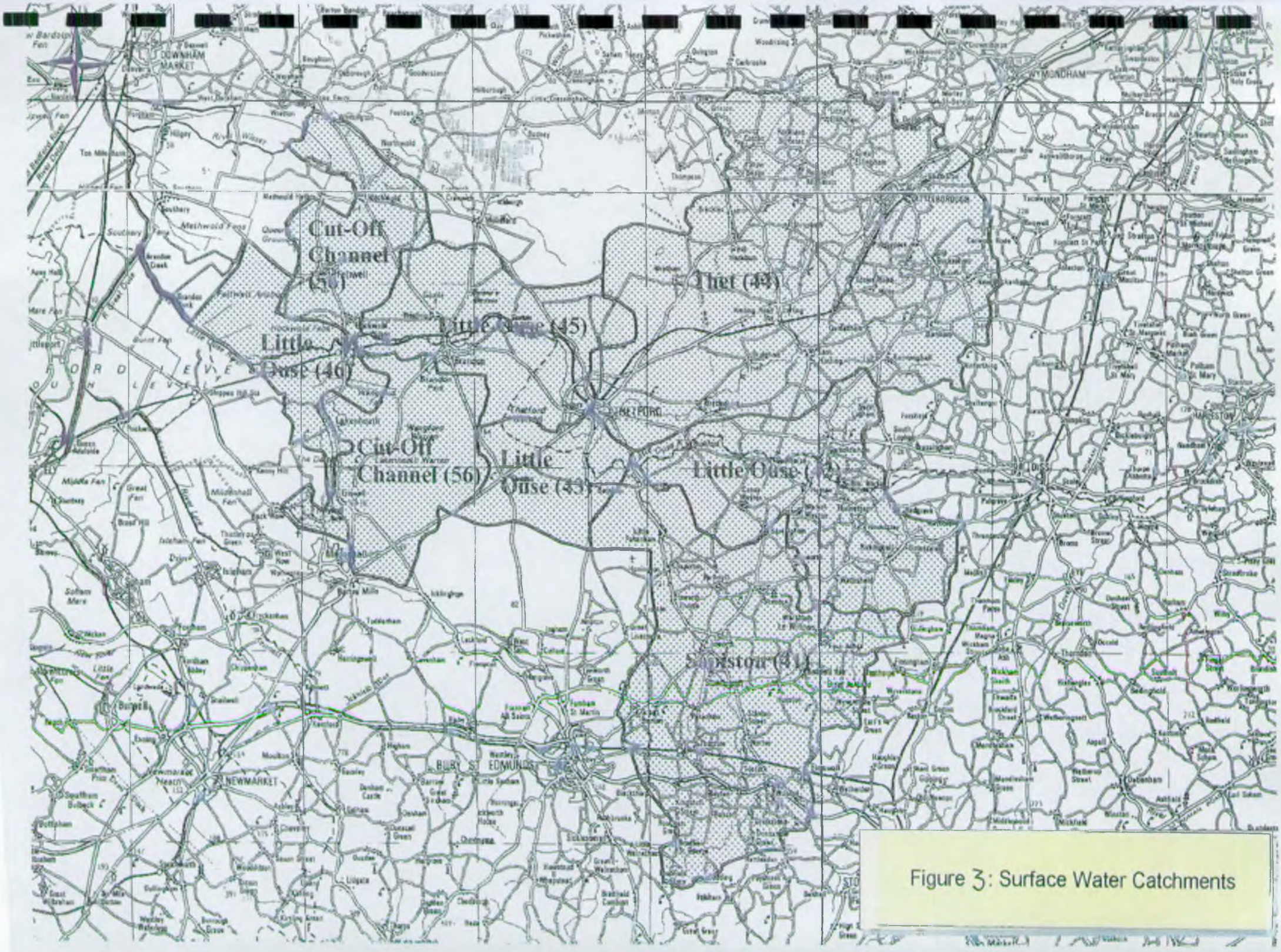


Figure 3: Surface Water Catchments

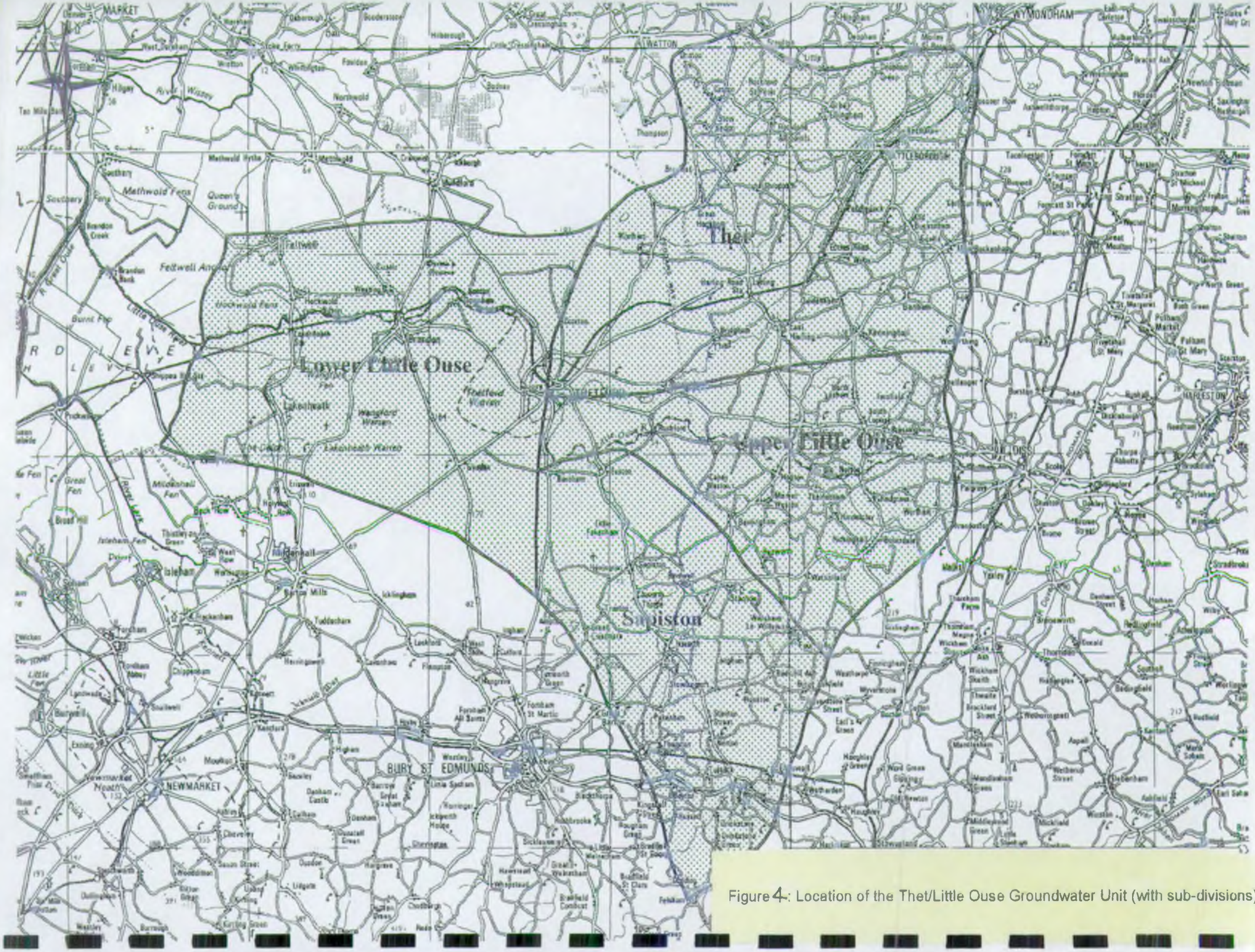


Figure 4: Location of the Thet/Little Ouse Groundwater Unit (with sub-divisions)

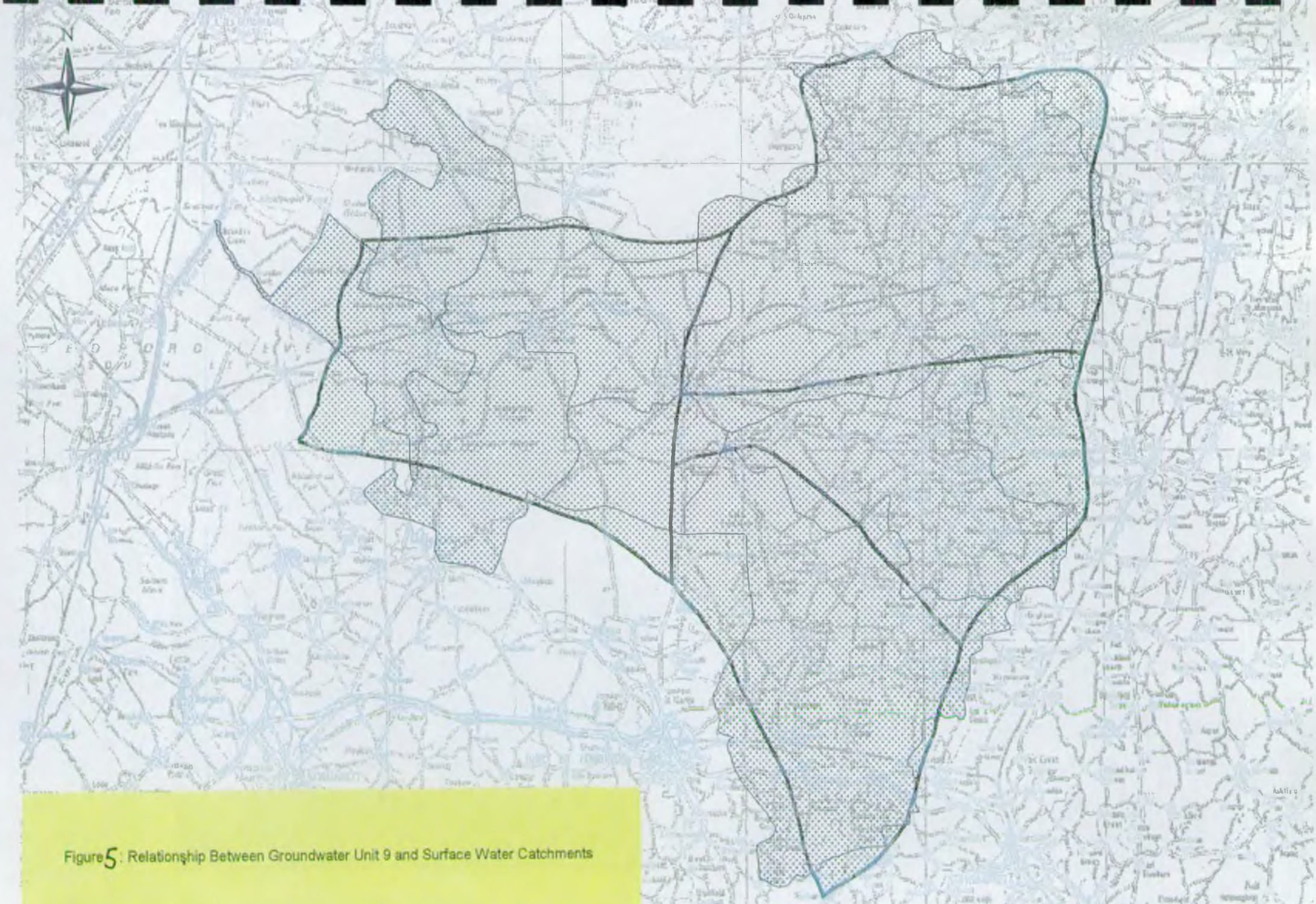


Figure 5: Relationship Between Groundwater Unit 9 and Surface Water Catchments

Plate 1: Upper Little Ouse at Knettishall, June 1999

Plate 2: Lower Little Ouse at Brandon, June 1999

Plate 3: River Sapiston at Ixworth, June 1999

Plate 4: River Thet at East Harling, June 1999

3. RESOURCE BALANCE / SUSTAINABLILITY STATUS

3.1 The Sustainability Status

A prime aim of the Environment Agency is to secure the sustainable development of water resources and meet the reasonable needs of abstractors and the needs of the water environment. This section sets out how the water resources of the Little Ouse catchment is calculated, and compares this to the level of sustainability.

Table 1 below describes different levels of water resource availability and gives these a category according to the sustainability. This is a nationally agreed categorisation.

Table 1: Sustainability Status Description

Status and Colour	Development Status Annual Balance for critical year scenario as % of Total Resource	Development Status Description	Surface Water (SW) /Groundwater (GW) availability
Light Blue	**Lightly to Moderately Committed** Surplus exceed 30% of total resource	Surpluses in all months, at a notable level in some summer months and most winter months.	GW – ✔ Summer SW – ✔ Winter SW - ✔
Green	**Significantly Committed** Surplus is between 10 and 30% of total resource	Slight surplus or "In balance*" in most summer months, possibly with a notable surplus level for a month or so. Winter months still have a clear surplus.	GW – ✔ Summer SW – ? Winter SW - ✔
Yellow	**Fully Committed** Surplus exists but does not exceed 10% of total resource	"In balance*" with no significant summer month surpluses or deficits, except perhaps a notable surplus for one month. Winter resource surpluses also likely to be limited or "in balance" but with the possibility of a slight surplus in some months.	GW – ✘ Summer SW – ✘ Winter SW - ✔
Orange	**Over Committed**** Deficit exists when using full licensed allocation but not when using current or actual utilisation level.	Using licensed allocations: deficit exists for most or all summer months and possibly some winter months. Re run using actual abstraction levels: balance meets criteria for Essentially Fully Committed or better status.	GW – ✘ Summer SW – ✘ Winter SW - ?
Red	**Over Developed*****	Using licence	GW – ✘

	(Over Committed** and Over Developed***) Deficit exists when using full licensed allocation and when using current or actual utilisation level.	allocations: deficit exists for most or all summer months and possibly some winter months. Re run using actual abstraction levels: Deficit still exists at least for most summer months.	Summer SW – ✗ Winter SW - ✗

Note1: * some months may have a small deficit but within calculation error bands
Note2: ** over committed means that water has been "committed" or allocated to the environment and existing users. The amount of water licensed exceeds the available resources
Note3: *** over developed is the same as Note2, however the resources are over developed as the amount of water abstracted exceeds the available resources.
Note4: GW is groundwater, SummerSW is summer surface water, WinterSW is winter surface water
Note5: ✗ means no water available, ? means water may be available, ✓ means water is available

3.2 Allocation of Surface Water Resources

The policy for surface water abstraction for the River Little Ouse Catchment is defined in the National Rivers Authority document "A Sustainable Strategy for Secure Water Supplies And a Better Water Environment", as published in 1994. This is a public document issued following consultation with interested parties and the general public. The policy states that winter water is available, and that a limited quantity of summer water is available from rivers augmented by the Great Ouse Groundwater Scheme. Increases in licensed abstraction since this policy was written has meant that at present no new summer surface water abstraction licences are issued.

In 1992, during the 1989 - 1992 drought, there was heightened awareness of the impact of drought conditions on the environment but, in fact, many external organisations and individuals blamed the problem on abstractions rather that the drought. Arising from this, a moratorium was placed on the granting of new licences in many catchments, and as many of the rivers are supported in lowflows by groundwater outflow, the moratorium was also applied to the groundwater catchments. The River Little Ouse came under this moratorium. Subsequently this situation was confirmed in the 1994 strategy. Using the sustainability categories in Table 1 our subjective interpretation is orange.

As stated in Section 3.3.1 below, the Agency is responsible for allocating water resources not only to the abstractor, but also to the "environment". At present in Anglian Region the amount of water allocated to the environment is calculated from a flow statistic known as the "naturalised 95 percentile" (the definition of this term can be seen in Section 3.3.1). When the river flow falls below the naturalised 95 percentile there may not be enough water for the environment, and environmental deterioration could be taking place. Analysis of the flow data of the River Little Ouse shows that the river flow has fallen below the naturalised 95 percentile on six out of the last nine summers, but on only two out of the last nine winters. In addition, in 1991 the flow of the River Little Ouse was below the naturalised 95 percentile for 48% of the summer, but for none of the winter. 1991 was chosen as an example year, with similar results obtained for other years.

Many abstraction licences contain conditions curtailing abstraction when the river flow falls below a predetermined level. These levels are set to protect existing water users, and to prevent environmental damage. In addition the Agency can impose restrictions on spray irrigators by reason of exceptional shortage of rain, or other such emergencies. These restrictions are implemented under Section 57 of the Water Resources Act, 1991. There has been some form of restriction on irrigation licences in six out of the last nine summers.

At present the river flow statistics are the only information that have been used to define the environmental allocation. Understanding and using the relationship of flow and hydroecology is an aspiration for the future, but the following serves to illustrate how biological data simplistically reinforces the resource allocations and decisions in 1992 and 1994.

One of the consequences of lack of surface water resources (and corresponding low flows) is that the biological quality of the river is likely to suffer. This will be as a result of siltation, low oxygen content of the water, and lack of dilution of discharges from sewage treatment works. If a stretch of river consistently fails to meet its biological water quality target during the summer, but passes during the winter, it can be concluded that the summer water resources of the catchment are insufficient to maintain the biological community living within that river stretch. There are a number of sites on the Thet, Little Ouse and Sapiston where this is the case. It should be noted that biological communities can withstand occasional droughts, and that extreme conditions are needed to cause deterioration the community.

The chemical quality of a river is also closely linked to the water resources of the catchment. The chemical water quality classification of rivers is based on the River Ecosystem Classification (RE Classification), whereby chemical targets are set according to what a watercourse is used for (e.g. fisheries, water sports). In order to calculate whether a river has met its RE classification a statistical analysis of the most recent 3 years of data is undertaken. In this way a "3 year water quality value" is obtained, which is compared to the chemical quality target to assess for compliance. The advantage of this methodology is that the quality of the river over the last three years is compared to the target, and so the effects of different seasons or drought years on water quality are "averaged out" in the 3-year statistical analysis. However, as a consequence of this averaging effect it is not possible to separate out winter and summer water quality, and thus not possible to conclude the adequacy of the summer surface water resources of the CAMS area from looking at the chemical water quality data.

Tables 2, 3 and 4 below compare the biological quality data, flow data and abstraction restriction data for the three main rivers in the CAMS area. 1991 was chosen as an example year, but similar results are obtained when looking at other years.

Table 2: Little Ouse Surface Water Availability

River Little Ouse	Summer 1991	Winter 1991/92
Biological Quality (LQI)*[1] (as measured at Blo Norton)	FAIL	PASS
Abstraction Restrictions	Cessation level restrictions	No restrictions
% of season below naturalised 95 percentile	48	0

Table 3: River Sapiston Surface Water Availability

River Sapiston	Summer 1991	Winter 1991/92
Biological Quality (LQI)*[1] (as measured at Pakenham)	FAIL	PASS
Abstraction Restrictions	Cessation level restrictions and spray irrigation restrictions	No restrictions
% of season below naturalised 95 percentile	93	73

Table 4: River Thet Surface Water Availability

River Thet	Summer 1991	Winter 1991/92
Biological Quality (LQI)*[1] (as measured at Portwood)	FAIL	PASS
Abstraction Restrictions	Cessation level restrictions	No restrictions
% of season below naturalised 95 percentile	23	0

*[1] LOQ is the Lincoln Quality Index and is used to measure the biological quality of a river

Tables 2, 3 and 4 above show that during 1991, an extreme drought year, the summer water surface water resources of the River Little Ouse, Thet and Sapiston were insufficient to:

- maintain the biological quality of the river
- prevent environmental damage (as defined by the naturalised 95 percentile)
- allow unrestricted abstraction.

3.3 Calculation of Groundwater Resources

The following sections describe how the groundwater resource is calculated in Anglian Region. It is expected that in the future the Environment Agency will adopt a National Methodology and this may supersede the Anglian method.

3.3.1 The Anglian Region Methodology

The Environment Agency is responsible for allocating water resources on a sustainable basis. This is done by firstly calculating the *"Available Groundwater Resource"* which is the quantity of water that can be renewed by rainfall and which is available to support the needs of rivers and wetlands and the needs of abstractors. The

available resource is calculated using long term rainfall statistics. In some years the rainfall exceeds the quantity needed to meet abstraction and environmental needs. In other years, such as recent drought years, it is less than required, but in the long term the available water resource describes a renewable sustainable quantity.

The methodology described below was first presented in 1994 in the Anglian Region Water Resources Strategy "A Sustainable Strategy for Secure Water Supplies And a Better Water Environment".

The Strategy is to be updated and reissued in December 2000. The National Strategy Consultation Document "Sustainable Water Resources for the Future: Values and Challenges", was issued in October 1999. The strategy highlights issues such as climate change, effective ways of saving water, sustainable uses of water, competition in the water industry and developing water resources on a local scale.

The Anglian Region Methodology can be seen as four steps. These are described as follows. Figure 6 shows the various components of the Groundwater Balance Methodology.

Step 1: The Available Groundwater Resource

The Gross resource is calculated using long term rainfall statistics with reference to catchment area and geology. If available, a calibrated computer model of the groundwater aquifer system is used. If not, a mathematical approach first presented by C.E. Wright in 1974 has been adopted in Anglian Region. Wright looked at the relationship between rainfall and infiltration of rainfall to the groundwater in a catchment (i.e. the inflows to the groundwater) compared to the river flow from the catchment (i.e. the outflows from the groundwater). He based his work in Norfolk in particular the catchments of the Rivers Nar and Ely Ouse. He devised a series of mathematical equations to describe the relationship. The equations can be seen in Appendix A8.2.1.

It is the practise in Anglian Region to reduce the Gross resource quantity by a percentage to reflect the fact that the groundwater aquifer system is not perfect in terms of it's ability to store water and make it available when it is needed. The percentage used depends on the type of aquifer and how fissured it is. The percentage used for Chalk aquifers is 20%, and this figure was originally obtained in the early 1980s. It is hoped that future computer models of the aquifers will provide a better understanding of the reliability of the groundwater resource and the need to make this adjustment from Gross to Available resource.

The quantity taken away from the Gross resource (i.e. 20%) is left for the environment and will probably contribute to rivers in wetter periods, but is not available for rivers during dry or drought periods.

Step 2: The Environmental Requirement for Water

Once the Available resource has been calculated, this is then divided between the Water Environment and Abstraction. Plates 5 to 8 show sites within the CAMS area, which make use of this "environmental water".

The Environment allocation is primarily based on the minimum flow requirements of the river. In other words, how much should be allowed to contribute to river flows. Ideally this quantity should be calculated using ecological studies which would quantify the needs of the aquatic life and habitats. Research into this aspect has been on the agenda for the Environment Agency for several years and studies have been undertaken in the Rivers Wissey and Babingley in Norfolk.

Figure 6 : Groundwater Balance Methodology

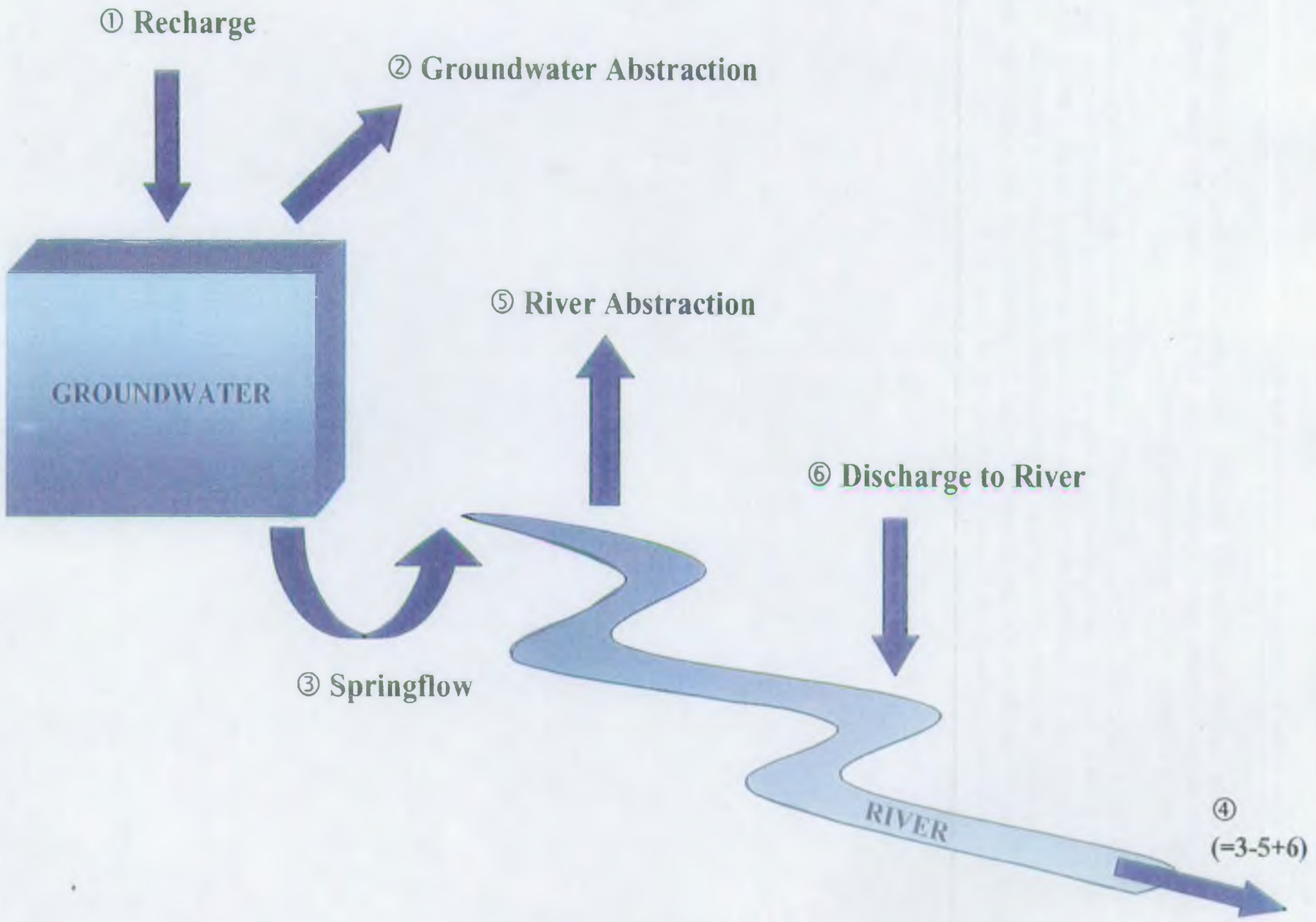


Plate 5: Hopton Fen, June 1999

Plate 6: Hopton Fen, June 1999

Plate 7: Langmere, November 1992

Plate 8: Langmere, June 1999

Without the ecological approach, the Environment allocation has been based on a flow statistic that is the "Naturalised 95 percentile". This is a low flow statistic calculated using historic records and describes a flow that would have occurred 95 % of the time in a period when there were no abstractions or discharges. In some cases, this low flow exceeds the flows experienced today as the catchment has been heavily developed with abstractions and discharges. In Anglian Region it is considered to be an acceptable flow for the river and has been reinforced by the ecological studies for the Rivers Wissey and Babingley.

In some catchments (but not the Little Ouse), an additional environmental allocation is made to prevent saline water intruding into the aquifers from estuaries.

The total quantity of water allocated to the river is:

- the contribution from the groundwater resource, that is the naturalised 95 percentile,
- the difference between the Gross and Available resource (which is the 20% mentioned in Step 1) and lastly, but probably more important during winter,
- rain which runs off the land directly contributing to river flow which occurs during periods of rainfall.

In practise, river flows are also sustained by effluent returns made to the river whether these are from sewage treatment works or industrial sites. These effluent returns are calculated using estimated flows from the works and estimated returns from licensed abstractions, for example 75% of water supplied for public consumption is assumed to return to the river but nothing is returned from abstraction made for spray irrigation. Where abstraction is made for export of water to other areas, this must be taken into account.

River flows are also affected by direct abstractions from them, and the quantity licensed for direct summer abstraction is included in the calculation for groundwater resources.

It should be noted that low flows in rivers are protected during drought situations by active management by the Environment Agency. Most licences describing direct abstraction from the river contain a cessation clause which links abstraction to a certain flow in the river. Therefore, during dry periods, if the river flow is reduced to a certain level then abstraction must cease. In addition, the Agency is able to control the quantity of water spray irrigated if river flows are adversely affected.

Step 3: Groundwater Abstractions

The calculation so far has produced an available groundwater resource and an allocation for the environment. The remaining quantity is thus, in theory, available for abstraction.

Water has been allocated for abstraction by the issue of abstraction licences since 1963 when the first legislation in this regard was passed. However, the available resource was not calculated in the present way until 1994. Therefore, in some catchments the quantity available for abstraction might be greater than the licensed

quantity, which is a satisfactory situation. However the reverse may be true where there is insufficient resources to meet the needs of the licensed abstractions. In this latter case, the actual situation may be satisfactory if not all the licensed allocation is actually being used. One of the issues that will be addressed in this document is the mechanisms that the Agency will adopt to try and address any in-balance between water available for abstraction and that allocated for abstraction.

The quantity taken for licensed abstraction does not include the water licensed for raw water transfer in particular the water allocated to the Great Ouse Groundwater Scheme (see Appendix A9.1.4), which allows abstraction from boreholes for discharge to rivers for subsequent transfer to meet public water supply needs. Plates 9 and 10 show an example of one of the Groundwater Scheme boreholes, and one of the river discharge points. The current policy allows abstraction which provides overall benefit to the environment. This type of abstraction would not be counted as "abstraction" in terms of the resource balance, but would be part of the "environmental allocation".

Step 4: The Groundwater Resource Balance

The groundwater balance for a catchment can, therefore, be calculated as follows:

The *available resource* minus the *environment allocation* (taking into account abstractions from and effluent returns to the river) minus the quantity licensed for *groundwater abstraction*.

The balance will show the catchment to be in surplus, equal (fully committed) or in deficit.

3.4 The Groundwater Resource and Sustainability Status of the Groundwater Resource for the Little Ouse Groundwater Unit

Table 5 below identifies the groundwater resource surplus or deficit for the whole of the groundwater unit and the appropriate sustainability category. The assessment has been made comparing the surplus/deficit with the Gross resource.

The Anglian method identifies the CAMS area groundwater resource to have a **deficit of 3.63 tcmd**. In terms of the sustainability category described in section 3.1 this would make the area orange or red. Extra analysis has been undertaken to compare the actual quantity of water abstracted to the deficit figure. The total quantity of water licensed for abstraction is 81.53 tcmd. However only 43.09 tcmd was abstracted in 1993. Therefore the Little Ouse CAMS area is shown to be category sustainability **ORANGE**

Table 5: Little Ouse Groundwater Sustainability Status

Area	Gross Resource (tcmd)	Surplus or Deficit (tcmd)	Sustainability Status
Whole Unit	263.44	- 3.67	Orange

Plate 9: Great Ouse Groundwater Scheme Borehole No 60, November 1992

Plate 10: Augmentation of the Larling Brook from Borehole No 60, November 1992

4. ABSTRACTION LICENCE POLICIES: WHAT THEY ARE AND WHERE THEY APPLY

4.1 Introduction

As discussed in section 3.2 and 3.4, the sustainability category for this CAMS area has been assessed as orange. From Table 1 this means that groundwater resources and summer surface water resources are fully allocated to existing users and the environment, and that in general surface water during the winter is available for new abstraction.

The following section outlines the licensing policies which apply for this area, and which will be used by the Agency when considering an application to abstract water. The policies are divided into 3 sections: -

1. Abstraction from **surface water** (rivers, lakes, ponds, ditches, streams) in the **non fenland** parts of the CAMS area. This is shaded blue on Figure 7.

2. Abstractions from **surface water in the fenland** parts of this CAMS area. This is shaded green on Figure 7.

3. Abstraction from **boreholes or wells anywhere** in the groundwater unit underlying this CAMS area. This is shown shaded green on Figure 4.

The policies for each of these sections are also split between summer and winter. In this CAMS area, "summer" and "winter" are normally defined as:

Summer: 1st April – 31st October
Winter: 1st November – 31st March.

The policies are each divided into 3 main sections, and indicated by icons as shown below: -

Resource availability – This identifies whether there is water available for new licences, and indicates the policies for renewing and varying current licences.

Time limits – this indicates the likely length of time that a licence will be issued for, according to the use of the water.

Cessations – this indicates the likely cessation conditions that will be applied to the licence in order to protect the water environment at times of low flow.

Table 6 below shows the main categories of policy, and can be used to determine which policy is relevant to a particular enquiry. For example, if an abstraction is required from the River Thet in winter then section 4.2 and 4.3.2 is relevant.

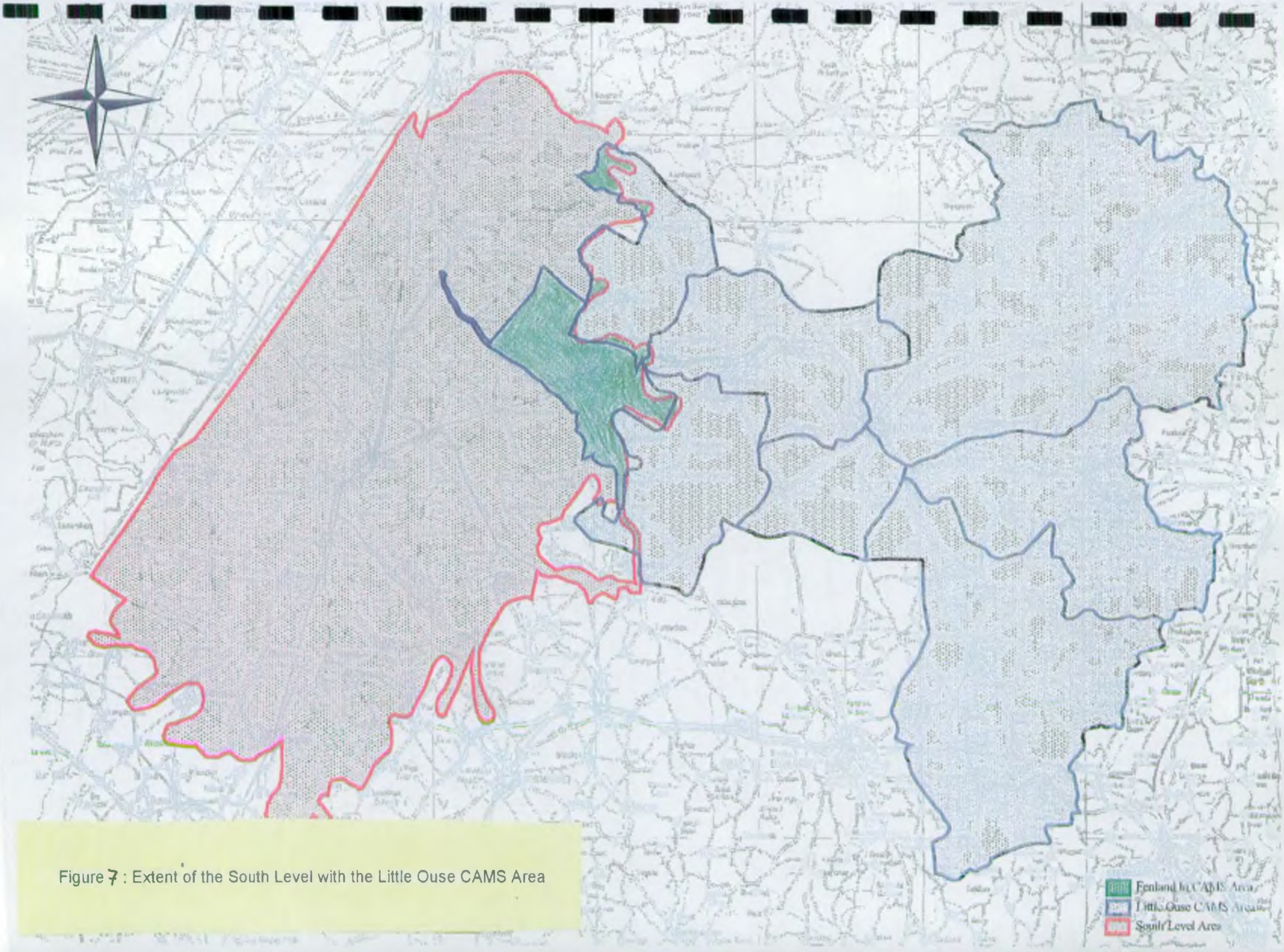


Figure 7 : Extent of the South Level with the Little Ouse CAMS Area

Table 6: Policy Table

Source	Period of Abstraction	Policy Section
Rivers, ponds, lakes, ditches , streams in the non fenland area of the map (shaded blue in figure 7)	Summer (1st April – 31st October)	4.2 and 4.3.1
	Winter (1st November – 31st March).	4.2 and 4.3.2
Rivers, ponds, lakes, ditches , streams in the fenland area of the map (shaded green in figure 7)	Summer (1st April – 31st October)	4.2 and 4.4.1
	Winter (1st November – 31st March).	4.2 and 4.4.2
Boreholes and wells into the chalk aquifer	Summer or winter	4.2 and 4.5.1
Boreholes and wells into all other water bearing rocks such as gravels.	Summer or winter	4.2 and 4.5.2

4.2 Additional Licencing Policies that apply to the CAMS Area

4.2.1 Sections 4.2 to 4.6 outline the licensing policies for surface waters and groundwater. The reader should refer to the NAMS document for general information about granting an abstraction licence. In general, where the sustainability category is orange, no additional groundwater or summer surface water will be licensed. However, the Agency does recognise certain exceptions and will allow an abstraction licence in the following circumstances.

- **Small Isolated Abstractions**

The Agency may consider applications for small quantities where the abstractor has **no alternative supply** (such as mains water). The Water Resources Act 1991 makes the exception for abstractions for domestic or household use if they are less than 20 m^3/day. The Agency has extended this concept to apply to all uses for up to 20 m^3/day and 5000 m^3/year, and refers to this as "de-minimis" quantities.

- **Abstractions where most of the water is returned to the source of supply after use**

New abstractions for predominantly non-consumptive uses may generally be allowed, subject to consideration of local effects. Where a very high proportion (95% or more) of the water is returned to the source of supply upstream or immediately downstream of the point of abstraction, a licence will normally be granted provided that any by-passed stretch of channel is adequately protected against low flows. Where overall losses exceed de-minimis quantities, a licence is unlikely to be granted.

- **Schemes that provide overall benefit to the environment**

New abstractions which are part of an arrangement which provides overall net benefit to the environment may also be generally be considered, but these will be considered on a case by case basis.

4.2.2 There may also be other reasons why a licence cannot be granted in accordance with the general licensing policies, or that different procedures must be followed. Some of these are listed below:

- **Justification of Need**

The Water Resources Act 1991 requires the Agency to have regard to the "reasonable requirements" of applicants, and there is a basic presumption to meet such requirements if possible. The Agency therefore assesses licence applications to check that the amount of water that is being applied for is reasonable and fully justified.

This means that if the Agency considers that a licence application is for an unreasonable volume of water for the stated purpose, or that the quantities applied for are not sufficiently justified, the licensed quantities could be reduced to quantities deemed reasonable.

- **Specific Impacts on Protected Rights**

It is illegal to issue a licence which derogates a protected abstraction right, except with the consent of the derogated party. Derogation means the practical inability to obtain the quantities licensed, but not a slight reduction in reliability, or a slight increase in costs associated with abstraction.

This means that all licence applications are subject to a full technical assessment of the impacts on other rights to abstract in the area. Therefore, even if, in general, there is water available for new abstraction in the catchment, if the proposed abstraction will cause derogation, and no consent is given, the licence quantities applied for could be reduced, or the licence application could be refused altogether.

- **Impacts on rivers and Wetlands**

The Agency has a duty to avoid adverse effects of abstraction on river flows, springheads, wetlands, meres and fens. This means that even if, in general, there is water available for new abstraction in the catchment, if the technical assessment demonstrates that a proposed abstraction will have an unacceptable effect, the licensed quantities / abstraction rates may be reduced. Alternatively the licence may be issued with conditions such as cessation clauses or compensation flows, or the licence could be refused.

There are a number of wetland sites in the CAMS area, in particular a number of important sites designated as SSSI. Table 27 in the Appendix gives a list of the wetland SSSI in the area. The table also shows that a number of these sites are also designated as SAC's or SPA under the Habitats Directive. The Habitats Directive (92/43/EEC) became law in Britain in 1994 with the introduction of the Conservation Regulations 1994 (Statutory Instrument no: 2716, Section 48). The purpose of the Directive is to restore or maintain favourable conservation status, natural habitats and species of wild fauna and flora of community interest, and applies to Special Protection Areas (SPA) and Special Areas of Conservation (SAC's). Government and Agency policy is to treat candidate and proposed sites, and Ramsar sites in the same way as designated European sites.

The Agency is the 'competent authority' for abstraction licensing. In practice this means that the Agency follows additional formal procedures when determining licence applications within the vicinity of a European site.

This means that in some cases the Agency will be unable to grant an abstraction licence in the vicinity of these sites, because the Habitats Directive adds another specific procedure over and above the normal licensing process. Table 7 shows the Wetlands Habitats Directive sites that are water dependent within the Little Ouse CAMS area: -

Table 7: Wetland Habitats Directive sites in the CAMS Area

SAC/SPA Site Name and SSSI included	National Grid Reference
Breckland SAC	
East Wretham Heath	TL 910 882
Norfolk Valley Fens SAC	
Swangey Fen	TM 015 932
Thompson Water, Carr and Common	TL 930 955
Little Ouse Valley Fens SAC	
Redgrave and Lopham Fens	TM 050 797
Blo'Norton and Thelnetham Fens	TM 017 790
Weston Fen *	TM 981 787

There are 14 other Habitats Directive Sites in the CAMS area that are not water dependant

4.3 Licensing Policy for abstraction from Non-Fenland surface water (blue on Figure 7)

4.3.1 Summer licensing policies (1st April to 31st October)

The sustainability category for the Little Ouse CAMS area is orange, therefore summer water is fully committed to existing abstractors and the water environment in all surface water catchments. The Agency is unlikely to recommend the issue of any licences for new summer abstractions. (See exceptions in Section 4.2.1).

The Agency will consider renewals of existing entitlements and variations with no increase in daily or annual quantities. However, applications are subject to a full technical investigation of the impacts. If granted, a replacement licence will normally contain conditions and will be time limited.

Minor increases to the hourly rate can be considered where the daily rate is sufficient to allow a practical period of abstraction to take place.

Time limits reflect the complexity of proposals and in general, the following time limits are applied: -

1. A **spray irrigation** licence would normally be issued for 10 years.
2. A **public water supply** licence would normally be issued for 10 years.
3. A licence for **industrial use** would normally be issued for 10 years.

Table 8 shows the standard cessation conditions (flows and levels used in licences to control abstraction during periods of low flows) that are applied to summer surface water abstraction in this CAMS area. The table also details where these conditions are applied, which surface catchment they are applied in, and where or what they are designed to protect. There is also an indication of the statistical average number of days per summer that the river flow or level would fall below the stated threshold, and therefore the number of days the cessation condition is likely to be enforced.

For example, a licence to abstract during the summer from the River Sapiston in catchment 41 would normally contain a condition stating that no abstraction would occur if the flow in the river at Rectory gauging station (at NGR TL 895 790) falls below 84 litres per second. The table also shows that on average, we would expect the flow to fall below 84 litres per second on 15 days of the summer season (1st April to 31st October).

Since 1992 the Agency has included the Denver Combined Flow Clause to all new and varied licences within the CAMS area. The following paragraphs explain why the clause was introduced.

During the drought period 1989 - 1992 there were surface water problems in the South Level Fenland System. There were particularly high temperatures resulting in high evaporative loss and spray irrigation demand. Water demand outstripped the supply from the Chalk upland, the outflow at Denver ceased and levels in the Ely Ouse reduced. As a result all surface water spray irrigation was banned for the rest of the summer until substantial rainfall occurred.

Analysis of the drought indicated that a method of controlling the high Fenland demand for water was needed, and therefore a decision was made to apply the Denver Combined Flow Clause to all surface water new or renewed licences. In addition to the specific flow conditions there is a clause which provides for "at the direction of the Agency" so that there can be flexibility in the application of the cessation to suit the particular circumstances

It should also be noted that there may be other "non standard" cessation conditions placed on individual licences on a case by case basis.

Table 8: Standard Summer Surface cessation conditions

Name	Watercourse	Where the clause is applied	Area clause protects	Flow / Level	% of time on average that flow is exceeded	Average no. of days restricted during the 214 day season
Denver Combined Flow	Ely Ouse and Cut Off Channel at Denver Sluices	Applied to all surface licences in the Ely Ouse system	Flows to tide, and the environment in the Ely Ouse system	1.3 m^3/s *	Not Available.	Not Available
Rectory	Sapiston (TL 895 790)	All surface water abstractions in catchment 41	River Sapiston and tributaries	84 l/s	93	15
County Bridge Euston	Little Ouse (TL 892 801)	Surface licences in catchment 42 between Euston GS and Knettishall GS	River Little Ouse and any tributaries between Euston GS and Knettishall GS	94 l/s	88	26
Bridgham	Thet (TL 957 855)	Catchment 44 - surface licences from the Thet and tributaries between Redbridge GS and the confluence with the Little Ouse	River Thet between Redbridge GS and the confluence with the Little Ouse.	350 l/s	95	11
Redbridge	Thet (TL 966 923)	Catchment 44 – River Thet and tributaries upstream of Redbridge GS	River Thet and tributaries upstream of Redbridge GS	145 l/s	88	26
Stonebridge	Larling Brook (TL 910 875)	Catchment 44 – all surface licences from the Larling Brook.	Larling Brook	20 l/s	65	75

* Between 1st March and 31st August. (For 1st September to last day of February, the cessation flow is 3.68 m^3/s)

4.3.2 Winter Licensing Policies (1st November to 31st March)

The sustainability category for the CAMS area is orange, therefore water is generally available during the winter period and abstractors are encouraged to store water in reservoirs for summer use.

Time limits reflect the complexity of proposals and in general, the following time limits are applied: -

1. A licence for **filling a reservoir with direct use from the reservoir in the summer** will normally be granted for 25 years.
2. A licence that involves **filling a reservoir in the winter, and then during the summer discharging water back into the river, and re-abstracting it remotely** is normally granted for a period of 25 years for the winter filling aspect, and 10 years for the re-abstraction aspect.
3. For schemes that are **more complex** or where the effects of abstraction cannot be determined, other time limits may apply

There are also some other basic principles that are applied to winter abstraction licences which involve discharge in the summer and remote re-abstraction: -

Discharge and re-abstraction requires a 10% compensatory factor. This means that the Agency will only allow re-abstraction of 90% of the volume of water that was discharged. The 10% reflects the fact that both abstraction and re-abstraction will be metered and errors of measurement could be up to 5%.

An example of this would be if an abstractor discharged 100 000 cubic metres of water from the reservoir, they would only be permitted to re-abstract 90 000 cubic metres.

Table 9 shows the standard cessation conditions (flows and levels used in licences to control abstraction during periods of low flows) that are applied to winter surface water abstraction in this CAMS area. The table also details where these conditions are applied, which surface catchment they are applied in, and where or what they are designed to protect. There is also an indication of the statistical average number of days during the winter period, that we would expect the river flow or level to fall below the stated threshold, and therefore the number of days the cessation condition is likely to be enforced.

For example, a licence to abstract during the winter from the River Sapiston in catchment 41 would normally contain a condition that states that no abstraction would occur if the flow in the river at Rectory gauging station (at NGR TL 895 790) falls below 120 litres per second. The table also shows that on average we would expect the flow to fall below 120 litres per second on 5 days of the winter season (1st November to 31st March).

It should be noted that there may be other "non standard" cessation conditions placed on individual licences on a case by case basis.

Table 9: Standard Winter Surface cessation conditions

Name	Watercourse	Where the clause is applied	Area clause protects	Flow / Level	% of time on average that flow is exceeded	Average no. of days restricted during the 151 day season
Denver Combined Flow	Ely Ouse and Cut Off Channel at Denver Sluices	Applied to all surface licences in the Ely Ouse system	Flows to tide, and the environment in the Ely Ouse system	3.68 m^3/s	Not Available	Not Available
Rectory	Sapiston (TL 895 790)	All surface water abstractions in catchment 41	River Sapiston and tributaries	120 l/s	97	5
Bridgham	Thet (TL 957 855)	Catchment 44 - surface licences from the Thet and tributaries between Redbridge GS and the confluence with the Little Ouse	River Thet between Redbridge GS and the confluence with the Little Ouse.	580 l/s	96	6
Redbridge	Thet (TL 966	Catchment 44 –	River Thet and	290 l/s	92	12

	923)	River Thet and tributaries upstream of Redbridge GS	tributaries upstream of Redbridge GS			
Stonebridge	Larling Brook (TL 910 875)	Catchment 44 – all surface licences from the Larling Brook.	Larling Brook	20 l/s	83	26

Between 1st September and last day of February. (For 1st March to 31st of August, the cessation flow is 1.3 m^3/s)

4.4 Licencing Policy for Abstraction from Fenland Areas (red on Figure 7)

The licensing policies described below apply to the whole of the South Level Fenland area, not just that part in the Little Ouse. This is because the South Level is a distinct unit with distinct licensing policies.

The South Level is an area of low-lying fenland where water resources are extensively managed. Ground level is below sea level in many places, and drainage of the land is managed by Internal Drainage Boards (IDB`s). During wet periods water needs to be pumped out of the low-level drains and up into the higher level rivers. In drier periods water is let into the fen areas from the higher level river via slackers and pumps. Some fenland areas also have significant springflow inputs.

Licensing policies have been developed specifically for abstraction from the South Level because of the different water resource management, and because this area has a very high demand for water for spray irrigation. The following section therefore outlines the policies.

4.4.1 Summer Licensing Policies (1st April to 31st October)

The general policies the outlined in Section 4.3 also apply to the South Level.

As the sustainability category for the area is orange, there is a moratorium on new summer water, pending a review of the quantities currently licensed, the needs of the water environment and other water users, and an investigation into the way in which the system functions.

The Agency will consider renewals of existing entitlements and variations with no increase in daily or annual quantities. However, applications are subject to a full technical investigation into the impacts. If granted, a replacement licence will normally contain cessation conditions and will be time limited.

Although the South Level is considered as a pond in terms of resource policy, there are certain areas within the system, where additional abstraction could not be supported. Therefore, for variations that do not involve an overall increase in quantities, but involve moving abstraction to new areas, the IDB is always consulted, and it may be that an application cannot be granted.

Particularly sensitive areas as follows: -

Grunty Fen (Littleport and Downham IDB)

Lakenheath IDB (part)
Mildenhall IDB (part)
Swaffham IDB
Middle Fen and Mere (part)
Waterbeach IDB (part)

Minor increases to the hourly rate can be considered where the daily rate is sufficient to allow a practical period of abstraction to take place.

Time limits reflect the complexity of proposals, and in general the following time limits are applied: -

1. A **spray irrigation** licence would normally be issued for 10 years.
2. A **public water supply** licence would normally be issued for 10 years.
3. A licence for **industrial use** would normally be issued for 10 years.

Table 10 shows the standard cessation conditions that are applied to "flowing" rivers and fenland drains and ditches in the South Level Area. Table 11 shows the standard cessation conditions that are applied to abstraction from the "ponded" fenland drains and ditches in the summer. It should be noted that the conditions in Table 10 are also applied to the ponded drains and ditches in the fenland. The tables also detail where these conditions are applied.

For example, summer abstraction in Middle Fen and Mere IDB from drains sourced from the Soham Lode would be subject to a cessation flow of 112 litres/second as measured at Fordham gauging station located at TL 631 703.

It should be noted that these cessation levels are distinct from the cessation levels applied to abstraction from the high-level river system. The clauses vary from time to time, so the Agency always consults with the relevant IDB about the appropriate clause. It is also sometimes necessary to devise an individual cessation condition for a localised situation, and this is done on a case by case basis.

Table 10: Standard Summer Cessation Conditions for all South Level Fenland Areas

Name	Watercourse	Where the clause is applied	Area clause protects	Flow / Level	% of time on average that flow is exceeded	Average no. of days restricted during the 214 day season
Denver Combined Flow	Ely Ouse and Cut Off Channel at Denver Sluices	Applied to all surface licences in the Ely Ouse system	Flows to tide, and the environment in the Ely Ouse system	1.3 m^3/s *	Not Available	Not Available

*Between 1st March and 31st August. (For 1st September to last day of February, the cessation flow is 3.68 m^3/s)

Table 11: Standard IDB Cessation Conditions

Name	IDB and NGR of control point	Where the clause is applied	Area clause protects	Flow / Level
100 Foot Pumping Station	Littleport and Downham (TL 508 891)	Drains sourced from the 100 Foot River	IDB drain levels	97.25 m SLD
Catsholme	Southery and District (TL 683 970)	All drains in the IDB	IDB drain level	98.2 m SLD
Southery	Southery and District (TL 612 932)	All drains in the IDB	IDB drain level	97.3 m SLD
Lakenheath Poors Fen SSSI	Lakenheath (TL 7007 8285)	Drains upstream of the dam	Lakenheath Poors Fen SSSI	99.8 m SLD
Ten Mile Pumping Station	Littleport and Downham (TL 606 940)	Drains sourced from the Ely Ouse	IDB drain levels	96.8 m SLD
Fordham	Middle Fen and Mere (TL 631 703)	Drains sourced from Soham Lode	Flows in the Soham Lode / River Snail	112 l/s
Pashford Poors SSSI	Lakenheath (TL 7364 8370)	Drains upstream of the dam	Levels in Wangford Drain and Pashford Poors SSSI.	2.4 m AOD
Wangford Drain	Lakenheath (TL 727 848)	Drains upstream of the dam at TL 7364 8370.	Levels in Wangford Drain	101.384 m SLD

4.4.2 Winter licensing policy (1st November – 31st March)

Water is generally available during the winter period and abstractors are encouraged to store water in reservoirs for summer use.

Time limits reflect the complexity of proposals and in general, the following time limits are applied: -

1. licence for **filling a reservoir with direct use from the reservoir in the summer** will normally be granted for 25 years.
2. A licence that involves **filling a reservoir in the winter, and then during the summer discharging water back into the river, and re-abstracting it remotely** is normally granted for a period of 25 years for the winter filling aspect, and 10 years for the re-abstraction aspect.
3. For **more complex** schemes or where the effects of abstraction cannot be determined the time limit may be less such as 5 years, for example if a period of monitoring is required, or where several transfers are necessary.

Table 12 shows the standard cessation conditions that are applied to abstraction from fenland drains and ditches in the winter. The Denver Clause is also applied to flowing rivers in the fenland areas. The table also details where these conditions are applied, which surface catchment they are applied in, and where or what they are designed to protect. There is also an indication of the statistical average number of days during the winter period, that we would expect the river flow or level to fall below the stated threshold, and therefore the number of days the cessation condition is likely to be enforced.

It should be noted that there may be other "non standard" cessation conditions placed on individual licences on a case by case basis.

Table 12: Winter Cessation Conditions for all South Level Fenland Areas

Name	Watercourse	Where the clause is applied	Area clause protects	Flow / Level	% of time on average that flow is exceeded	Average no. of days restricted during the 151 day season
Denver Combined Flow	Ely Ouse and Cut Off Channel at Denver Sluices	Applied to all surface licences in the Ely Ouse system	Flows to tide, and the environment in the Ely Ouse system	3.68 m^3/s *	Not Available	Not Available

* Between 1st September and last day of February. (For 1st March to 31st of August, the cessation flow is 1.3 m^3/s)

There are also some other basic principles that are applied to winter abstraction licences which involve discharge in the summer and remote re-abstraction.

1. **Discharge and re-abstraction requires a 10% compensatory factor**. This means that the Agency will only allow re-abstraction of 90% of the volume of water that was discharged. The 10% reflects the fact that both abstraction and re-abstraction will be metered and errors of measurement could be up to 5%.
   An example of this would be if an abstractor discharged 100 000 cubic metres of water from the reservoir, they would only be permitted to re-abstract 90 000 cubic metres.
2. In the **fenland areas, discharge and re-abstraction in the same ponded drain level** in the Internal Drainage Board also requires a 10% compensatory factor (Except for totally isolated situations).
3. Where re-abstraction is **remote** i.e. in non-directly sourced areas but is sourced by slackers, discharge must be made to adjacent main river.
4. Where **non-directly sourced areas occur**, licence conditions are included to control re-abstraction.

An example of this would be when slacker use is restricted or where dams may restrict movement of water. In these situations a transfer of water may be applicable with additional compensation factors.
In general the Agency considers the South Level rivers as one large "pond", so discharge anywhere into the high level river system will support a re-abstraction anywhere else on the high level river system (subject to the 10% compensation factor). However, there are some exceptions to this, where it is unlikely that the Agency would grant re-abstraction without a compensatory discharge made **upstream** of the re-abstraction point, and within the South Level boundary. These are: -

1. Bottisham Lode – upstream of gates
2. Swaffham Bulbeck Lode – upstream of gates
3. Reach Lode system – upstream of gates
4. Soham Lode – upstream of gates
5. Cottenham Lode – upper reaches (above pond level)
6. Willingham Lode – upper reaches (above pond level)
7. Lee Brook

8. For any other minor tributaries, backwaters and catchments the situation is assessed on a case by case basis.
9. Cut Off Channel (which forms the rough boundary of the South Level area) – anywhere (discharge and re-abstraction within the Cut Off Channel is acceptable)

Source Areas - the South Level is complex because the fen is sourced from a number of different river systems as well as from water flowing from springs and run-off of rainwater across the land. Therefore, licensing policies such as cessation clauses will vary depending on the source.

4.5 Licencing Policy for Abstraction from Boreholes and Wells

The following section details the groundwater licensing policies that currently apply to the CAMS area. It has been divided into boreholes and wells abstracting water from the Chalk and boreholes and wells abstracting from other aquifers (water bearing rocks).

4.5.1 Abstraction from boreholes and wells in the Chalk for summer (1st April to 31st October and) and winter (1st November to 31st March)

The sustainability category for the CAMS area is orange. The groundwater resources of the Chalk aquifer are fully committed to the water environment and existing abstractors, so there is no additional water available for abstraction from the Chalk.

Renewals of existing entitlements and variations with no increase in daily or annual quantities can be considered, but are normally subject to a full technical investigation of the impacts. If granted a renewal is normally subject to conditions and is normally time limited.

Minor increases to the hourly rate can be considered where the daily rate is sufficient to allow a practical period of abstraction to take place.

Time limits reflect the complexity of proposals, and in general, the following time limits are applied: -

1. A **spray irrigation** licence would normally be issued for 10 years.
2. A **winter storage** licence would normally be issued for 25 years.
3. A **public Water Supply** licence would normally be issued for 10 years
4. A licence for **industrial use** would normally be issued for 10 years.
5. A licence **within 5km of the Breckland Meres** would normally be issued for 5 years.

There is a special cessation clause for some groundwater abstractions within 5km of the Breckland Meres. The meres are located in an area 6km north east of Thetford. Most of the meres are SSSI and they also form part of the Breckland candidate Special Area of Conservation. They are unique series of water bodies, influenced by the chalk groundwater. Figure 8 shows the location of the meres, and the 2 km and 5 km Breckland Mere zones (see below for further details).

The Agency imposes a cessation condition on local groundwater abstractors to protect the meres. The cessation clause refers to the water level, as measured in Ringmere, and states that no abstraction may take place when the level on the gauge board at Ringmere is equal to or less than 27.5 mAOD.

In addition, the area around the meres is divided into two "zones" for which policy is different. In general the following policies are applied, but each proposal is considered on a case by case basis.

1.Within **2km of the meres (zone 1)**: no abstraction will be permitted that potentially results in the level in the nearest groundwater sensitive mere being reduced by more than 5 cm. For abstractions that will cause a loss of level of less than 5cm, the Ringmere cessation level of 27.5 m AOD will be applied.

2. Between **2km and 5 km of the meres (zone 2)**: abstraction that potentially results in a loss of level of over 5 cm is permitted, but licences will be subject to the Ringmere cessation level of 27.5 m AOD.

4.5.2 Abstraction from boreholes and wells in other aquifers for summer (1st April to 31st October and) and winter (1st November to 31st March)

Applications for groundwater abstraction from "minor" aquifers such as sands and gravels within the CAMS area are treated on a case by case basis. Individual technical assessments are made on proposals to assess the nature of the aquifer, and the impacts of the abstraction. In some cases, if the aquifer is in direct contact with a local river or other surface water, then the relevant surface water policy will be followed.

Time limits will be applied on a case by case basis.

Cessation conditions are applied as appropriate.

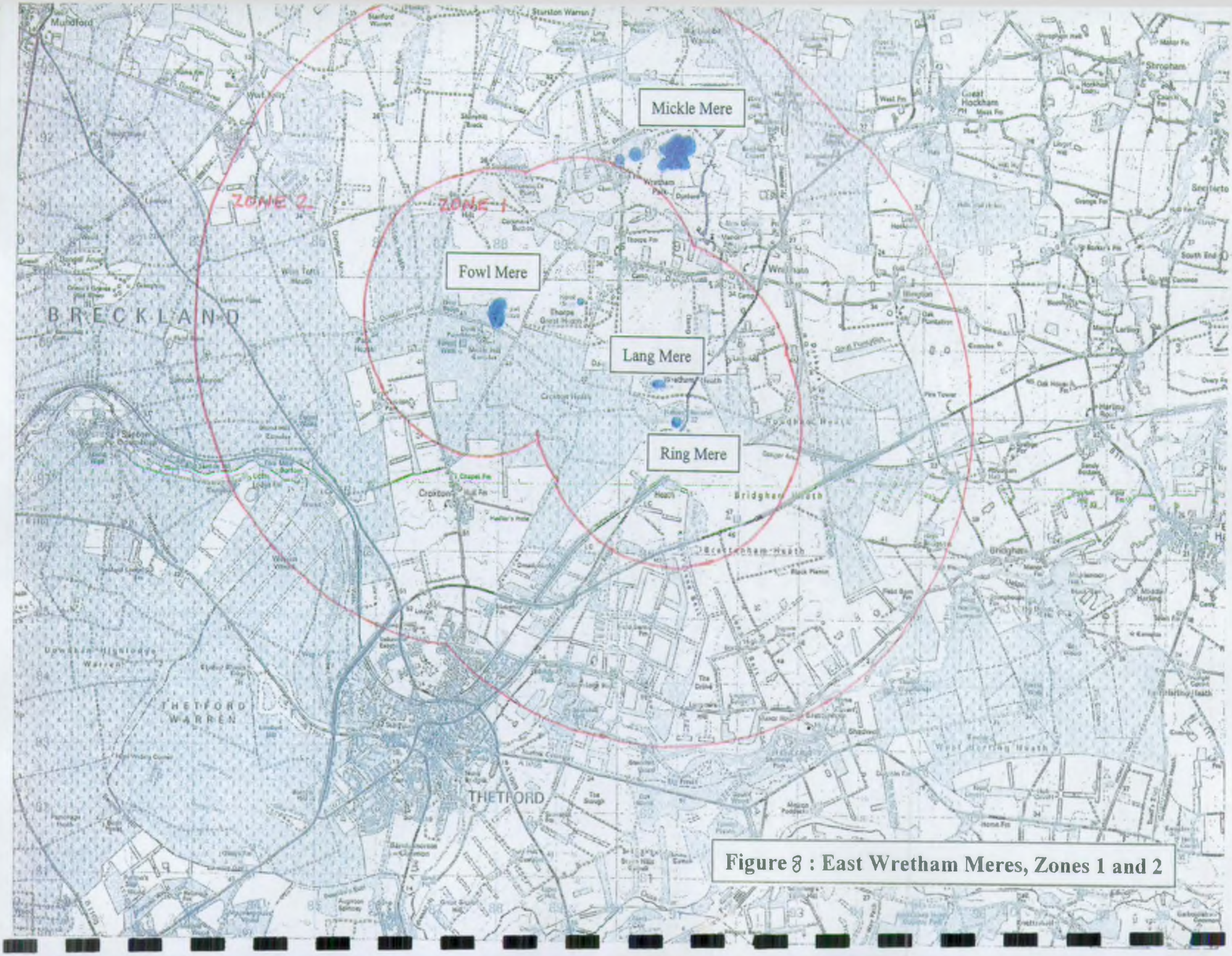


Figure 8 : East Wretham Meres, Zones 1 and 2

4.6 Drought Policy

Drought policies are detailed in the Regional Drought Plan, which is periodically updated as drought experiences change. For spray irrigation, information about drought actions is detailed in the Environment Agency leaflet "Prospects for spray irrigation: Making every drop count."

Historically spray irrigation restrictions, either voluntary or formal (through the use of Section 57 of the water resources Act), have been needed through the drought conditions. Surface water abstractions between the Great Ouse Groundwater Scheme discharge points (see Figure 28) and the transfer at Hockwold are classed as supported sources. These have historically been excluded from drought restrictions.

5. FUTURE STRATEGIES AND PROPOSED ACTIONS

5.1 Introduction

Sections 3 and 4 of this report have described how the water resource is calculated, and the present licensing policies. The Agency recognises that there is a need to change and improve the way we assess and allocate water for abstraction. The consultation document for the National Water Resources Strategy document published in 1999 highlighted the need for change, and raised several issues for discussion. The Government has also promised to review the legislation concerning water resources and following an extensive consultation exercise led by the Department of Environment, change is expected in 2002, or when parliamentary time allows.

This section outlines what future changes for this CAMS area will happen, and in particular what this means for present abstraction licence holders and those who wish to apply for a licence.

5.2 Aspirations

The Agency has two main aspirations with respect to water resource planning, and they are:

1. Aspiration to identify the water resource using the best technique available

2. Aspiration to manage the water resource in the most effective way

These aspirations have always underlined the work carried out by the Agency with respect to water resources planning and management.

This section looks at each aspiration and outlines the proposed strategies and activities the Agency has identified to carry these aspirations forward for the next six years.

The text has been coded with symbols and colours. The Aspirations are shown in a **rectangle.** The first aspiration, to identify the water resource using the best technique available, has been coded blue. The second aspiration, to manage the water resource in the most effective way, has been coded yellow. Under each aspiration are several strategies shown in a **hexagon,** and under each strategy are several activities in a **diamond** together with their associated advantages and disadvantages.

Figures 9 and 10 shows how the symbols:

relate to each other, and how the Agency will thus work toward fulfilment of the overall aspirations.

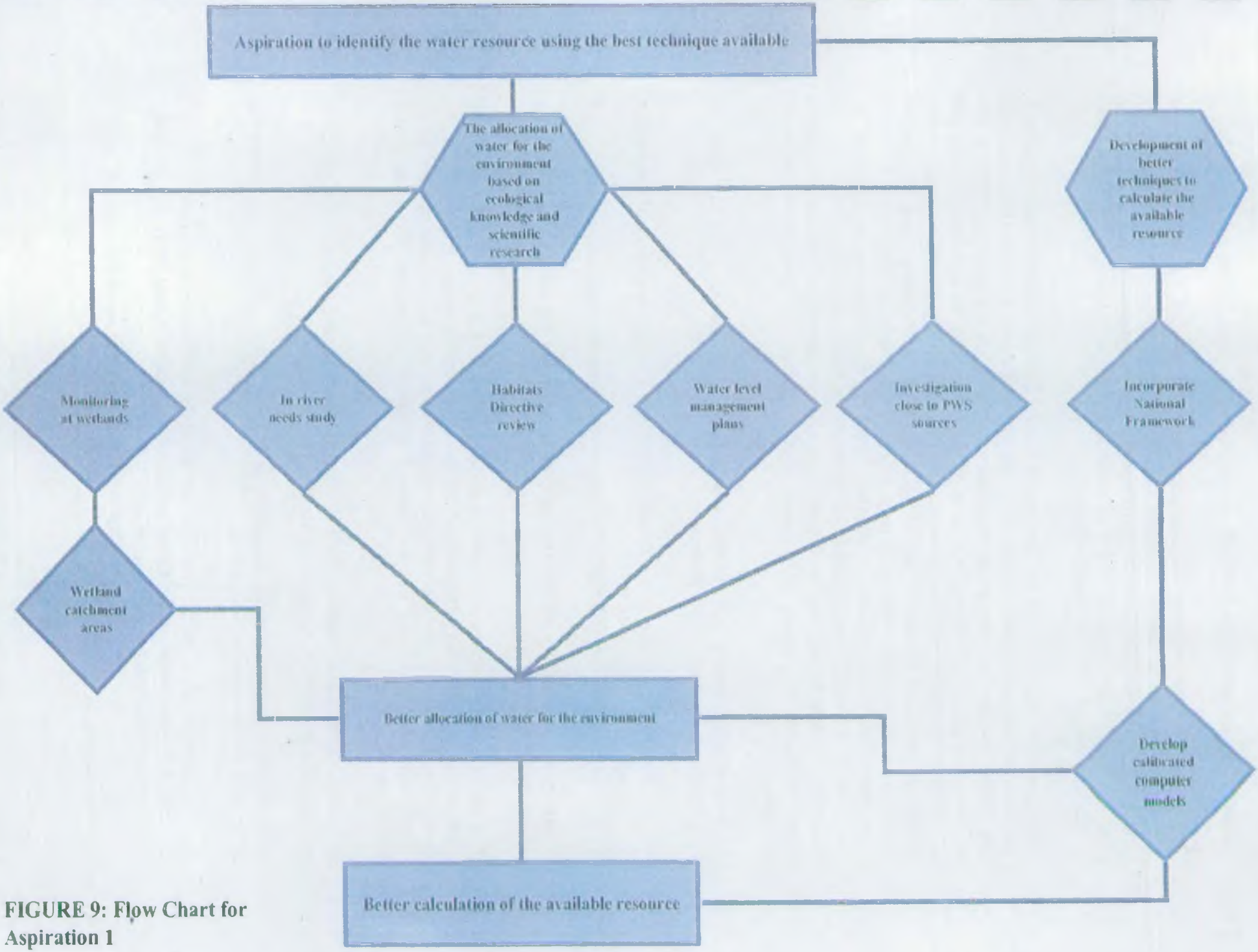


FIGURE 9: Flow Chart for Aspiration 1

5.3 Aspiration to Identify the Water Resource using the Best Technique available

The present system of water resource calculation and allocation is well tested. It has achieved a reasonable balance between the needs of the abstractors, whether they are public supply water companies or farmers who need to spray irrigate vegetables, and the water environment in the form of river and wetland habitats and the flora and fauna they sustain. So why change things?

The recent drought years caused the Agency to be a focus for concern that our policies were not robust and did not provide for a sustainable balance between abstraction and the water environment for future generations. The need for water in East Anglia continues to grow with more people needing more water in the home and in all types of industry including farming. People require higher standards of living and better quality of food and this can be expensive in terms of water supply. There is also the uncertainty about climate change, which is predicted to mean wetter winters and drier summers. The water environment whether, in the rivers or wetlands, is important for the diversity of wildlife and needs to be protected for future generations to enjoy. The knowledge about habitat and the dependant species has increased and research about better policies to protect sites from adverse effects of abstraction must be incorporated.

Therefore, the Agency accepts that our policies will change. Our strategies to accomplish this aspiration are given as:

- Strategy to allocate water for the environment based on ecological knowledge and scientific research
- Strategy to develop better techniques to calculate the available resource

5.3.1 Strategy to allocate water for the environment based on ecological knowledge and scientific research

The Environment Agency is unable to issue any abstraction licence that allows any abstraction which would adversely affect the water environment. Every application for abstraction is examined and the quantity authorised may be less than applied for or conditions are introduced on the licence in order to protect the local water environment.

In terms of the whole balance for the whole catchment, the Agency also allocates some of the available water resource for the water environment.

The Anglian Region method described in Section 3.3.1, allocates the following quantities for the water environment:

1. The contribution from the groundwater that is the naturalised 95 percentile,
2. The difference between the Gross and Available resource, and lastly, but probably the most significant during winter,
3. rain which runs off the land directly contributing to river flow which occurs during periods of rainfall.

The strategy to improve the allocation of water for the environment has several facets. Table 13 below summarises the activities together with the associated advantages and disadvantages.

Promote "In River Needs" Study: A future activity would be to allocate water according to the type of habitat, water quality needs and recreation aspects such as navigation and fishing that occur in the locality. In other words, to ensure that these aspects in the catchment are sustained to their appropriate level. In terms of navigation this could be a necessary depth of water whereas to support a population of trout there may need to be stretches of clean gravel. Research into this aspect has been made in recent years and studies (known as "In River Needs" studies) have been undertaken in the Rivers Wissey and Babingley in Norfolk. The next step would be to review the research undertaken to date and recommend the way forward.

Identify Wetland Catchment Areas: The protection and enhancement of important wetland sites is essential. Individual applications for water are assessed to ensure that the proposed abstraction will not cause an adverse effect to a wetland site. In addition, the Agency has aspired to identify areas surrounding wetlands in which abstraction would not be permitted in order to protect the sites. This concept has been difficult to achieve as many wetland sites derive their water in a complex way, and in most cases from a combination of rainfall runoff, seepage through soils and underground layers of saturated rock. However, the aspiration still remains and various initiatives such as wetland monitoring projects (where the Agency has drilled boreholes at wetland sites in order to monitor the water table) and computer modelling studies are being undertaken.

Review of Consents in Habitats Directive Sites: In addition to the Agency's duties under the Water Resources Act 1991, we have a responsibility under the Habitats Directive (see section 4.2.2). The regulations apply to Special Areas of Conservation (SAC's), which are all SSSI controlled by English Nature, and Special Protection Areas (SPA), which are designated under the Birds Directive 1979. The Agency must ensure that new or varied abstraction licences do not adversely affect these sites. This is already part of the Water Resources Act 1991. However, the new aspect is the obligation by the Agency to review by 2004 all existing permissions, which may affect SAC's and SPA. It is likely that if an abstractor holds an abstraction licence, which is shown to affect one of these sites, the licence will be revoked or reduced. The water dependant SAC sites in the CAMS area are shown in Table 7.

Produce Water Level Management Plans: An initiative introduced by MAFF in 1994 also designed to protect wetlands, is the production of Water Level Management Plans (WLMP's). A list of the WLMP sites can be seen in Appendix A4.2. These plans provide the means by which water level requirements for a particular site can be discussed and the range of activities such as agriculture, flood defence and nature conservation can be balanced and integrated.

Investigations Agreed by OFWAT: Another mechanism that has been used by the Agency is to advise the Government that the water companies should undertake environmental investigation and improvement work, and this should be allowed by OFWAT when agreeing the prices the companies are allowed to charge their customers. In 1999 OFWAT reviewed the price limits for the water companies for the

period 2000 to 2005 and the environmental work has been included. This means that in this CAMS area, Anglian Water will investigate the impact of pumping their borehole sources at Quidenham upon Kenninghall and Banham Fen SSSI.

Agency Investigations: Finally, the Agency has it's own programme of investigations related to areas where there has been persistent low flow or low water level problems resulting in environmental damage. This programme includes the investigation and resolution of low levels at Redgrave and Lopham Fen SSSI. It was shown that abstraction from a borehole used by Essex and Suffolk Water Company had gradually reduced the water flow to the fen. The borehole has now been closed and another source drilled and commissioned several kilometres to the east. This is a success and as a result of co-operation between Essex and Suffolk Water Company, Suffolk Wildlife Trust, English Nature and the Environment Agency. There are no other sites identified in this CAMS area.

Review of GOGWS: In this CAMS area, the river flow is supported by pumping water from the Great Ouse Groundwater Scheme boreholes, and discharging the water into the river. Further details of the scheme can be found in the Appendix. This scheme is operated as required, in order to export water which will eventually be used by public supply customers in Essex. (The water is transferred at Denver via the Ely to Essex Transfer Scheme). The rivers Thet and Little Ouse benefit by the extra flow during periods of low rainfall. The operating rules for this scheme could be examined to explore the possibility of operating the scheme to meet local river flow needs in periods when export is not required.

Table 13: Allocating Water to the Environment

Activity	Advantage	Disadvantage
Promote "In River Needs " Study for this area.	Carries forward present thinking in Water Resources Management to ensure better practice to protect rivers and wetlands.	Time and Cost for the Agency (to pursue recent research)
Carry out monitoring at wetland sites.	Provides more information to better protect wetlands	Time and Cost
Identify wetland catchment areas using conceptual or computer modelling.	Better protection of wetlands and better identification of policies	Time and Cost Monitoring data will be necessary before this can be carried out
Carry out Review as required by the Habitats Directive	Better protection of important wetland habitats	Time and Cost May lead to revocation or reduction of abstraction licences which will be a cost to abstractors to provide alternative supplies
Produce Water Level Management Plans.	Provides better approach to management of water levels necessary to protect wetlands in particular the consensus of all interested parties.	Time and Cost (including organisation of committees)
Carry out investigations and	Better protection of wetland	Time and Cost to Water

monitoring on wetland sites close to PWS boreholes (as agreed by OFWAT)	sites	Company and it's customers
Review the operation of the Great Ouse Groundwater Scheme to explore the possibility of operation to meet local needs.	Better management of the scheme to meet local as well as export needs.	Time and Cost
Do Nothing (not possible due to the Habitats Directive)	Save time and cost	Failure to protect wetlands to the **best advantage**.

5.3.2 Strategy to develop better techniques to calculate the available resource

The Environment Agency is responsible for calculating the available water resource and allocating this between the water environment and abstraction. The methods currently used are described in Sections 3.3. The methodology in Anglian Region may change following research described in section 5.3.1 relating to the allocation of water for the environment. It will also change as a result of the National Framework, which is currently under development. The National Framework Methodology will be used and computer models developed within the framework, which will represent the local area in more detail. These models will be calibrated using actual records of rainfall, geology, river flow and groundwater levels. The computer models are expected to be available from 2005. Table 14 below describes the activities which are necessary to improve the definition of the water resources balance with the associated advantages and disadvantages.

Table 14: Work to Improve the Definition of the Water Balance

Activity	Advantages	Disadvantages
Improve Anglian Methodology as required by the National Framework initiative	Better identification of the water resources balance	Cost to Agency for research development and implementation
Better definition of the allocation for the water environment as a result of work identified in section 5.3.1	Better allocation of water for the water environment than presently allowed by the Anglian Method	Cost to Agency for research ,development and implementation
Develop Computer Models of the CAMS areas to establish a better understanding of the water balance	Better identification of the water resource balance and the tool to examine options for future changes	Cost to Agency for research , development and implementation

5.4 Aspiration to manage the water resource in the most effective way

At present the Agency manages water resources to the best advantage. However, there is a recognition that there are better ways to manage the resource, and the following sections outline these together with the advantages and disadvantages.

The proposed strategies to achieve this aspiration are given as:

- Strategy to identify policies to achieve a sustainable water resource balance
- Strategy to identify policies to meet local needs
- Strategy to promote efficient use of water
- Strategy for effective management during drought periods

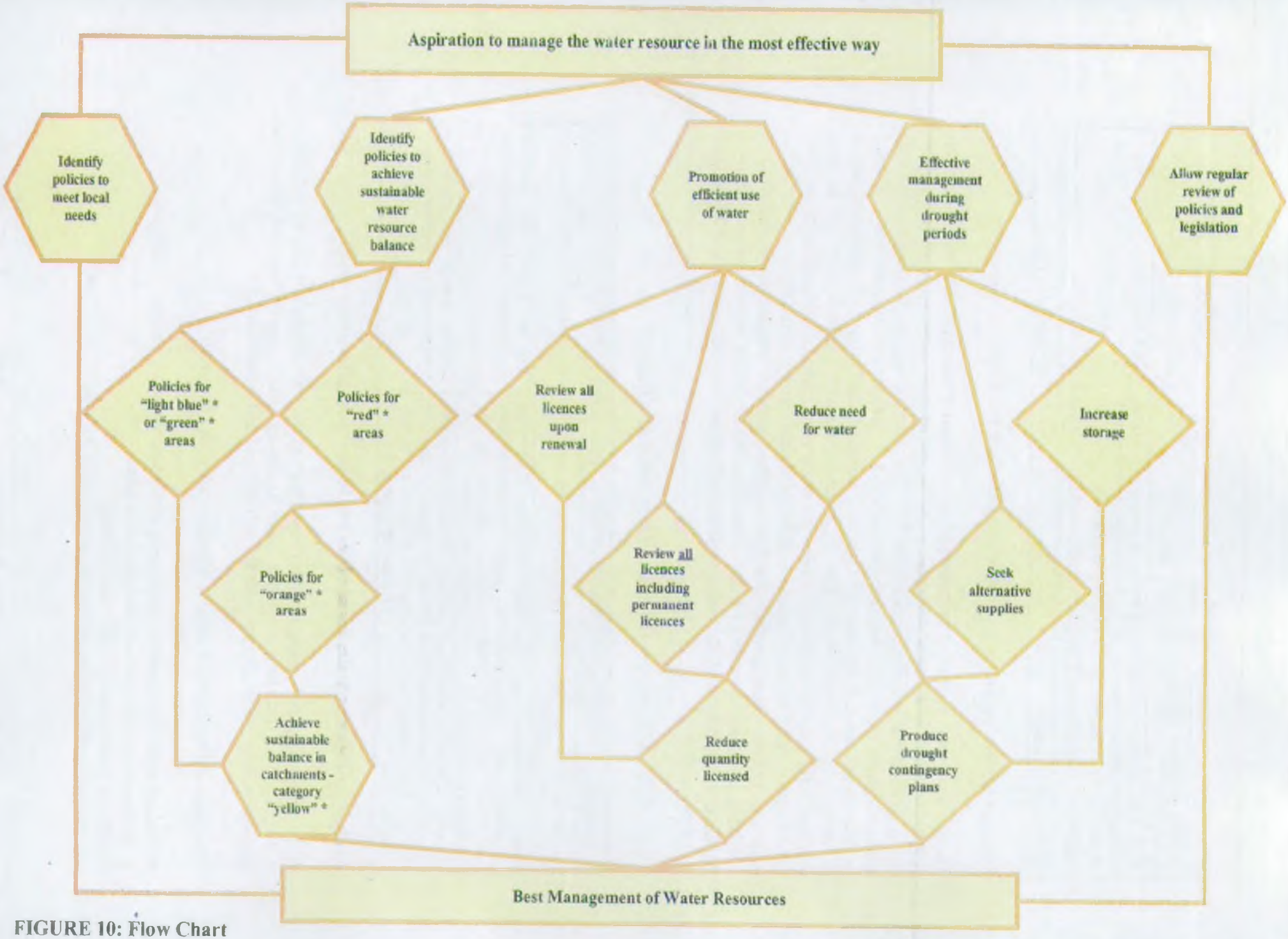


FIGURE 10: Flow Chart for Aspiration2

* For definition of these sustainability colour categories, see section

•Strategy to allow for regular review of policies and incorporate changes of legislation

5.4.1 Strategy to Identify policies to achieve a sustainable water resource balance

Regardless of the method used, the Agency aims to quantify the available water resource and an indication of the quantity remaining after the existing allocation for the environment and the quantity already licensed for abstraction was taken into account. The conclusion could show that the area was fully committed or in other words, all the available resource has been already allocated. This type of catchment would be "in balance". In terms of the sustainability codes described in Section 3.1, the code would be ***yellow***. In this type of catchment, there is no more water available for any new applications to abstract water and the water environment has not been adversely affected. This status of "in balance" can be seen as the future ideal for all catchments, as it is a state that satisfies the water environment and fully allocates the remainder to meet the needs of abstraction. The only disappointment would be for those who want to abstract more water beyond that already licensed.

So, the future is yellow.

The policy or activity to achieve a yellow status for a particular catchment would depend on the starting point for the catchment. Table 15 below is presented to illustrate the type of polices that will be in place. The sustainability categories are presented in section 3.1.

The Little Ouse CAMS area has been classed as sustainability category Orange because there is a small deficit when the total available resource is compared to the quantity already licensed and the recognised needs of the water environment. The sustainability category is still orange with reference to the actual quantity of water abstracted.

Table 15: Table of Sustainability Policies

Present Sustainability Category	Policy or Activity to achieve Yellow Status	Advantages	Disadvantages
Light Blue	Allow more abstraction subject to evaluation of local impacts	Allows development such as housing, and industry in local area. Satisfies future demand for water	Less water for water environment
Green	Allow more abstraction subject to evaluation of local impacts. Summer surface water would not be available.	Allows development	Abstraction methods may be more expensive if need to construct winter storage reservoirs Less water for the water environment
Yellow	Maintain status quo, only allocate more water for abstraction if other licences have been	This is a sustainable balance which is satisfactory for those with licences and satisfactory for the	No further abstraction is permitted therefore this will increase the cost of development if water needs to be imported or better storage

	revoked or reduced. Small quantities would be allowed where there is no alternative. Schemes which give benefit for the water environment would be allowed	water environment	such as reservoirs constructed.
Orange	Transfer all licences to a temporary status Review all licences when application for renewal is considered, in particular seek better justification of need and reduce quantity on licence where appropriate. Small quantities would be allowed where there is no alternative Schemes which benefit the water environment would be allowed	More water is recovered for the water environment Will secure a better or sustainable balance between abstraction and the water environment Encourage better use of water and minimise wastage	Costs for the abstractor Cost to Agency defending their policy at licence appeals
Red	Transfer all licences to a temporary status Seek better justification of use when dealing with renewals. Introduce a policy of "recovery", i.e. reduce all licences by 10% regardless of justification of use. Schemes which benefit the water environment would be allowed. Small exceptions	More water is recovered for the water environment Will secure a better or sustainable balance between abstraction and the water environment Encourage better use of water and minimise wastage	Cost to abstractor to find alternative supplies or better methods to manage demand for water such as reducing demand, recycling or importing water. Cost to Agency defending their policy at licence appeals

	not allowed		

5.4.2 Strategy to Identify policies to meet local needs

The policies adopted in this CAMS area apply to whole catchments and only differ depending on the source of supply, whether the abstraction is from river or groundwater, or the time of year, whether the abstraction is during the summer or winter. (See Section 4.3 to 4.5)

It is an aspiration to identify policies at a more local level. The policies could relate to individual streams or a river system. For example a policy for the River Sapiston would be different from the River Little Ouse above Thetford, which in turn would be different from the River Little Ouse below Thetford.

As a first stage the available resource has been calculated for four "sub" units or divisions for this CAMS area (see Figure 4) and the results are presented in Table 16 below. Table 17 describes the activities relevant to this strategy.

Table 16: Little Ouse Groundwater Unit Sub-division Sustainability Status

Area	Surplus or Deficit (tcmd)	Sustainability Status
Thet Sub Unit A	-14.61	Red
Upper Little Ouse Sub Unit B	- 8.99	Orange
Sapiston Sub Unit C	1.43	Yellow
Lower Little Ouse Sub Unit D	18.50	Green

Table 17: Development of Sub-divisions

Activity	Advantages	Disadvantages
Continue with whole unit or catchment policies		May not achieve best practise for local needs
Develop local or sub catchment based policies	Water resources are managed to meet local needs Water may be more available for abstraction in some areas	Cost of change to local abstractors where policy changes to their disadvantage

5.4.3 Strategy to Promote efficient use of water

The need for water is examined when an application for an abstraction licence is considered, whether the application is for new abstraction or a renewal of existing permissions. The quantities authorised in any licence document are those considered to be reasonable and justified for the use proposed. In some cases the quantities authorised are less than those applied for. Table 18 below describes how the justification is evaluated at present. Research by the Agency is currently being undertaken with respect to the efficient use of water.

Table 18: Calculation of Water Requirement

Water Use	Local Status
Public Water Supply	The water companies have a new duty, introduced by the Environment Act 1995 to promote efficient use of water by their customers. This duty is regulated by OFWAT, but the Agency is involved in consultation. OFWAT has required the companies to produce water efficiency plans to meet this duty and the Agency is keen for leakage control and demand management to be given high priority. The planning horizon is 25 years although public water supply licences are issued for 10 years (at present). The water company must have demonstrated that they have carried out effective demand management, reduced leakage to economic rates and, where water resources are under stress, considered metering of domestic use before extra water resources will be allocated. The companies in this CAMS area do achieve reasonable levels of leakage.
Spray Irrigation and Agriculture	The requirement of water needed with respect to the types of crops and soil conditions are taken into account when considering applications for spray irrigation. The number and type of animals and their associated water requirements are checked when determining agricultural licences. The Agency promotes good irrigation practise in association with MAFF. The type of advice would be to use boom irrigators instead of rain guns, irrigate at night to avoid evaporation losses, check the equipment is functioning well and to use methods to determine the water requirement of the soil in order to apply only that which is needed.
Industrial	The type of industrial process is considered as well as the life expectancy of the plant and equipment.

It is proposed that all existing licences could be reviewed to ensure that the quantities authorised follow the current guidelines about justification of use. This review could include identification of licences which describe abstractions no longer carried out, or those which are no longer required by the licence holder. It is fair to say that most large quantity licences are valid and relevant as the licence holder is regularly reminded about the existence of the licence by annual charges. It is likely to be small quantity licences that are disused. There is a concern that the review may reactivate licences by bringing them to the licence holder's attention! The intention would be to recover licences not used, and reduce those which authorised abstraction in excess of the current guidance about proper use. This will hopefully be achieved by agreement between the Agency and the Licence holder, following co-operation and consultation about the issues involved. Therefore, it will be voluntary until perhaps the change of legislation offers a different way to achieve this.

Table 19 outlines the activities and options available.

Table 19: Promotion of Efficient use of Water

Activity	Advantages	Disadvantages
Promote water conservation techniques such as metering supplies to homes, night irrigation for farmers etc.	More water is recovered for the water environment	Cost of changing infrastructure e.g. installation of meters etc.
Review all licences when application for renewal is considered, in particular seek better justification of need and reduce quantity on licence where appropriate by agreement with the applicant	More water is recovered for the water environment Encourage better use of water to minimise wastage	Cost to licence holder in order to secure alternative ways of meeting water demand
Review all existing licences against the guidelines for justification and reduce or revoke licences with agreement of the licence holder.	Give notice of change to allow abstractors to arrange alternative ways of meeting demand More water is recovered for the water environment Encourage better use of water to minimise wastage	Cost to licence holder Cost to Agency in term of staff time

5.4.4 Strategy for Effective management during drought periods

The Agency has an effective system of managing water demand during drought periods. However, the present legislation gives the Agency the ability to control spray irrigation in order to protect river flows, but control over abstraction for other uses is harder to administer. The Agency is able to apply to the DETR for a Drought Order to control abstraction to protect the environment. The Drought Order could then require the water company to introduce demand restrictions such as hosepipe bans.

The DETR have recommended that the legislation is changed to put the onus on the abstractor to better prepare for drought situations, and to ensure that his business is less vulnerable by planning and installing solutions. This could mean using more storage such as tanks and reservoirs in the supply system, switching to or using more reliable sources of water such as winter river flows, or reducing the overall demand for the water.

Table 20 outlines the activities involved.

Table 20: Drought Management

Activity	Advantages	Disadvantages
Abstractors develop Drought Contingency plans	Better plans to avoid problems during drought periods	Cost to abstractor of developing a plan and installing the solution
Increase storage in supply systems – i.e. store water during periods of plenty to use during periods of drought	Better security during drought periods	Cost to abstractor
Change to more reliable sources of water e.g. winter abstraction	Better security during drought periods	Cost to abstractor Reduces water available during winter, the Agency would need to keep this under review
Decrease demand for water	Better security during drought periods More water left for the water environment	Cost to abstractor

5.4.5 Strategy to allow for regular review of policies and incorporate changes of legislation

There will always be review of Agency policies and practise. The Agency operates within and subject to the current legislation, in particular the Water Resources Act 1991. The Agency reviews and recalculates the available resource routinely and publishes the changes in policy in National and Regional Water Resources Strategies, and in Local Environment Agency Plans (LEAP's). The current Anglian Region Water Resource Strategy is dated 1994 and is due to be reissued in 2000. The Ely Ouse LEAP has been recently published (dated September 1999), and describes the current issues in this area.

It must be remembered that the Agency is a public authority which is accountable to society and its elected Government. It also acts on behalf of society by enforcing the legislation considered necessary. The demands of society have changed and the present Government, in recognition of this, has undertaken a review of the current water resources legislation. The Department of the Environment, Transport and Regions (DETR) issued a consultation paper entitled "The Review of the Water Abstraction Licensing System in England and Wales" in June 1998. They received over 200 replies and in March 1999, they published their decisions in the document "Taking Water Responsibly". The actual change in legislation may not occur until 2002, or when parliamentary time allows. One aspect of the new legislation may be that all abstraction licences will be temporary and subject to review. This aspect is part of future legislation. Table 21 indicates the intended time limits for abstraction licences in this CAMS area.

Table 21: Time Limits

Use	Time Limit in Years			
	Surface Water Summer	Surface Water Winter	Groundwater Summer	Groundwater Winter
Public Water Supply	10	25	10	10
Spray Irrigation	10	25	10	10
Agriculture (non Spray Irrigation)	20	25	20	25
Industrial non consumptive e.g. cooling or mineral washing	20	25	20	25
Industrial use consumptive	10	25	10	25

As already mentioned in section 4.2.2 and 5.3.1, the Agency is also subject to European legislation, and the Habitats Directive in particular. This requires the Agency to review (by 2004) all permissions including abstraction licences which are shown to significantly affect a SAC or SPA site.

5.5 Conclusions

Firstly, the Agency accepts that the methods of calculating the available resource will be revised and legislation may change. This will result in change to abstraction licence policies. Table 22 outlines the expected timing of change:

Table 22: Changes Within the CAMS Area

Year	Expected Change	How information could be made available
1999	Change from "whole catchment" policies to local "sub catchment" polices Introduction of sustainable catchment policies	Review of CAMS document
2000	Anglian Methodology revised in accordance with National Framework Available Resource reassessed and local policies amended	Review of CAMS document
2001	In River Needs and Wetland Catchment Studies concluded Available Resource reassessed and local policies amended	Review of CAMS document
2002	Review of Water Resources Legislation Move to temporary licences, more categories of abstraction requiring a licence., small quantities now exempt	Review of CAMS document
2004	Review associated with the Habitats Directive complete and licences amended or revoked as necessary	Review of CAMS document

2005	Calibrated Computer Model of the Ely Ouse area (including this CAMS area) available Available Resource reassessed and local policies amended	New CAMS document

The future policy for this CAMS area is given in Table 23 below.

Table 23: Future Policies

Area	Surplus or Deficit (tcmd) and Sustainability Status	Policy
Whole CAMS	-3.67 Orange	Recover licences identified by the Habitats Directive Review Review all abstraction licences and seek reduction by agreement with licence holder Reassess policy as appropriate following changes (see previous table)
Thet Groundwater Applications in Sub Unit A (Thet) Surface Water Applications in Sub Catchment 44	-14.61 Red	Recover 10% quantities licensed for abstraction for all uses by agreement with licence holder. This action will not entirely address the balance as the deficit exceeds the quantity licensed. No further quantity available and small exceptions allowed. Allow schemes which benefit the water environment
Upper Little Ouse Groundwater Applications in Sub Unit B (Little Ouse) Surface Water Applications in Sub Catchment 42	- 8.99 Orange	Make all licences temporary Seek Justification of use Allow small exceptions where no alternative. Allow schemes for the Benefit of the water environment
Sapiston Groundwater Applications in Sub Unit C (Sapiston) Surface Water Applications in Sub Catchment 41	1.43 Yellow	No new or increases in abstraction licences Allow small exceptions where no alternative available. Allow schemes which benefit the water environment

Lower Little Ouse Groundwater Applications in Sub Unit D (Lower Little Ouse) Surface Water Applications in Sub Catchments 43, 45 , 46 and 56	18.50 Green, but upstream of Other catchments Which are in Deficit	Allow increases in abstraction subject to assessment of local impact Except in Areas of South Level Fen where the summer surface water resources are fully committed

6. CONCLUSION

The Little Ouse CAMS sets out the Agency's shared strategy for the sustainable management of the water resources of the Little Ouse. It does so by providing an explanation of how water resource availability is presently calculated, describing the licensing policies that that are currently used, and finally sets out the strategy for future licensing policies in the catchment.

The policies contained within this CAMS document will allow for the legitimate development of water resources, were they are available, without harming the aquatic environment.

APPENDIX

OVERVIEW OF WATER RESOURCES INFORMATION AND CATCHMENT DATA

A1. HYDROLOGY

The Little Ouse CAMS area covers the catchments of the River Little Ouse, River Thet and River Sapiston. Figure 2 shows the network of rivers and their main tributaries. The Cut Off Channel is a flood relief channel constructed between Denver and Mildenhall. The Cut Off Channel runs under the Little Ouse through a syphon at Hockwold.

The principal rivers are sustained during most summers and drought periods by baseflow from the chalk aquifer and discharges from sewage treatment works. It is estimated that baseflow contributes approximately 70% of total river flow over an average year.

Headwaters of the rivers do not usually benefit from baseflow from the Chalk or discharges from sewage treatment works, however they may benefit from flow derived from drift deposits.

During periods of heavy rainfall the rivers may benefit from runoff, particularly in their upper reaches where the drift is predominantly Boulder Clay. Runoff is more likely to occur in winter when the Boulder Clay may become saturated. Baseflow is then supplemented by relatively short duration runoff events.

River flows in the Thet and Little Ouse may be augmented by groundwater from boreholes operated under the Great Ouse Groundwater Development Scheme. The main purpose of the scheme is to provide water for transfer to Essex (via the Cut Off Channel) However the scheme also provides local benefit by supporting flows in the Thet and Little Ouse during drought periods.

Figure 11 shows the flow of the Upper River Thet and the Lower Little Ouse. Figure 12 shows the deviation in the annual rainfall from the Long term Average (LTA) for the rain gauge at Elvedon from 1961 to 1998. Figure 13 compares the average monthly rainfall at Elvedon Hall with the actual evaporation data for the CAMS area.

Figure 11: Annual Hydrograph of the River Thet and Little Ouse

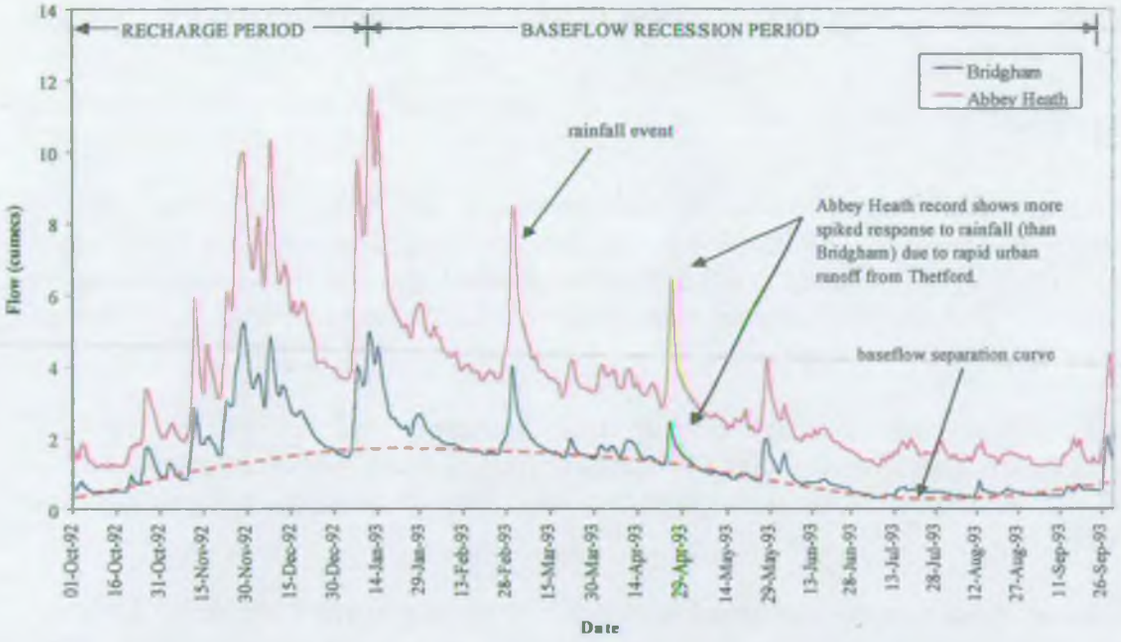


Figure 12: Deviation from the Long Term Average Rainfall at Elvedon Hall

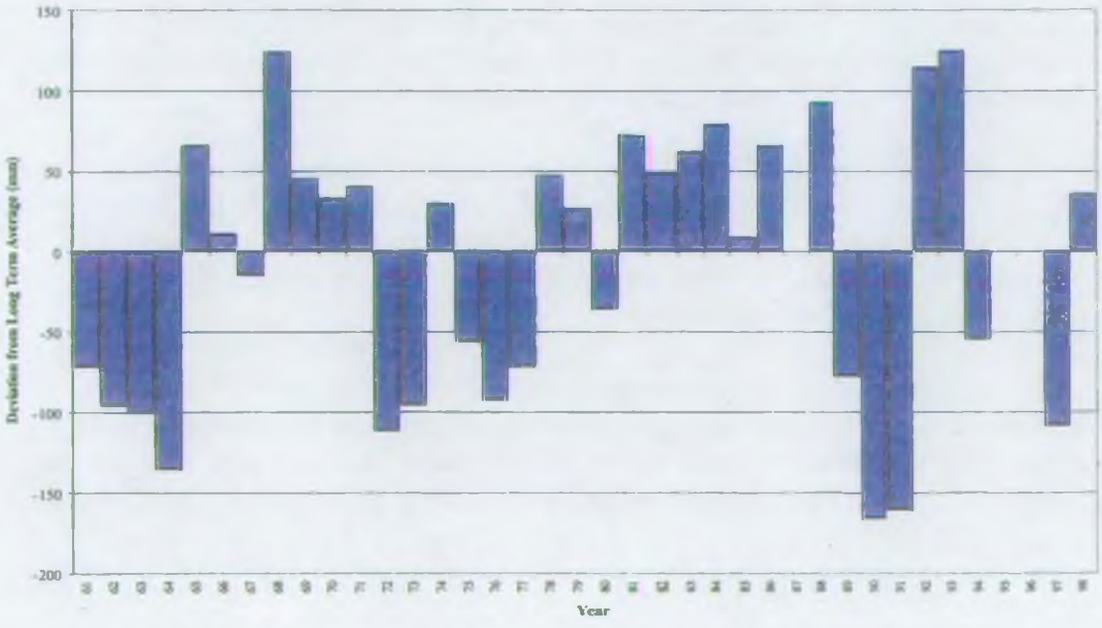
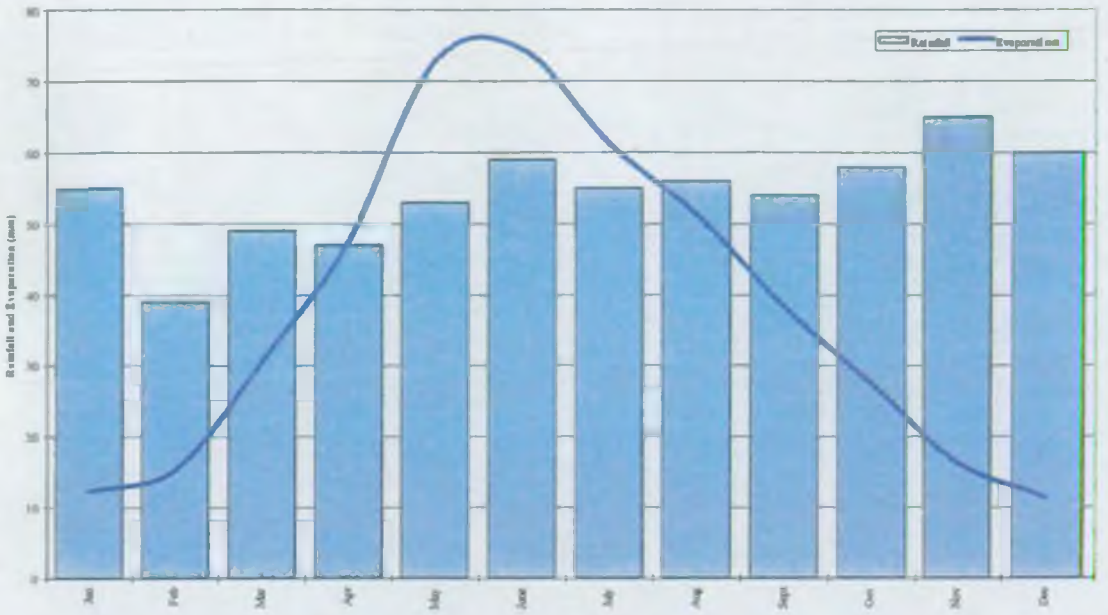


Figure 13: Average Monthly Rainfall and Actual Evaporation in the CAMS Area



A2. HYDROGEOLOGY

Figure 14 gives an overview of the geology of the area. The principal aquifer which underlies the whole of the CAMS area is the Chalk. This is fine grained and extensively fissured. Flints occur in bands within the Chalk. The Chalk is subdivided into Upper, Middle & Lower units. The Upper/Middle Chalk outcrops in the west of the unit and along the majority of the main river valleys. The Chalk transmits water effectively with the majority of the water flow occurring through fissures. The general direction of Chalk groundwater flow in the CAMS area is towards the west. Figures 15 and 16 show Chalk groundwater level contours estimated from data recorded in April 1988 and September 1991 respectively.

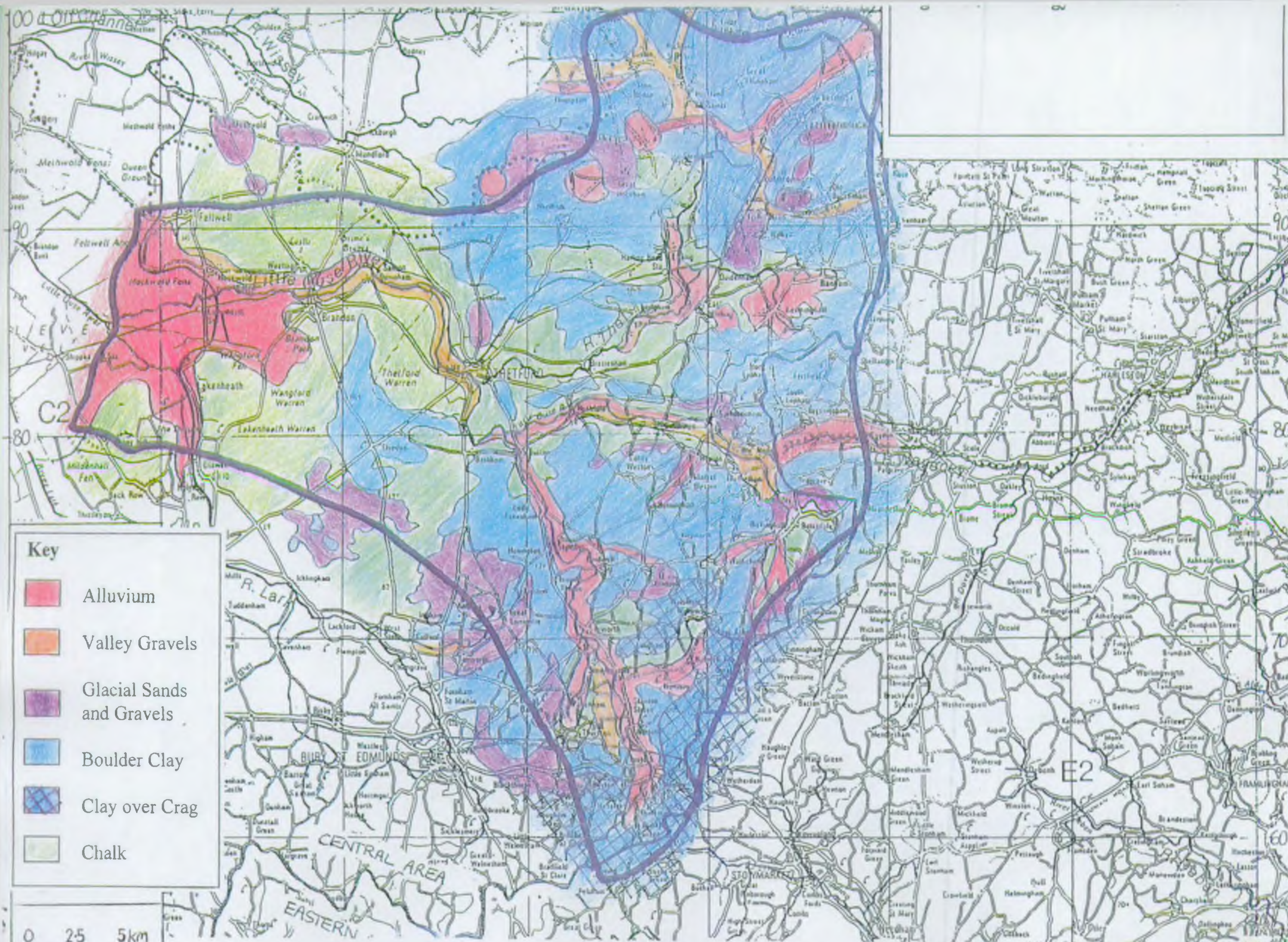

Key
Alluvium
Valley Gravels
Glacial Sands and Gravels
Boulder Clay
Clay over Crag
Chalk
0 2·5 5km
C2
E2
CENTRAL AREA
EASTERN
Thetford Warren
Wangford Warren
Lakenheath Warren
Little Ouse River
R. Wissey
R. Lark
BURY ST EDMUNDS
THETFORD
90
80
70
60

FIGURE 16

CHALK GROUNDWATER LEVELS APRIL 1988

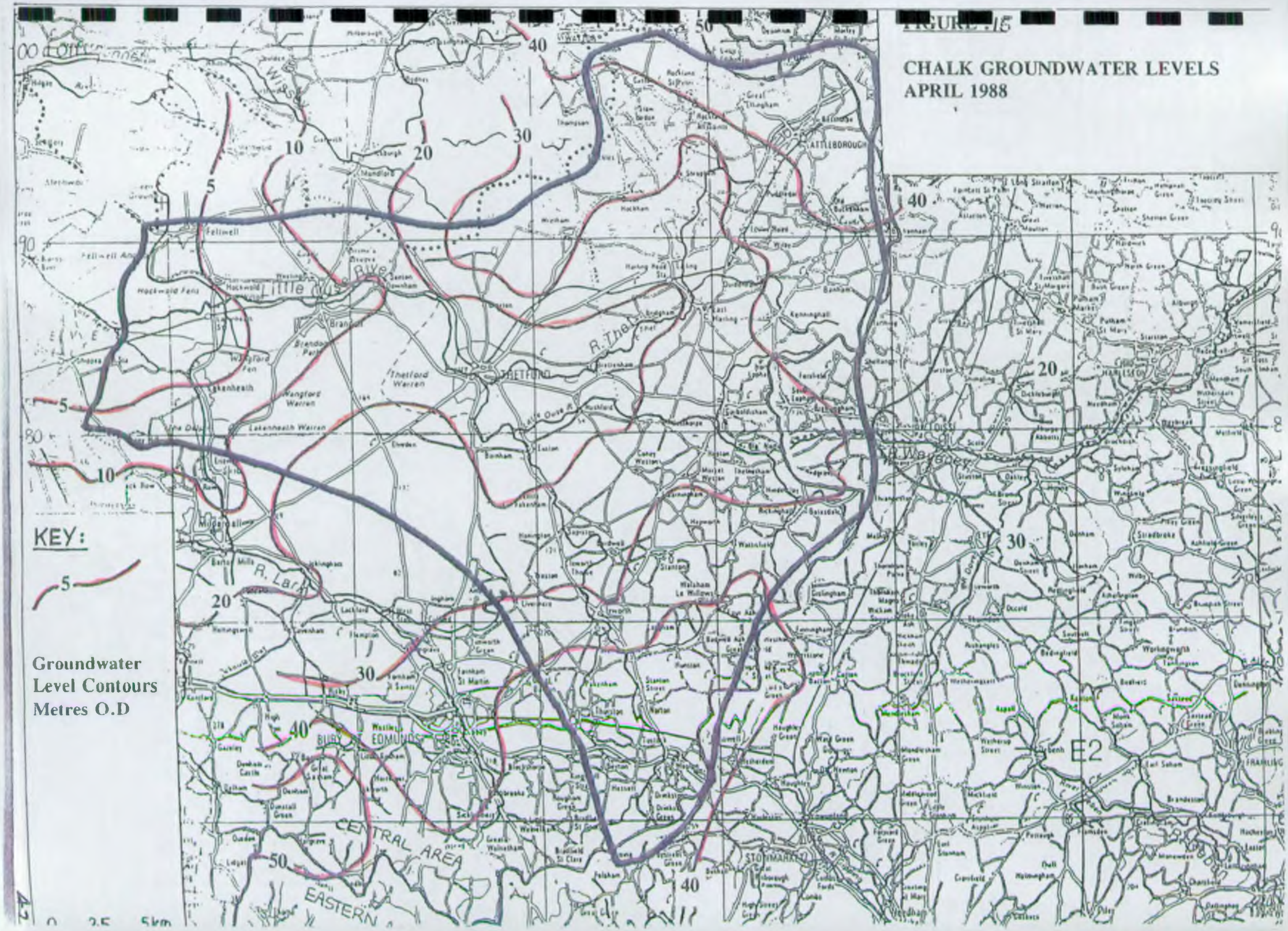
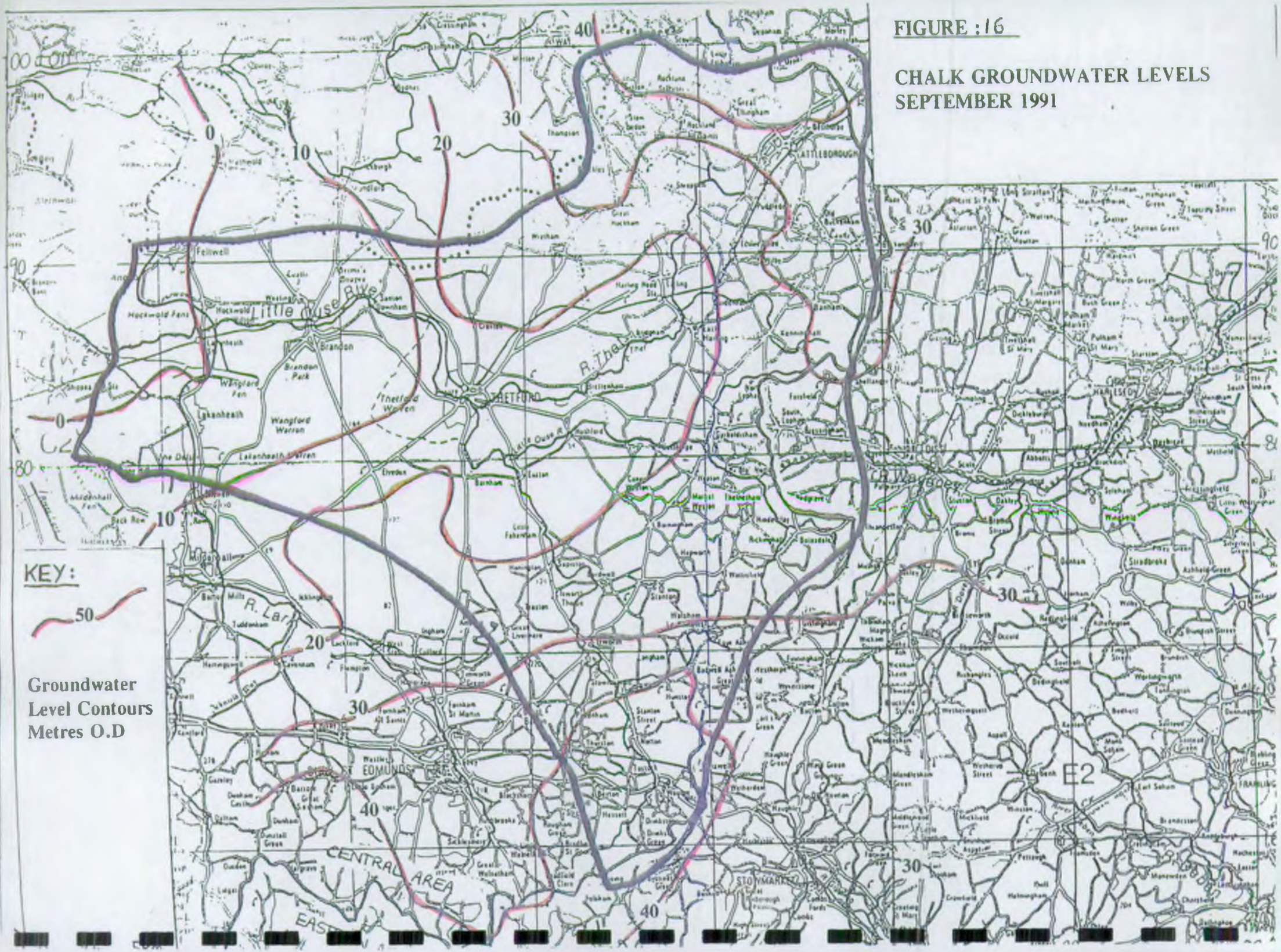


FIGURE : 16

CHALK GROUNDWATER LEVELS SEPTEMBER 1991



The Little Ouse groundwater unit is subdivided into 4 sub units, these are the Thet (sub unit A), the Upper Little Ouse (sub unit B), the Sapiston (sub unit C) and the Lower Little Ouse (sub unit D). These subdivisions have been made on the basis of knowledge of groundwater flow in the area. The boundaries of the subdivisions are shown on Figure 5 together with the boundaries of the surface water catchments.

Boulder Clay covers the Chalk in the eastern part of the CAMS area. To the north of Thetford, the Boulder Clay is a pale grey/blue type consisting of pebbles of Chalk flint and other rocks in a sandy Chalk matrix. This has been called Chalky Boulder Clay. The rest of the Boulder Clay area consists of a darker type with Chalk and other pebbles in a matrix of sand and Jurassic Clay. This type is referred to as Chalky Jurassic Boulder Clay. Both types of Boulder Clay are semi-permeable. The principle valleys of the Thet, Little Ouse and Sapiston cut through the Boulder Clay to the underlying Chalk.

There are several types of Sand and Gravel deposits in the CAMS area. Firstly, Glacial Sands and Gravels in the upper part of the catchment occurring below and on top of the Boulder Clay and at outcrops along the valley sides. Crag, consisting of unconsolidated or poorly consolidated ferruginous sands and gravels with shells, occurs beneath the boulder Clay to the south east of the unit. Deposits known as Valley Gravels occur along parts of the river valleys. The above types of Sand and Gravel deposits are usually water bearing and are classed as minor aquifers.

A2.1 Main Recharge Areas

The Boulder Clay in the eastern part of the CAMS area limits the recharge into the Chalk aquifer and encourages surface water runoff. However the Boulder Clay has a highly variable permeability (depending mainly on sand content) and it is likely that in some areas recharge occurs through more permeable parts of the Boulder Clay.

A2.2 Main Discharge Areas

In the Little Ouse tributaries, the 20m contour appears to correspond to the lower boundary of a seepage zone where groundwater discharges into the tributaries. There are fewer discrete springs than in the valleys of the Lark and Wissey. Extensive marshland in the Little Ouse and Thet occurs alongside the river on the terrace deposits. These are in continuity with the Upper/Middle Chalk. In the Sapiston valley these marshlands occur at about the 30m contour. A secondary spring line occurs at about 60m in the extreme headwaters of the Sapiston. This relates to the Crag deposit outcrop. These springs are important in maintaining flows in the headwaters of the Sapiston, however by Rectory Bridge flow gauging station this contribution has usually been lost.

The majority of the rivers run in a bed of Alluvium. This consists of silts, clays and some sand layers. Most of the main rivers run along lines of buried channels in the Chalk. The exceptions include the River Little Ouse between Blo Norton and Euston and the River Thet between East Harling and Thetford. The buried channels can be 30 metres deep filled mainly with glacial sands and silts, which are considered to be semi-permeable.

A3. HYDROMETRY

A3.1 River Flow Monitoring

The Environment Agency monitors flow in main rivers by means of a network of permanent flow gauging stations. Table 24 gives details of the flow gauging stations in the CAMS area. The locations of these are shown on Figure 17. All the flow gauging stations in the Little Ouse catchment are linked by telemetry to Environment Agency offices.

Table 24: Gauging Stations

Name of Station	National Grid Reference	Period of Record	Average Flow (tcmd)	95% (tcmd)	Base Flow Index
Knettishall* (River Little Ouse)	TL956 807	1/1/80 – 31/12/91 1/1/80 – 31/12/88	38.62 44.67	10.80 13.74	0.70 0.68
County Bridge* (River Little Ouse)	TL892 801	1/1/70 – 31/12/91 1/1/70 – 31/12/88	39.74 42.68	7.52 10.28	0.75 0.74
Abbey Heath* (River Little Ouse)	TL851 844	1/1/70 – 31/12/91 1/1/70 – 31/12/88	316.48 335.84	97.63 113.79	0.80 0.80
Stonebridge (Larling Brook)	TL927 907	1/1/70 – 31/12/91 1/1/70 – 31/12/88	4.67 5.01	0.78 1.04	0.82 0.82
Quidenham* (River Wittle)	TM027 878	1/1/70 – 31/12/91 1/1/70 – 31/12/88	10.63 11.40	1.21 1.64	0.64 0.64
Shropham* - Redbridge (River Thet)	TL996 923	1/1/70 – 31/12/91 1/1/70 – 31/12/88	71.37 75.95	11.40 11.66	0.64 0.63
Bridgham* (River Thet)	TL957 856	1/1/70 – 31/12/91 1/1/70 – 31/12/88	130.29 137.98	33.09 33.70	0.75 0.74
Melford Bridge* (River Thet)	TL880 830	1/1/70 – 31/12/91 1/1/70 – 31/12/88	158.20 166.67	41.47 41.64	0.76 0.77
Rectory Bridge* (River Sapiston)	TL896 791	1/1/70 – 31/12/91 1/1/70 – 31/12/88	59.79 64.89	7.26 13.05	0.63 0.63

Notes:
* shows where the flows have been augmented at times since 1988.

The 95%ile is the flow that is exceeded for 95 per cent of the time.

Base Flow Index (BFI) is the ratio of the flow derived from the aquifer to the total river flow. eg BFI of 0.7 indicates that about 70% of the total annual flow is derived from the aquifer.

Plates 11 and 12 show Knettishall Gauging Station and Melford Bridge Gauging Station.

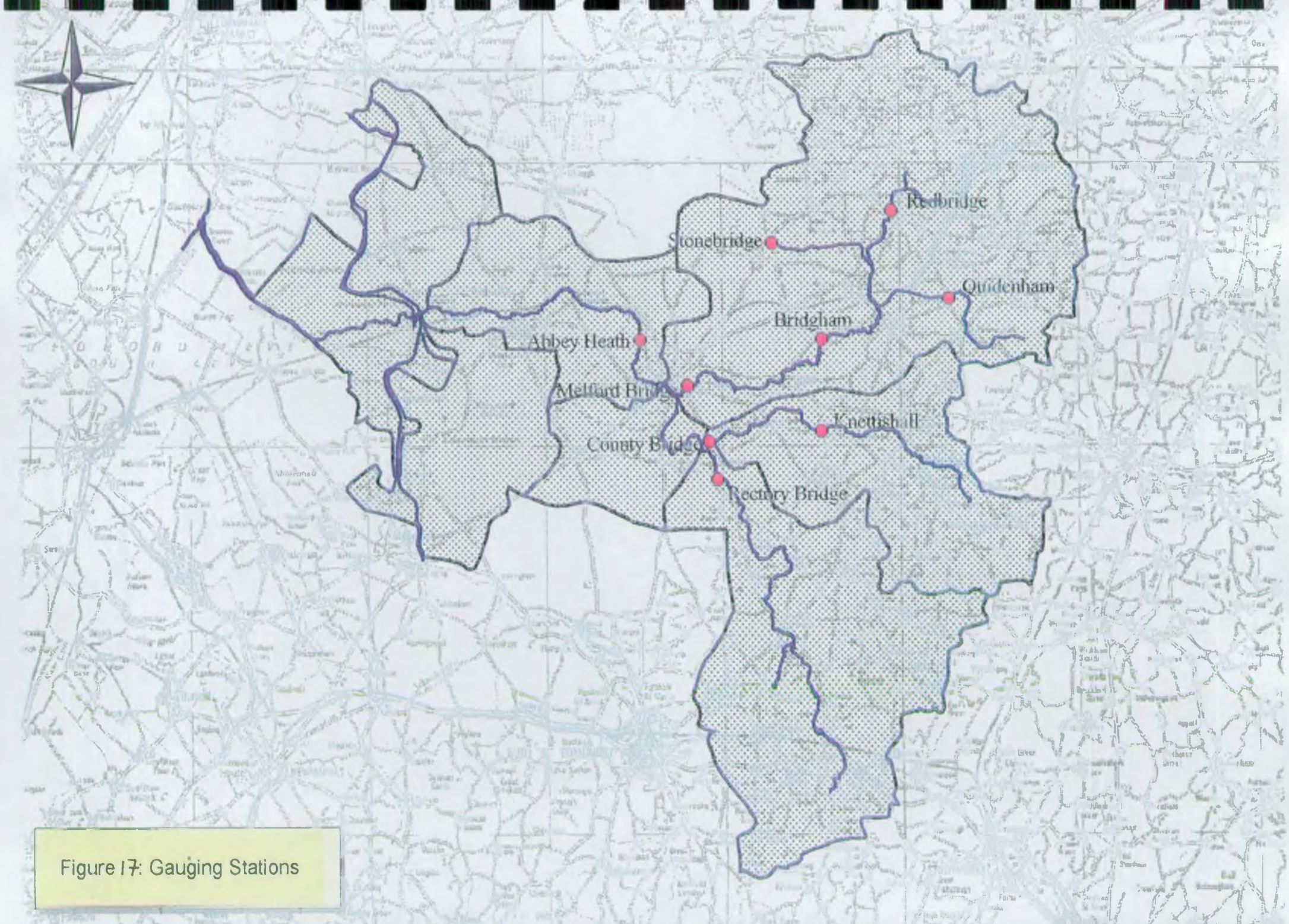


Figure 17: Gauging Stations

Plate 11: Knettishall Gauging Station, June 1999

Plate 12: Melford Bridge Gauging Station, June 1999

In addition to the flow gauging stations, there are a number of sites in the CAMS area where current meter readings have been taken in the past. The names and locations of these sites are shown in the Table 25 below. Current meter readings are generally less accurate than gauged flows. However, current metering may be carried out without the need for a permanent gauging structure in the river.

Table 25: Current Metering Sites

Environment Agency Reference	Site Name	Grid Reference
334207	Hopton Fen	TL 989 807
334208	Euston Weir	TL 894 804
334301	Dog Kennels	TL 992 808
334202	Gasthorpe Bridge	TL 975 806
334303	Knetishall Park	TL 956 808
334304	River Little Ouse	TM 004 802
334305	Blo Norton	TM 012 791
334306	Rishford Bridge	TL 925 812
334307	Wymers Farm	TM 027 789
334401	New Buckenham	TM 082 904
334402	Tributary of the River Thet	TM 073 903
334403	Railway Crossing	TM 022 913
334404	Hall Farm	TM 025 918
334405	A11 Bridges	TM 026 929
334406	A11 Old Bridges	TM 026 928
334407	Swangey Ford	TM 006 945
337708	Mount Pleasant	TL 993 945
334411	Larling Bridge	TL 973 907
334412	East Harling	TL 989 869

A3.2 Groundwater Level Monitoring

Groundwater levels are monitored by the Environment Agency by means of a network of observation boreholes. Water levels at most of the boreholes are measured on a monthly basis by Environment Agency staff. In addition, some of the boreholes are equipped with automatic water level recorders. Figure 18 shows the locations of boreholes used by the Environment Agency for groundwater level monitoring within the CAMS area.

A3.3 Rainfall

The Environment Agency monitors rainfall over the area by means of a network of rain gauges. Table 26 shows summary statistics for rainfall in the area.

Table 26: Rainfall Statistics

Station Name	Station Number	Grid Reference	Sub-catchment	1941-1970 Met Office Average	1961-1990 Annual Average
Brandon Wks No 2	190567	TL 796 862	Lower Little Ouse	-	667 mm
Elveden Hall	189014	TL 822 795	Lower Little Ouse	603	653 mm

Thetford, Kings House Gardens	190343	TL 870 832	Thet	-	582 mm
East Harling, Harling Farm	190118	TM 002 871	Thet	-	585 mm
Thurston STW	188598	TL 917 668	Sappiston	-	581 mm
Knettishall Farm	188013	TL 966 806	Upper Little Ouse	-	598 mm

A4. CONSERVATION

A4.1 SSSI, SAC, SPA and RAMSAR Sites

A total of 21 Sites of Special Scientific Interest (SSSI) containing wetland features exist within or partly within the boundary of the CAMS area. Information on these sites is given in Table 27 below. A number of these sites form part of a Special Area of Conservation (SAC) designated under the EU Habitats Directive. The name of the relevant SAC is also shown in Table 27. Each SAC is made up of a number of component SSSI, some of which may be situated in other CAMS areas.

Each SAC has been designated because it contains habitat types and/or species, which are rare or threatened within a European context. A summary of the European interests of each SAC follows:

Breckland:

- Open grassland with grey-hair grass and common bent grass of inland dunes. (for which this area is the only outstanding locality in the United Kingdom)
- Naturally nutrient rich lakes or lochs that are often dominated by pond weed.
- Dry heaths.
- Dry grasslands and scrublands on limestone

Norfolk Valley Fens:

- Calcium-rich spring water fed fens
- Desmoulin's snail

Waveney and Little Ouse Valley Fens:

- A rare type of chalk rich fen dominated by saw sedge (great fen sedge)
- Purple moor grass meadows
- Desmoulin's snail
- Narrow-mouthed whorl snail

Studies have been carried out in recent years following concerns that water abstraction in the vicinity of some SSSI sites may have affected water levels at the site and therefore may have impacted on the ecology of the sites. Following the results of these studies a joint review has been carried out by English Nature and the Environment Agency in order to identify SSSI that are affected by abstraction.

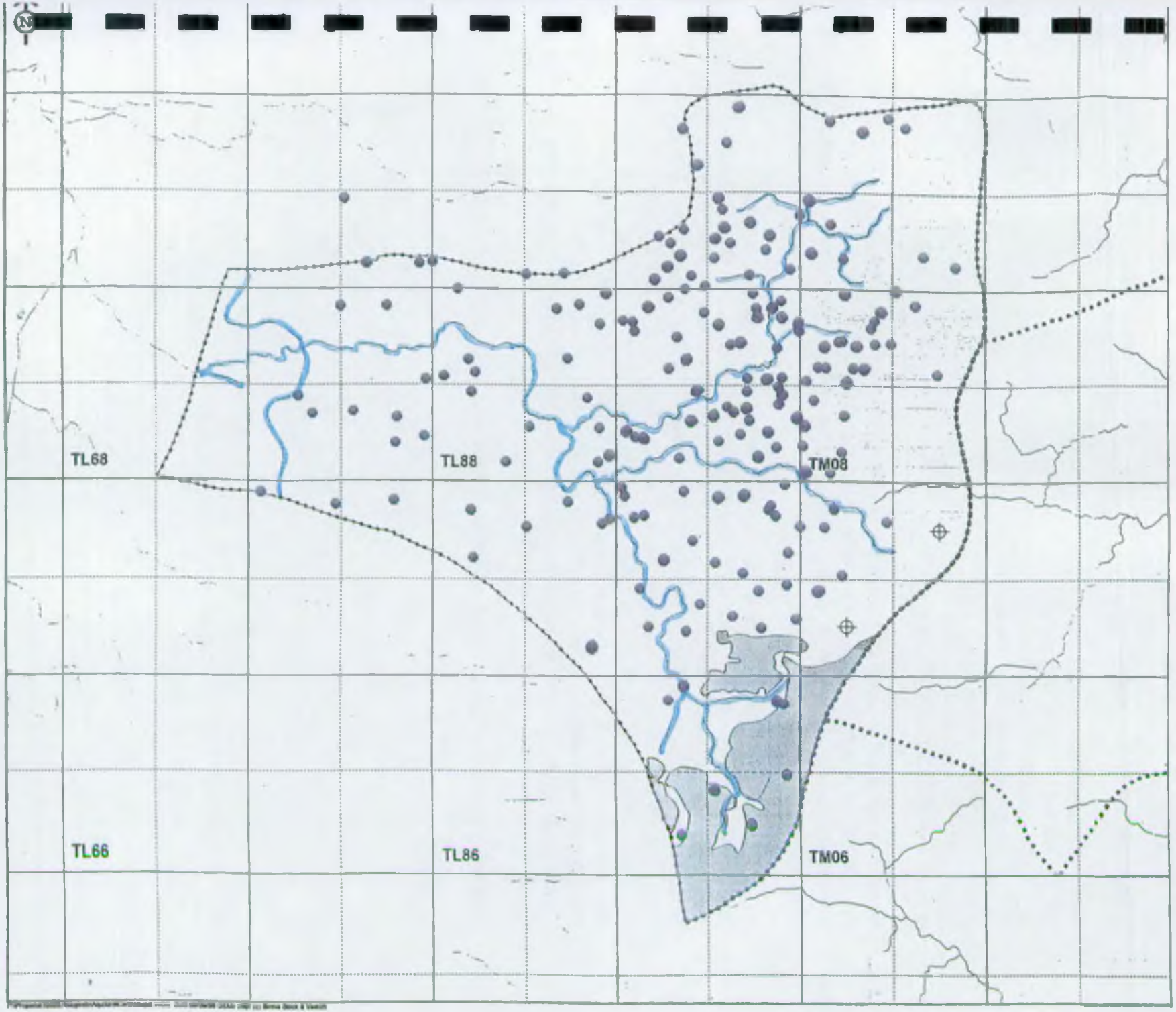


Figure 18: Location of Observation Boreholes

Categories have been assigned to most of the sites, giving an indication of vulnerability to abstraction and status of remedial works/investigations. These categories can be seen in Table 27.

Categories are defined as follows:

1a Remedial action completed
1b Remedial action underway
1c Remedial action specified
2a Monitoring investigation underway
2b Monitoring investigation proposed
3 Not yet evaluated
4 Not affected by abstraction

Sites were assigned to category 4 when it was clear that there was no significant effect as a result of abstraction. In some cases declining water levels were attributed to other causes such as: drought, drainage, watercourse engineering, gravel removal and quarrying.

As a result of studies carried out by the Agency and water companies, a number of sites in Anglian Region have been identified requiring remedial action for the effects of abstraction for public water supply. Funding for remedial action at these sites has been allowed for under AMP3. There are 2 sites in this CAMS area which have been identified in this category, Kenninghall & Banham Fens (SSSI) and Redgrave & Lopham Fen (SSSI and SAC). The category given in column AMP_CAT of Table 27 below refers to this. It should be noted that remedial work at Redgrave & Lopham Fen has already been carried out and therefore is not identified as requiring future work. Category 4 in this column indicates no significant effect identified at this site as a result of abstractions for public water supply.

A number of the conservation sites within the CAMS area can be seen in Figure 19.

Table 27: Wetland SSSIs in the Little Ouse LAMS area

NAME	GRID REF	RAMSAR	SAC	SAC NAME	WLMP	EN CAT	AMP3 CAT
Blo Norton & Thelnetham Fens	TM01707900		Y	Waveney and Little Ouse	Y	2 b	
Buggs Hole Fen, Thelnetham	TM00607920				?	3	
Cranberry Rough, Hockham	TL93409360				Y	4	
East Harling Common	TM00008790				Y	1 b	
East Wretham Heath	TL91008820		Y	Breckland	?	2 a	4
Hopton Fen	TL99008000				Y	4	
Kenninghall & Banham Fens & Quidenham Mere	TM04108750				Y	2 a	2
Knettishall Heath	TL95008050						
Lakenheath Poors Fen	TL70108270				Y	4	
Middle Harling Fen	TL98908520				?	1 b	
Old Buckenham Fen	TM04809200				Y		
Pakenham Meadows	TL93406860				Y		
Pashford Poors Fen, Lakenheath	TL73208350				Y	2 b	
Redgrave & Lopham Fens	TM05007970	Y	Y	Waveney and Little Ouse	Y	1 b	
Stanford Training Area	TL87009400		Y	Breckland		3	4
Swangey Fen	TM01509320		Y	Norfolk Valley Fens	Y	2 a	
Thetford Golf Course & Marsh	TL84508380				Y		
Thompson Water, Carr & Common	TL93009550		Y	Norfolk Valley Fens	?	2 a	
Wangford Warren and Carr (U)	TL 758 833						
Weston Fen	TL98107870		Y	Waveney and Little Ouse	Y	4	
Wretham Park Meres	TL90209180				?		

Description of column headings in table:

GRID REF	National Grid Reference
RAMSAR	(Y) designated as a Ramsar Site (internationally recognised site for migratory birds)
SAC	(Y) designated as a SAC (Special Area of Conservation)
WLMP	(Y) Environment Agency Water Level Management Plan exists for this site or is in preparation
EN CAT	Category assigned by English Nature in 1999
AMP3 CAT	Category assigned by the Environment Agency following AMP3 studies of the effects of abstraction on vulnerable sites

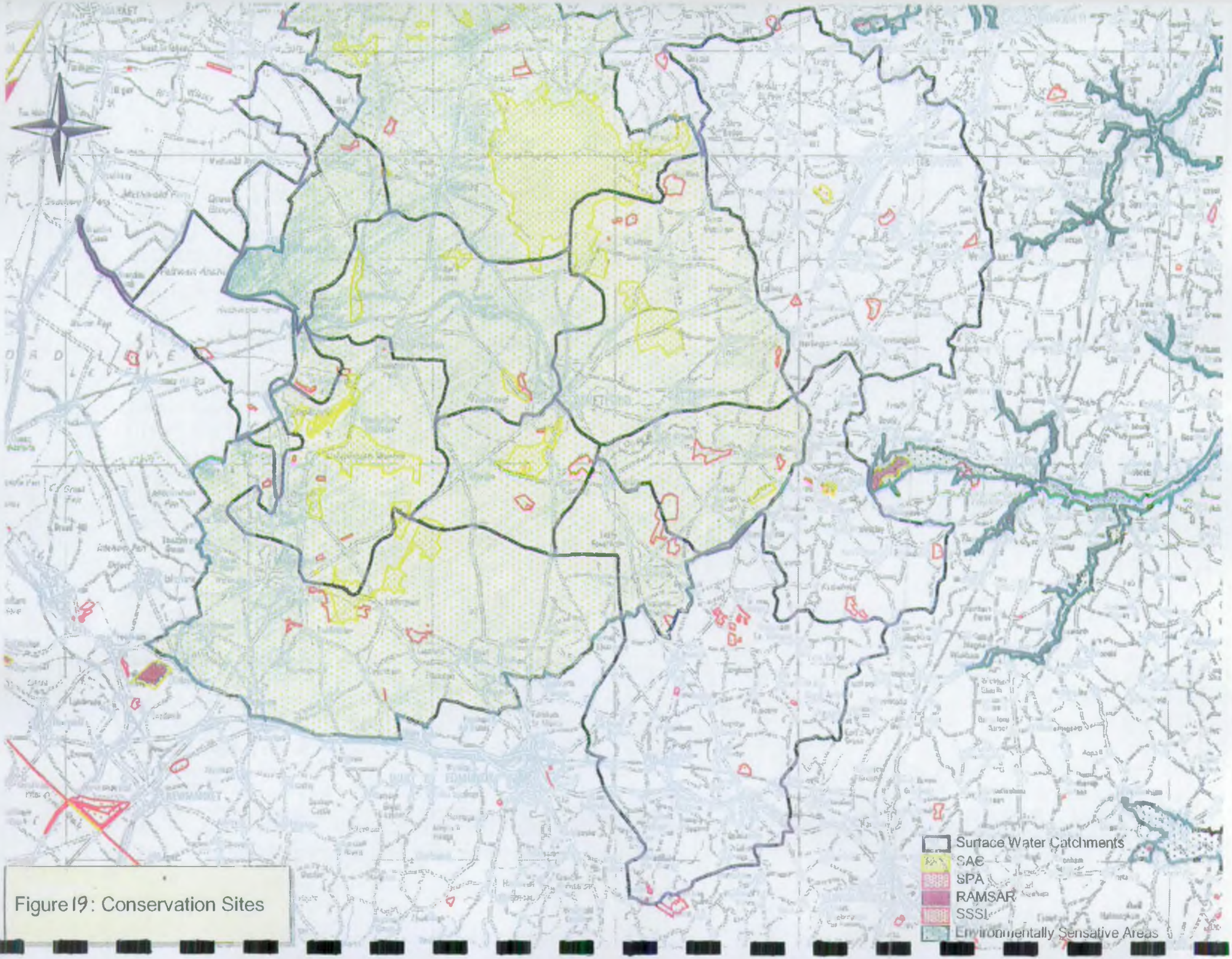


Figure 19: Conservation Sites

A4.2 Water Level Management Plans

The concept of Water Level Management Plans (WLMP) was introduced by the Ministry of Agriculture Fisheries and Food (MAFF) in 1994. The plans provide a framework by which the water level requirements of a particular site can be discussed, and the range of activities that take place within the site (such as agriculture, conservation and flood defence) can be incorporated and integrated. The Environment Agency has a responsibility to be involved in the production of the WLMP in consultation with other interested bodies such as English Nature, Internal Drainage Boards, conservation groups and landowners. The locations of WLMP within the Little Ouse Catchment are given in the Table 28 below.

Table 28: Water Level Management Plans

Water Level Management Plan	Approximate Grid Reference
Blo Norton and Thelnetham Fen	TM 017 790
Swagney Fen	TM 015 932
Pakenham Meadows	TL 923 668
Stallode Wash	TL 675 853
Wangford Warren	TL 758 833
Thetford Golf Course and Marsh	TL 845 838

A5. FISHERIES

The Little Ouse catchment supports only coarse fish rather than salmonid fish. In the upper section of the Little Ouse (above Barnham) the river channel is characterised by a series of riffles and pools over a predominantly gravel substrate. This is reflected in the fish species present, with the population dominated numerically by dace and gudgeon.

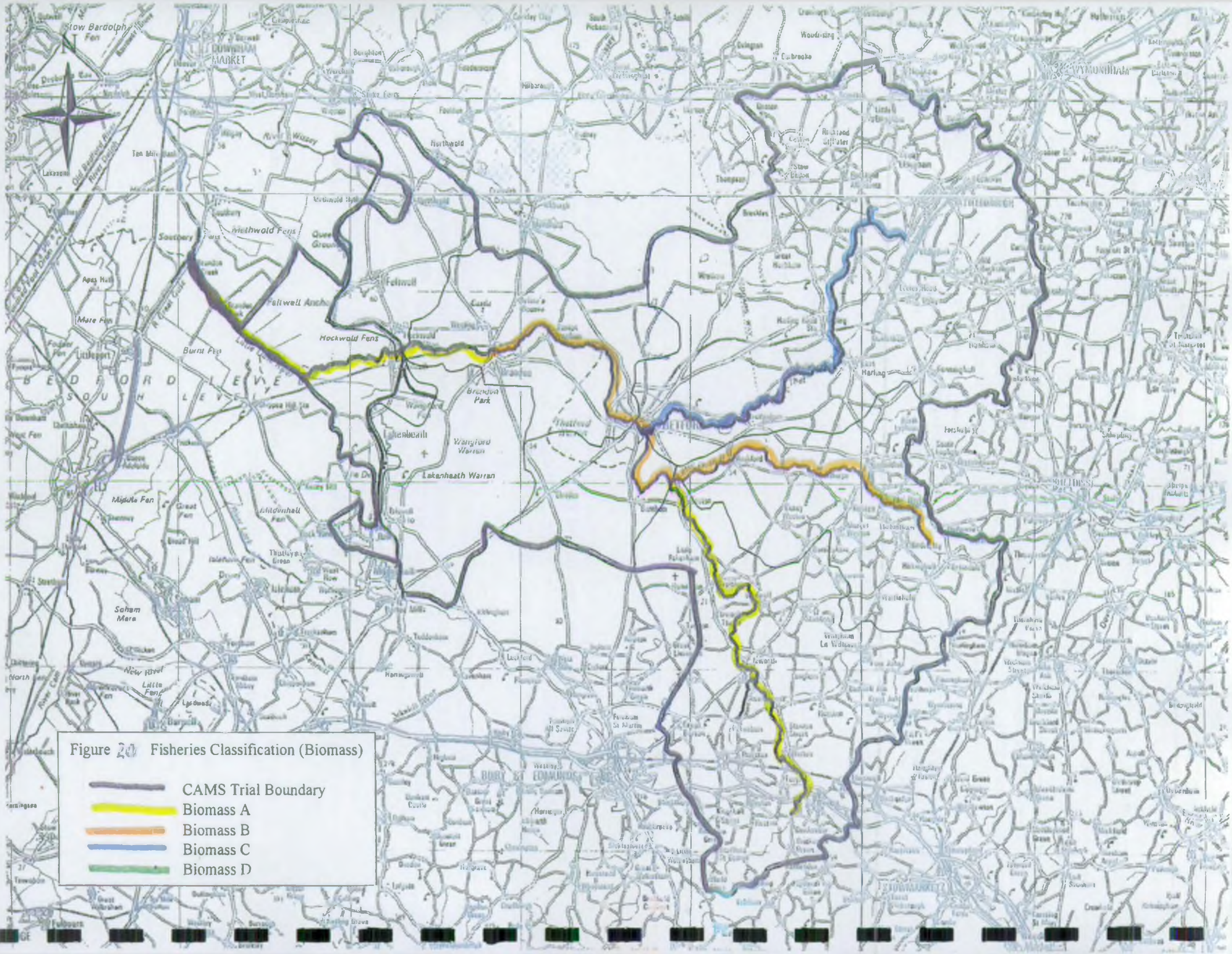
The Lower Little Ouse is an important Coarse Fishery with populations of roach, bream and pike. As the river flows across the fenland it slows and becomes more eutrophic. However the level of water is more important than flow to these fish species since they spawn on plants and do not rely on clean gravels in the channel.

The river Sapiston has the best fish population of all the main rivers in this CAMS area. A Class 'A' fishery was recorded in the last survey of the Sapiston. Dominant species in the Sapiston are roach, dace and chub.

Figure 20 shows the fisheries class of each main river in this area. Fisheries classes are defined on the basis of biomass as follows:

Class A: $>20 g/m^2$
Class B: $10 - 20 g/m^2$
Class C: $5 - 10 g/m^2$
Class D: $< 5 g/m^2$

For further information on fisheries refer to Viewpoint 5 of the Ely Ouse Environment Overview (1999).


Stow Bardolph Fen
DOWNHAM MARKET
Methwold Fens
Feltwell
Hockwold Fens
Lakenheath
Lakenheath Warren
Brandon Park
Harling
Middle Fen
Mere Fen
Burn Fen
Soham Mere
New River
Little Fen
Figure 20 Fisheries Classification (Biomass)
CAMS Trial Boundary
Biomass A
Biomass B
Biomass C
Biomass D

A6. NAVIGATION

The River Little Ouse is presently navigable from its confluence with the River Ely Ouse to Brandon Staunch (TL 780 867), a distance of some 20km. The navigation used to extend to Thetford, and there are plans to extend it into Brandon town centre. In 1998 the Environment Agency secured some additional funding from the European Union for a navigation improvement project on the Little Ouse near Hockwold. For further information on navigation in the area refer to Viewpoint 6 of the Ely Ouse Environment Overview (1999).

A7. WATER QUALITY

The Environment Agency monitors the quality of river water and groundwater in the CAMS area. Monitoring involves the chemical and biological analysis of samples taken from rivers, effluents, wells and boreholes.

Licenced discharges of effluent are shown on Figure 21. Each of these are sampled twelve times a year.

Figure 22 shows the target River Ecosystem (RE) class of each main river in the area. The RE class is based on chemical quality standards. The classes can be seen in Table 29 below.

Table 29: RE Classes

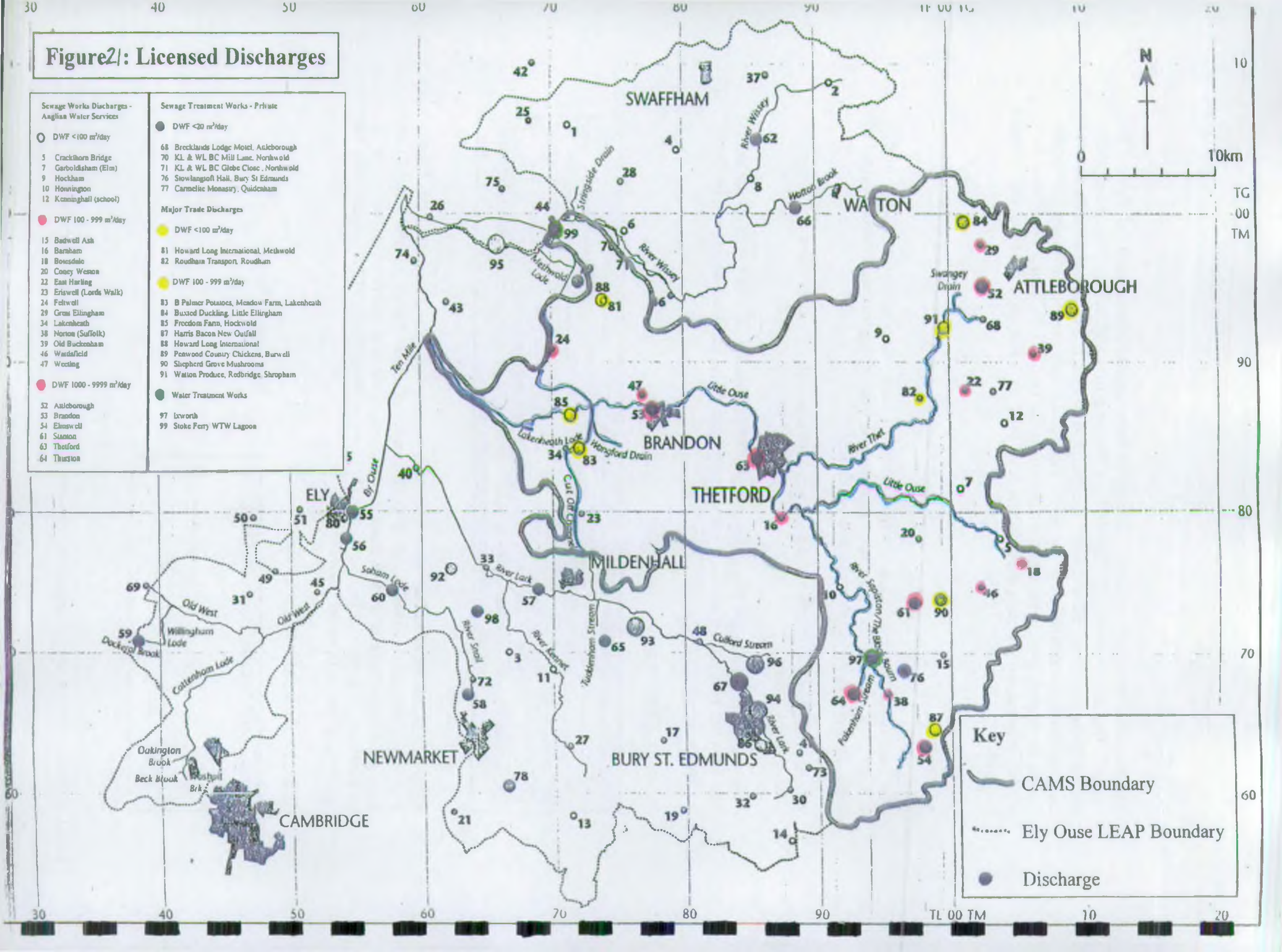
Class	Description
RE1	Water of very good quality suitable for all fish species
RE2	Water of good quality suitable for all fish species
RE3	Water of fair quality suitable for high class coarse fish populations
RE4	Water of fair quality suitable for coarse fish populations
RE5	Water of poor quality that is likely to limit fish populations
Unclassified	Water of bad quality in which fish are unlikely to be present or insufficient data available by which to classify water quality.

Figure 23 shows the actual RE class grades as recorded up to and including 1997 data. Figure 24 shows the Biological (GQA) grade of main rivers in the area. The biological assessment scheme is based on groups of aquatic macroinvertebrates such as mayflies, shrimps, beetles and bugs. The general description of Biological (GQA) grades is given in Table 30 below.

Table 30: Biological (GQA) Grade

Biological (GQA) grade	Description
A	Very good
B	Good
C	Fairly good
D	Fair
E	Poor
F	Bad

Figure2/: Licensed Discharges



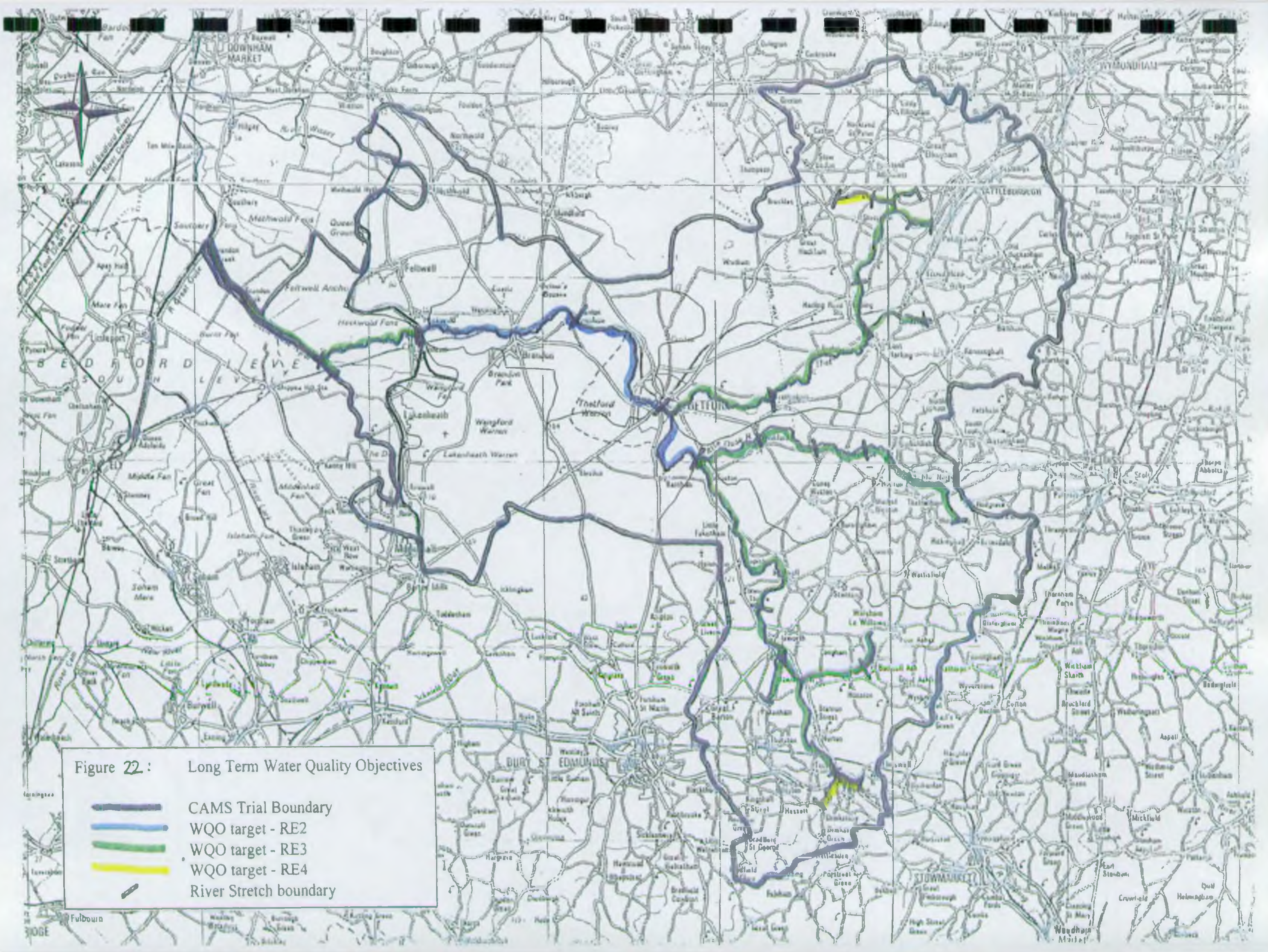


Figure 22: Long Term Water Quality Objectives

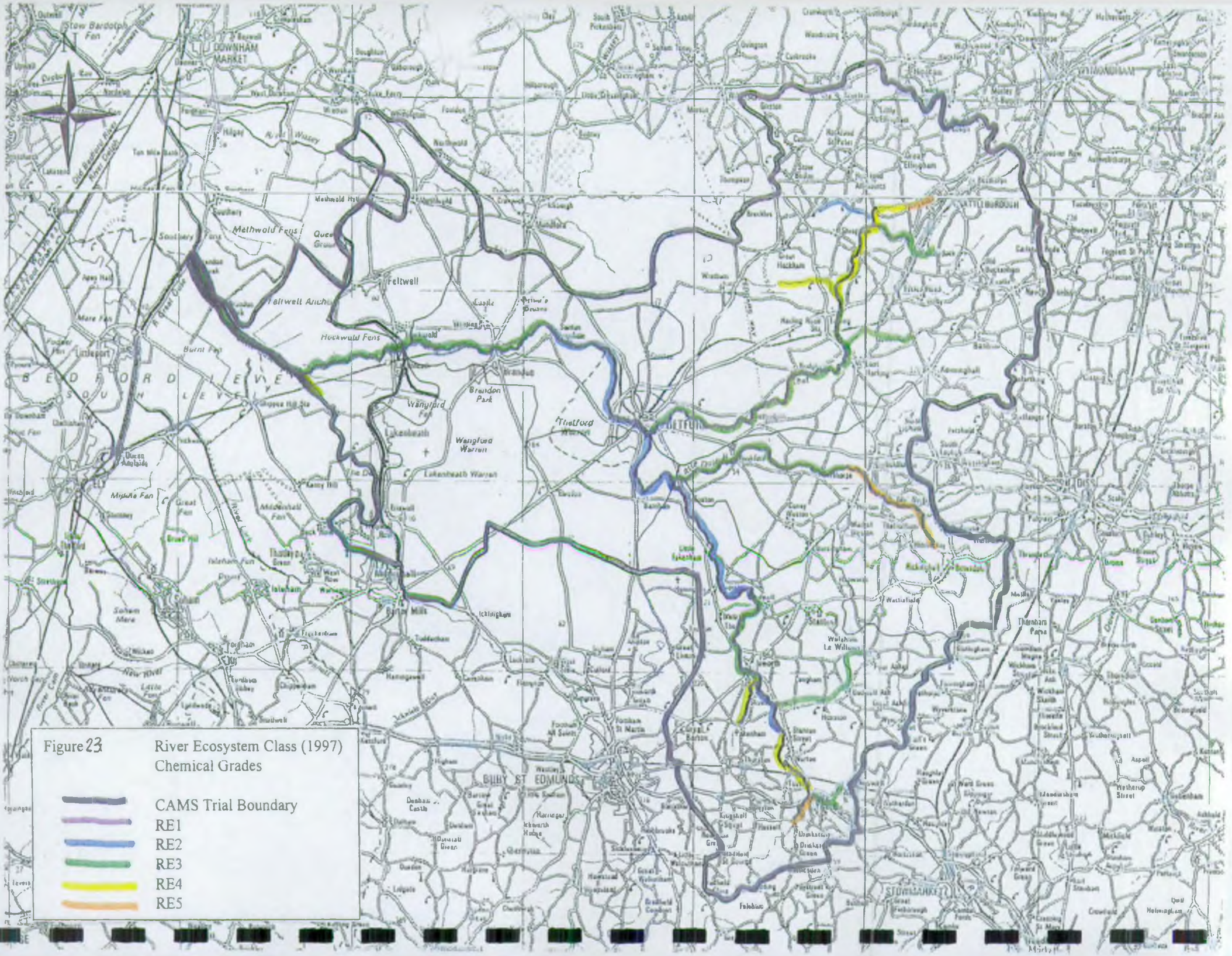


Figure 23
River Ecosystem Class (1997) Chemical Grades
CAMS Trial Boundary
RE1
RE2
RE3
RE4
RE5

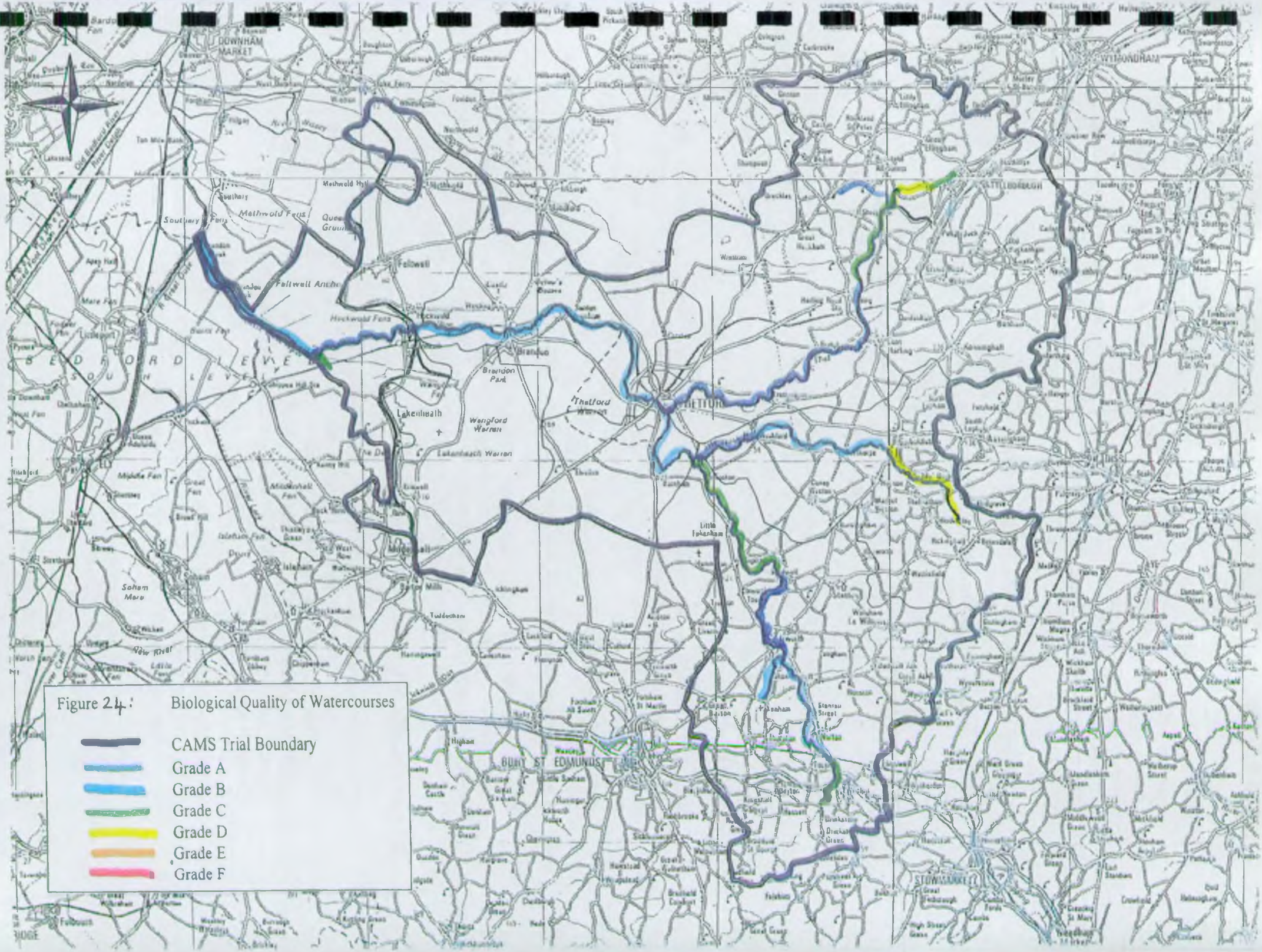


Figure 24: Biological Quality of Watercourses
CAMS Trial Boundary
Grade A
Grade B
Grade C
Grade D
Grade E
Grade F

For further description of water quality objectives and water quality grades of rivers in the CAMS area refer to section 4.3 of the Ely Ouse Environment Overview 1999.

For information on the quality of groundwater refer to section 4.4 of the Ely Ouse Environment Overview 1999.

A8. WATER RESOURCES METHODOLOGY

A8.1 Definition of the Little Ouse Groundwater Unit

Figure 4 shows the area of the Chalk aquifer which contributes to the flows in the rivers Thet, Little Ouse and Sapiston. This area, known as the Little Ouse groundwater unit is slightly different in extent but is the best basis for determining policy with respect to the licensing of abstraction from Chalk groundwater.

The western boundary of the groundwater unit is defined where the base of the Totternhoe Stone horizon within the Chalk reaches the surface. This is a hard rock layer in the Chalk. Most abstraction from the Chalk occurs from boreholes drilled in to the aquifer above or down to this layer. The Chalk aquifer below this layer yields significantly less and is not utilised in significant quantities.

The other boundaries are based on groundwater divides (lines of high spots in the groundwater table) derived from the minimum level of the Chalk groundwater table as experienced in 1976, and mapped by British Geological Survey. This is the most recent published information but it is probable that the recent drought years produced a different pattern of groundwater divides.

A8.2 Calculation of the Groundwater Resources in the Little Ouse

The calculations have been made for the whole of the groundwater unit and for four subdivisions. The sub divisions have been made looking at groundwater contours and describe the areas of aquifer which contribute to each of the tributaries above Thetford and the remainder of the river Little Ouse below Thetford.

A8.2.1 The Available Groundwater Resource

The Wright equations have been used to calculate the Gross Resource (C.E. Wright, 1974). There are three equations that have been used. The first for areas of Chalk outcrop, the second for areas of Chalky Boulder Clay over Chalk which allows some rainfall to penetrate to the Chalk below and finally the third equation is for areas of Jurassic Boulder Clay over Chalk which allows less rainfall to infiltrate. The equations are given as:

The Infiltration through Chalk: $I = 0.81 \times R - 308$ (mm/a)
The Infiltration through Chalky Boulder Clay: $I = 0.202 \times R - 70$ (mm/a)
The Infiltration through Jurassic Boulder Clay: $I = 0.202 \times R - 77$ (mm/a)

Where R = long term average annual rainfall (mm)
I = infiltration (mm)

Table 31 shows the areas of different geology.

Table 31: Geology

Area	Areas of Geology (km2)		
	Total Area	Chalk	Boulder Clay
Whole Unit	970	434	536 (237*)
Sub Unit A (Thet)	309	72	237*
Sub Unit B (Upper Little Ouse)	171	76	95
Sub Unit C (Sapiston)	209	46	163
Sub Unit D (Lower Little Ouse)	281	240	41

* This Boulder Clay has been taken as Chalky Boulder Clay.

The rainfall statistics comprised of records from 23 rain gauging sites for the period 1996 to 1990. The statistics were averaged for the whole of the groundwater unit and gave a long term average rainfall figure of 586 mm per year.

The calculation made for the whole unit is given below:

Gross Resource: = (0.81 x 586 – 308) x 434 x 10-3
+ (0.202 X 586 – 70) x 237 x 10-3
+ (0.203 x586 – 77) x 299 x10-3
= 96164832 /365 days
= 263.44 tcmd

Table 32 below shows the results of the calculations.

Table 32: Water Balance Calculations

Area	Gross Resource(tcmd)
Whole Unit	263.44
Sub Unit A (Thet)	64.14
Sub Unit B (Upper Little Ouse)	45.47
Sub Unit C (Sapiston)	39.39
Sub Unit D (Lower Little Ouse)	114.44

Note: tcmd is thousand cubic metres per day

The Gross groundwater resource for the Little Ouse unit is **263 thousand cubic metres per day.**

The percentage reduction for Chalk aquifer conditions is 20. The Available groundwater resource is therefore 210 thousand cubic metres per day. Table 33 below lists the results for the sub units.

Table 33: Available Resource

Area	Available Resource (tcmd)
Whole Unit	210.75
Sub Unit A (Thet)	51.31
Sub Unit B (Upper Little Ouse)	36.38
Sub Unit C (Sapiston)	31.51
Sub Unit D (Lower Little Ouse)	91.55

A8.2.2 The Environmental Requirement for Water

Table 34 below shows the Naturalised 95 percentile flow which apply for the River Little Ouse and its tributaries. The flow figure has been derived from a computer model of the river network produced by Anglian Water Authority and the Water Research Centre in 1990, which has been subsequently calibrated to account for conditions between 1971 and 1992.

Table 34: Naturalised 95 Percentiles

Area	Naturalised 95%ile (tcmd)
Whole Unit	144.70
Sub Unit A (Thet)	54.43
Sub Unit B (Upper Little Ouse)	14.23
Sub Unit C (Sapiston)	13.82
Sub Unit D (Lower Little Ouse)	62.22

The direct abstractions from the river have been taken as all licenced summer abstractions. The quantities are given in table 35 below.

Table 35: Summer Abstractions

Area	Licenced Summer Abstractions (tcmd)
Whole Unit	5.27
Sub Unit A (Thet)	2.24
Sub Unit B (Upper Little Ouse)	0.39
Sub Unit C (Sapiston)	0.78
Sub Unit D (Lower Little Ouse)	1.82

The effluent return is calculated as the sum of the following elements:

75% of the sum of all Dry Weather Flows from Discharge Consents to the catchment (Public Supply and Industry)
75% of water licenced for Private Water Undertaking
95% of water licenced for non-consumptive Cooling Water
90% of water licenced for Agriculture and other Miscellaneous Uses
(Spray Irrigation is considered to be entirely consumptive)

Table 36 gives the effluent return calculated for the whole unit and each sub unit.

The effluent return contributes to the river flow and hence provides part of the environmental requirement for water. The second column shows the environment allocation (as given in the previous section) minus the effluent return.

Table 36: Effluent Data

Area	Effluent Returns (tcmd)	Naturalised 95%ile minus Effluent Returns (tcmd)
Whole Unit	17.04	127.66
Sub Unit A (Thet)	3.03	51.40
Sub Unit B (Upper Little Ouse)	0.83	13.40
Sub Unit C (Sapiston)	3.93	9.89
Sub Unit D (Lower Little Ouse)	9.25	52.97

A8.2.3 Groundwater Abstractions

The total groundwater abstraction has been given as the total of licenced quantities per type of use. Table 37 below shows the water that has been allocated in the whole unit per use, and the next table shows the total abstraction divided per sub unit. The figures are given in thousand cubic metres per day, which has been calculated from the annual licenced quantity divided by 365 days.

Table 37: Groundwater Abstractions by Use

Licenced Abstraction	Quantity (tcmd)
Public Water Supply	54.81
Spray Irrigation	15.56
Industrial	4.93
Cooling	1.01
Agricultural	2.82
Private Water Undertaking	0.90
Crown Exempt	1.50
Total	**81.53**

Table 38: Groundwater Abstractions by Area

Area	Groundwater Abstraction (tcmd)
Whole Unit	81.53
Sub Unit A (Thet)	12.28
Sub Unit B (Upper Little Ouse)	31.58
Sub Unit C (Sapiston)	19.41
Sub Unit D (Lower Little Ouse)	18.26

These figures do not include the quantity of water licenced for raw water transfer in particular the water allocated to the Great Ouse Groundwater Scheme, which allows abstraction from boreholes for discharge to the rivers for subsequent transfer to meet public water supply needs. The method could take this quantity into account by

assuming that all abstraction made in excess of the Environmental Allocation for water (that is the water that would be just to benefit export and not meet local needs) should be taken into account and counted as abstraction.

A8.2.4 The Groundwater Balance

The final calculation showing the balance of supply versus demand for water in the Little Ouse groundwater and the sub units is given in Table 39 below.

Table 39: Groundwater Balance

Area	Surplus or Deficit (tcmd)
Whole Unit	- 3.67
Sub Unit A (Thet)	-14.61
Sub Unit B (Upper Little Ouse)	- 8.99
Sub Unit C (Sapiston)	1.43
Sub Unit D (Lower Little Ouse)	18.50

A9. WATER RESOURCES

A9.1 Abstractions

Water is abstracted from rivers (surface water) and the ground (groundwater) and used for several purposes that are outlined below. Abstractions of water, apart from a few statutory exceptions, require a licence under the Water Resources Act 1991.

The Environment Agency only issue a licence if there is sufficient water available, the need for the water is justified, all rights of existing users are protected and the water environment (e.g., rivers, springs and wetland sites) is not unacceptably affected. Abstraction from surface water sources is subject to low water level or flow restrictions in order to protect the river and downstream users (low flows will have an impact on the effect of any discharges). The final use of the abstracted water can be constrained by its quality. The Environment Agency do not guarantee the quality of ground or surface waters for the suitability of its use, e.g. there may be a naturally high content of minerals such as iron.

The abstraction type is divided into potable water supply, agricultural use, industrial use and raw water transfer. The information is summarised in Figures 25 and 26. It should be noted that all the abstraction licence quantities and percentages quoted in the following sections are calculated for the whole of the Ely Ouse LEAP area. Thus they include licences from the catchments of the Little Ouse, Lark, Wissey and the Great Ouse from Earith to Denver.

A9.1.1 Potable Water Supply

The abstraction of water for public water supply (PWS) represents over 37% of all water licenced for abstraction. The locations of PWS sites in the CAMS area are shown on Figure 27.

Anglian Water Services Ltd (AWS) supply water to most of the population within the CAMS area. The company operates a comprehensive water supply mains network and hence the water can be distributed from the borehole or river source to the point of demand. After use the water is returned to the rivers via Sewage Treatment Works (STW). The total quantity of water licenced from sources in the Ely Ouse LEAP area to AWS is 52 million cubic metres per year. All of this concerns abstraction from boreholes into the Chalk aquifer.

Cambridge Water Company holds licences which enable them to operate three borehole sites near Thetford to meet the demands of people living in Cambridge. The total quantity licenced is 8.5 million cubic metres per year. Essex and Suffolk Water operate one source at Rickinghall for local needs. The total quantity licenced is 0.5 million cubic metres per year.

The CAMS area also supports a large number of groundwater sources used for private domestic supply. These abstractions are principally from the Chalk aquifer but there are some shallow wells into the sand and gravel deposits. The majority of this use is exempt from licensing under the Water Resources Act 1991. The small quantity that is licenced for private water supply is 0.3% of the total volume licenced.

A9.1.2 Agricultural Abstraction

Agricultural use of water comprises of stock watering, crop spraying, anti-frost spraying and spray irrigation. The Ely Ouse LEAP area is rural in nature and it is not surprising that the quantity licenced for agricultural abstraction is over 25% of the total volume licenced.

Water abstracted for spray irrigation is considered as a total loss to resources as the water is not returned to the river after use. Instead, the water is taken up by the crops or evaporates. Both rivers and groundwater are used for spray irrigation. The water resource is fully allocated for the groundwater and summer surface waters. Hence the only scope to meet the future needs of abstraction, in particular for spray irrigation, is to construct reservoirs in order to store winter river water to be used for the following summer.

Figure 25: Volume of Water Licenced in Ely Ouse LEAP Area

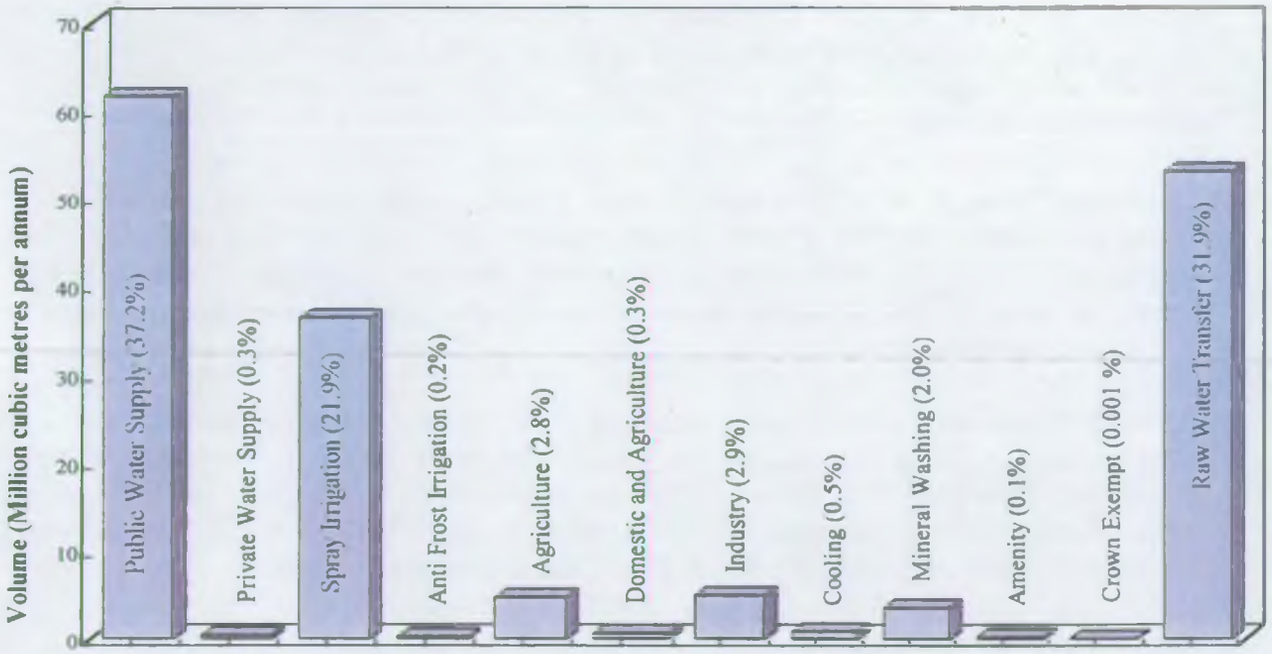
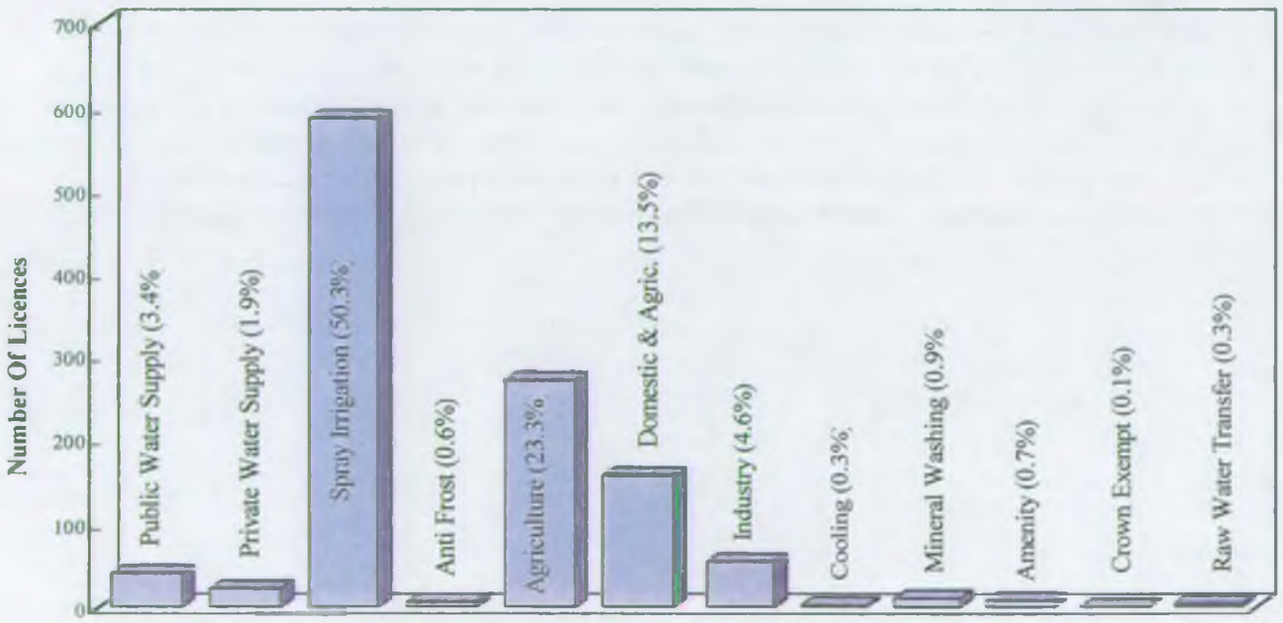


Figure 26: Number of Licences Issued in Ely Ouse LEAP Area



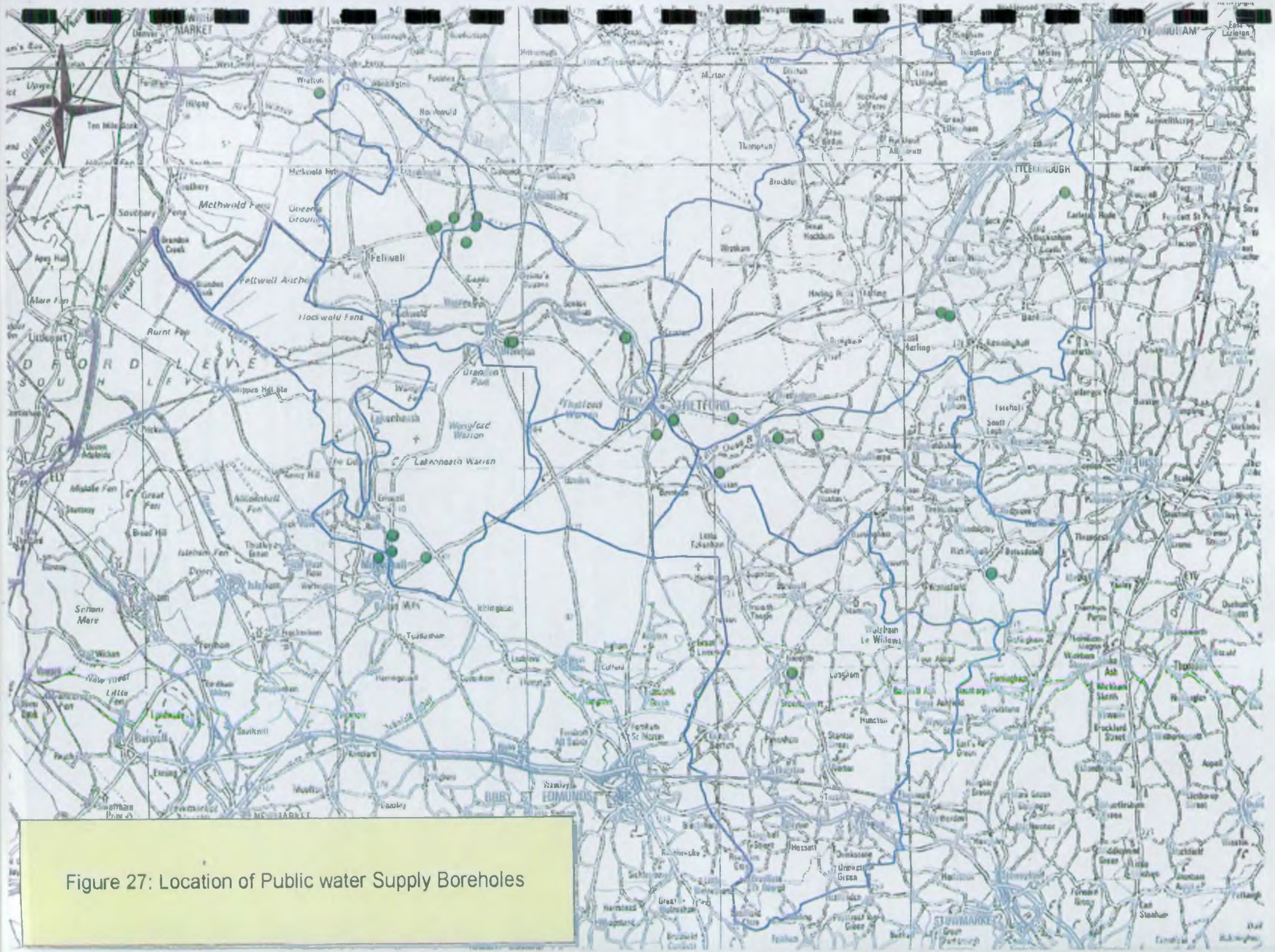


Figure 27: Location of Public water Supply Boreholes

The majority of spray irrigation in the fen areas uses water from the drains controlled by Internal Drainage Boards (IDB). Water is transferred to these drains via "slackers" (pipes and valves) from the main surface watercourses. This transfer of water supports both the use of spray irrigation and the water levels in the sub soil. The latter could represent up to ten times the quantity that is licenced for spray irrigation and is lost by evapotranspiration.

The Agency is unable to control the quantity of water transferred, as this abstraction does not require a licence. This is an important issue because during dry periods, up to 100% of the river flow could be transferred into the South Level system in this way. In practice, the Agency and the IDB work in co-operation to ensure that the needs in the river are meet as well as the irrigation needs in the fen. Any new or renewed irrigation abstraction licences since 1992 now contain a cessation clause which is designed to stop irrigation when flows become critically low at Denver.

A9.1.3 Industrial Abstraction

Most industrial needs are supplied by the water companies and the water is licenced as public water supply. The 68 licences held by individual companies refer to supplies from boreholes or the river directly for industrial use. The type of industrial use in the Ely Ouse LEAP area includes sand and gravel washing, vegetable washing, brewing, poultry processing, food processing, manufacture of drugs, bottling water and other manufacturing processes. The total quantity for industrial purposes is 9.2 million cubic metres per year.

The use of water for sand and gravel washing accounts for nearly 3.5 million cubic metres per year. Most of this water is taken from the shallow sand and gravel aquifers and most of the water is re-circulated during use. The estimated loss to the resource is 10% of the quantity abstracted.

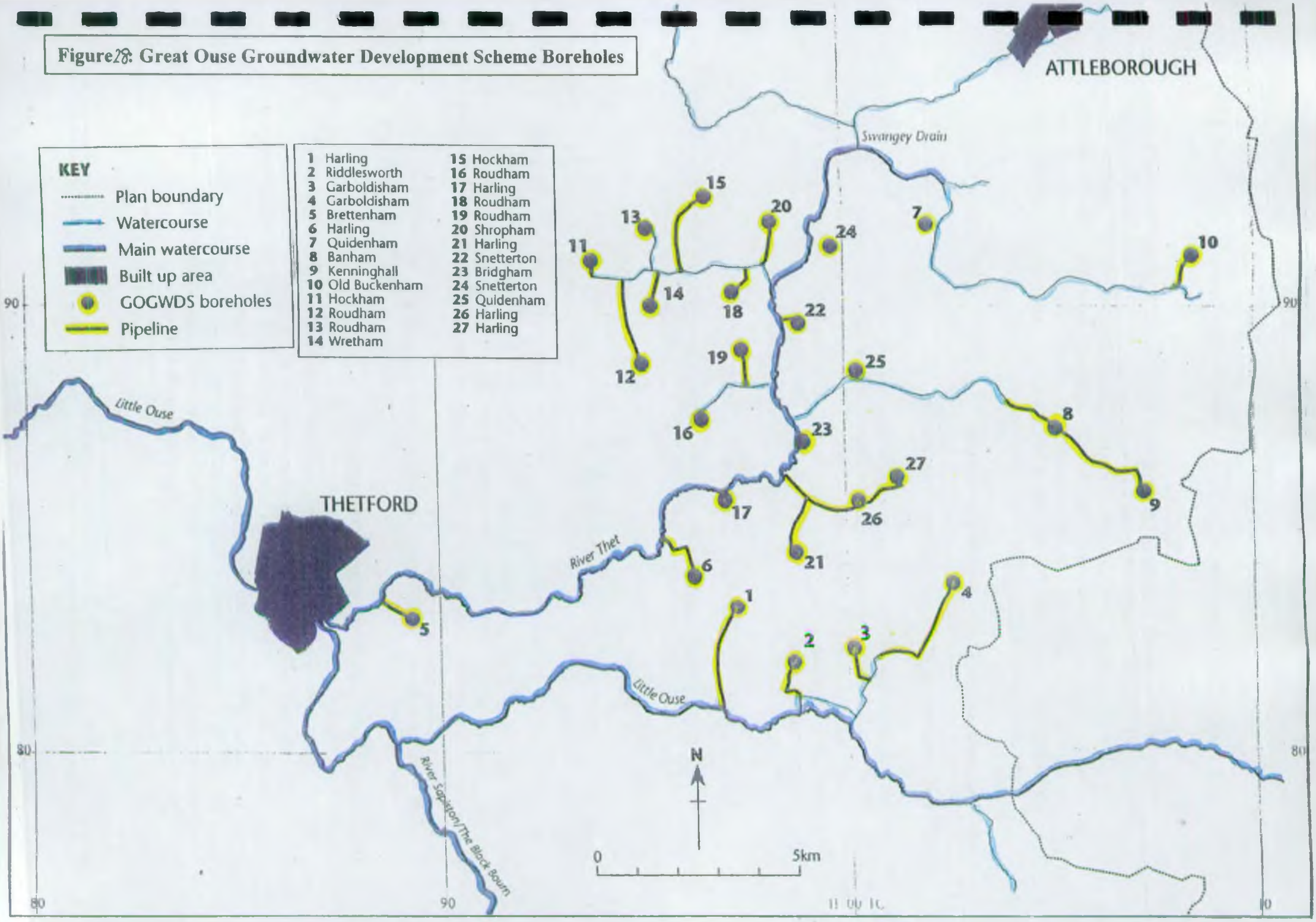
A9.1.4 Raw Water Transfer

The Agency has a responsibility to conserve, redistribute and protect water resources and, therefore, undertakes raw water transfers to redistribute water from areas of surplus to areas of local deficit. There are raw water transfers between river catchments and also within the same river catchment. Where possible the schemes use existing watercourses to redistribute the water.

The main scheme, which operates downstream of the CAMS area - the Ely Ouse to Essex transfer scheme - was promoted in the 1960s and authorised by the Ely Ouse to Essex Water Act 1968. The works were completed in 1971. Water is diverted at Denver from the Ely Ouse River into the Cut Off Channel and is subsequently pumped from the Cut Off Channel at Blackdyke through tunnels and pipelines and into Essex watercourses to augment the supply to PWS reservoirs there.

At times of natural low flows, the water availability in the Ely Ouse is insufficient to meet demands in Essex and a supplementary scheme was designed. This is the Groundwater Development Scheme and the Hockwold Transfer. The Agency operates 27 Chalk boreholes (see Figure 28) in order to pump water into the rivers Thet and Little Ouse. This water is subsequently transferred from the River Little

Figure 28: Great Ouse Groundwater Development Scheme Boreholes



Ouse to the Cut Off Channel at Hockwold, where the pipes have a capacity of 68 tcmd.

The boreholes were developed in the 1970s and authorised by the Anglian Water Authority (Great Ouse Groundwater Development) Order, 1976 following a Public Inquiry. Abstraction licences were issued and limit the quantity abstracted to 28.3 million cubic metres per year. The licences allow for more sites than have been drilled to date. In particular, the Agency has powers to drill 5 boreholes in the Sapiston sub catchment. The transfer at Hockwold was constructed in c.1985 and is licenced for 24.8 million cubic metres per year.

A9.2 Implementation of Abstraction Restrictions

A9.2.1 Implementation of Cessation Level Conditions

Many abstraction licences contain conditions curtailing abstraction when the river flow falls below a predetermined level. These levels are set to protect existing water users, and to prevent environmental damage. The Agency monitors the flows of the rivers used to set these restrictions, and informs the abstractors when they must cease abstracting, and when the flows have recovered such that they can once again abstract water. Table 41 shows the years when level restrictions have been applied.

Table 40: Implementation of Cessation Levels (Summer)

Site	Cessation Limit	Date Implemented (Sd= Start Date Ed= End Date**)								
		1990	1991	1992	1993	1994	1995	1996	1997	1998
Rectory Bridge	64 l/s *	Sd 12/07	Sd 31/07	Sd 15/06						
Rectory Bridge	84 l/s							Sd 23/07 Ed 13/09	Sd 08/08	
Euston	84.6 l/s *	Sd 31/07	Sd 24/07	Sd 29/06 Ed 13/07						
Redbridge	110 l/s *	Sd 25/07	Sd 16/08							
Bridgham	350 l/s									

Notes: * these cessation limits were revised after 1993
** if end dates are not shown it should be assumed that condition continued until the end of summer irrigation season

A9.2.2 Implementation of Voluntary Restrictions

Voluntary restrictions on abstraction during the summer were encouraged in 1992 in response to the reaction of farmers to a total ban in the summer of 1991. In the Sapiston eleven groundwater users agreed to implement a 50% restriction from the beginning of the irrigation season and the scheme was formalised into the Pedders Way Group in February 1992. As resources became limited this voluntary ban on groundwater was supplemented by a 50% surface water restriction and enforced by a 50% groundwater restriction for the Sapiston groundwater unit.

A9.2.3 Implementation of Section 57 Spray Irrigation Restrictions

Under section 57 of the Water Resources Act, 1991 the Agency is entitled to restrict certain categories of abstraction during drought periods. Details of the restrictions as applied in this area from 1990 to 1998 are given in Table 41.

Table 41: Section 57 Abstraction Restrictions

River	Type	Notes	Date Implemented (Sd= Start Date Ed= End Date)								
			1990	1991	1992	1993	1994	1995	1996	1997	1998
Ely Ouse Upper Reaches	S.57		Summer								
Ely Ouse Upper Reaches	S.57	7 nights x 50% only							Sd 23/07	Sd14/08 Ed 06/11	
Ely Ouse Upper Reaches	S.57	4 nights x 50% only						Sd 23/08 Ed 13/09	Sd 31/07 Ed 20/12		
Ely Ouse Upper Reaches	Vol	Night time only						Sd 10/08 Ed 13/09			
Sapiston	S.57	See text for details	Early Summer	August	Summer						
Sapiston	S.57	4 nights x 50% only							Sd 13/09 Ed 20/12		
Sapiston	Vol	50% restriction			Summer G/W						

In 1990 general restrictions were applied on all Ely Ouse catchments including those of the Thet and Little Ouse because the total output of the GOGWS was required for transfer via Hockwold to the Cut-Off-Channel. In 1990 the Sapiston restrictions were imposed earlier than the general ban in direct response to low water levels and fisheries problems. In 1991 a 50% groundwater restriction was issued in the Sapiston as flows reached 70 l/s. Following further decline in flows to 30 l/s partial surface water restrictions were imposed. These partial restrictions did little to halt the decline, and a total ban in the Sapiston was instituted in mid-August. In 1992 the voluntary restrictions imposed by the Sapiston group were backed up by a 50% restriction in SW use as flows began to reduce to 70 l/s. As flows dropped to approximately 30 l/s total surface water bans were introduced and the river support scheme switched on.

In the summers of 1995, 1996 and 1997, Section 57 Restrictions were again applied to the upper reaches of the Ely Ouse, including the Thet, Little Ouse and Sapiston. Abstraction was restricted to 50% of licenced quantities and to night-time only.

A9.2.4 Implementation of Breckland Meres Policy (1988 onwards)

The cessation level applicable to licences included in the Breckland Meres Policy is 27.5mAOD as measured at Ringmere gauge-board TL98/166. Records indicate that water levels at Ringmere fell below the cessation level in early July 1990 and remained below the cessation level until early January 1994. During the 1996 to 1997

drought period, water levels at Ringmere fell below the cessation level in April 1996 and remained below the cessation level until June 1998. The Breckland Meres Policy was implemented during these periods.

A10. OPERATION OF THE GREAT OUSE GROUNDWATER SCHEME

The Environment Agencies Great Ouse Groundwater Scheme is authorised under licence number 6/33/42/74. This authorises the abstraction of 500m^3/hour, 11000 m^3/day and 3000000 m^3/year, with an aggregate of 5200 m^3/hour, 62400 m^3/day and 10550000 m^3/year. Table 42 below shows the usage of the boreholes since 1989.

Table 42: Abstraction from the Great Ouse Groundwater Scheme

Operation of Great Ouse Groundwater Development Scheme (1) Licence 6/33/42/74

Each source is licensed for 500m³/hr, 11000m³/d, 3000000m³/yr with an aggregate of 5200m³/hr, 62400 m³/d, 10550000 m³/yr or 17570000 m³ in 600 days from 1st April in any year.

Site No.	Site Name	National Grid Ref.	Drilled Y/N	Operational Y/N	Actual Abstraction (tcma)									
					1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
4	Harling	TL 9716 8298	Y	Y	Nil	Nil	243.84	166.87	Nil	Nil	226.14	274.83	194.74	Nil
5	Riddlesworth	TL 9855 8176	Y	Y	Nil	Nil	381	260.83	Nil	Nil	255.90	468.43	163.17	Nil
6	Garboldisham	TM 0011 8198	Y	Y	Nil	Nil	1014.73	695.30	Nil	Nil	713.73	763.57	Nil	Nil
7	Blo' Norton	TM 0163 8022	N	N	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
9	Garboldisham	TM 0251 8361	Y	Y	Nil	Nil	548.64	375.84	Nil	Nil	437.72	0.54	Nil	Nil
13	Euston	TL 9033 7977	Y	Sold to CWCo.										
15	Euston	TL 9344 8142	Y	Sold to CWCo.										
17	Euston	TL 9383 7943	N	N	← Nil →									
18	Bardwell	TL 9423 7722	N	N	← Nil →									
20	Knettishall	TL 9577 7946	N	N	← Nil →									
21	Barningham	TL 9616 7749	N	N	← Nil →									
24	Hepworth	TL 9915 7646	N	N	← Nil →									
25	Wattisfield	TL 9983 7250	N	N	← Nil →									
26	Thelnetham	TM 0009 7792	N	N	← Nil →									
27	Rickinghall Inferior	TM 0166 7290	N	N	← Nil →									
28	Hinderclay	TM 0223 7568	N	N	← Nil →									
29	Hinderclay	TM 0283 7714	N	N	← Nil →									
30	Rickinghall Superior	TM 0499 7349	N	N	← Nil →									
31	Botesdale	TM 0539 7568	N	N	← Nil →									
32	Burgate	TM 0699 7453	N	N	← Nil →									

Operation of Great Ouse Groundwater Development Scheme (2) Licence 6/33/44/137

Each source is licensed for 500m³/hr, 11000m³/d, 3000000m³/yr with an aggregate of 6240m³/hr, 74880m³/d, 13070000m³/yr or 21780000 m³ in any period of 600 days from 1st April in any year.

Site No.	Site Name	National Grid Ref.	Drilled Y/N	Operational Y/N	Actual Abstraction (Iema)									
					1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1	Brettenham	TL 8890 8281	Y	Y	468	1212	2004	1044	Nil	Nil	1476	89.57	420.14	Nil
2	Brettenham	TL 9109 8233	Y	Sold to CWCo.										
3	Harling	TL 9612 8369	Y	Y	828.12	667.32	1342.68	Nil	← Nil →					
8	Quidenham	TM 0214 9168	Y	Y	Nil	683.6	272.25	Nil	Nil	Nil	622.23	213.74	Nil	Nil
10	Banham	TM 0509 8710	Y	Y	Nil	840.24	1299.26	677.0	Nil	Nil	546.83	653.52	622.416	Nil
11	Kenninghall	TM 0713 8562	Y	Y	Nil	451.83	132.8	Nil	Nil	Nil	292.90	199.22	Nil	Nil
12	Old Buckenham	TM 0835 9100	Y	Y	Nil	806.4	1286.4	835	83.25	Nil	39.26	Nil	Nil	Nil
53	Hockham	TL 9393 9060	Y	Y*	Nil	Nil	684.7				← Nil →			
54	Roudham	TL 9492 8851	Y	Y*	Nil	Nil	36.33				← Nil →			
55	Hockham	TL 9515 9150	Y	Y*	Nil	Nil	224.11				← Nil →			
56	Wretham	TL 9512 9013	Y	Y*	Nil	Nil	135.77				← Nil →			
57	Hockham	TL 9629 9215	Y	Y*	Nil	Nil	200.1	Nil	Nil	Nil	Nil	Nil	18.29	Nil
58	Roudham	TL 9637 8723	Y	Y(iron)	418.28	Nil	Nil	Nil	Nil	Nil	111.10	Nil	Nil	Nil
59	Harling	TL 9694 8550	Y	Y	422.3	496.1	684.7	Nil	Nil	Nil	504.79	16.42	205.20	Nil
60	Roudham	TL 9714 9047	Y	Y	165.13	456.84	706.41	368.0	Nil	Nil	403.87	485.78	177.30	Nil
61	Roudham	TL 9737 8883	Y	Y	560.63	239.36	Nil	Nil	Nil	Nil	271.91	37.86	238.90	Nil
62	Shropham	TL 9810 9179	Y	Y	242.62	37.32	Nil	Nil	Nil	Nil	377.18	816.71	181.88	Nil
63	Harling	TL 9863 8424	Y	Y	Nil	Nil	169.34				← Nil →			
64	Snetterton	TL 9877 8944	Y	Y	388.0	456.17	629.59	Nil	Nil	Nil	507.71	512.26	Nil	Nil
65	Bridgham	TL 9885 8674	Y	Y	311.47	Nil	504.34	Nil	Nil	Nil	341.73	408.41	144.20	Nil
66	Snetterton	TL 9941 9120	Y	Y	180.26	498.96	771.54	402.0	Nil	Nil	219.90	660.33	231.16	Nil
67	Quidenham	TM 0017 8837	Y	Y	Nil	Nil	194.65				← Nil →			
68	Harling	TM 0018 8541	Y	Y	Nil	Nil	165.24				← Nil →			
69	Harling	TM 0113 8595	Y	Y	231.34	243	375.75	Nil	Nil	Nil	71.16	3.82	8.07	Nil

GLOSSARY

Abstraction	The removal of water from any source, either permanently or temporarily.
Abstraction Licence	A statutory document issued by the Agency to permit removal of water from a source of supply. It is usual for both daily and annual limits to be set.
Alluvial	Sedimentary deposits resulting from the action of rivers. Typically composed of fine-grained material (e.g. silt) carried by the river and deposited in areas such as floodplains.
Above Ordnance Datum (AOD)	Land levels are measured relative to the average sea level at Newlyn in Cornwall. This average level is referred to as 'Ordnance Datum'. Contours on Ordnance Survey maps of the UK show heights in metres above Ordnance Datum.
Aquifer	A water bearing-stratum situated below ground level. The water contained in aquifers is known as groundwater.
Biochemical Oxygen Demand (BOD)	A standard test which measures over 5 days the amount of oxygen taken up by aerobic bacteria to oxidise organic (and some inorganic) matter.
Biodiversity	Diversity of biological life; the number of species present.
Biomass	Total quantity or weight of organisms in a given area or volume - eg, fish biomass is measured as grams per square metre (gm^{-2}).
Borehole	Well sunk into water-bearing rocks.
Boulder Clay	Rock-type deposited under glaciers as they move. It consists typically of a mixture of rock fragments, clay, sand and gravel.
Catchment	An area of land which collects and drains the water which falls on it. It is usually composed of a single river system and its tributaries
Coarse Fish	Freshwater fish other than salmon and trout.
Controlled Waters	All rivers, canals, lakes, groundwater, estuaries and coastal waters to three nautical miles from the shore, including the bed and channel (which may be dry for periods of time).
Cumecs	Cubic metres per second: equivalent to 86.4 thousand cubic metres per day.
Cyprinid fish	Coarse fish of high angling value (except pike and perch) such as roach, dace, bream and chubb.
Discharge Consent	A statutory document issued by the Agency. It can authorise entry and indicate any limits and conditions on the discharge of an effluent to a Controlled Water. A land drainage consent is an approval for specified structural works in areas under Agency control.
Dissolved Oxygen (DO)	The amount of oxygen dissolved in water. Oxygen is vital for life so this measurement is an important, but highly variable, indicator of the 'health' of the water. It is used to classify waters.
Drift	Transported superficial deposits, especially those transported by ice.
EC Directive	Legislation issued by the European Union that is binding on Member States in terms of the results to be achieved. It leaves to Member States the choice of methods.

EC Regulation European Community legislation having legal force in all Member States.

Ecosystem A functioning, interacting system composed of one or more living organisms and their natural environment, in biological, chemical and physical senses.

Effluent Liquid waste from industry, agriculture or sewage treatment plants.

Environmentally Sensitive Area (ESA) An area where traditional farming methods may be supported by grant aid from the Ministry of Agriculture, Fisheries and Food (MAFF) to support distinctive landscape, wildlife habitats or historic features.

Eutrophic A description of water which is rich in dissolved organic and mineral nutrients. At worst, such waters are sometimes beset with unsightly growths of algae.

Fish Biomass A measure of the quality of a fishery as found in terms of surveys. It is measured as mass per area (g/m^2).

Floodplain This includes all land adjacent to a watercourse over which water flows or would flow but for flood defences in times of flood.

Fluvial Relating to rivers.

General Quality Assessment (GQA) A new scheme replacing the National Water Council Classification system. It provides a means of assessing and reporting environmental water quality in a nationally consistent and objective way. The chemical grades for rivers introduced in 1994 uses BOD, Ammonia and Dissolved Oxygen limits for water quality between A (Very Good) and F (Bad). Other grades for estuarine and coastal waters are being developed and aesthetic components will be measured and graded by a system under trial at present.

Habitat The customary and characteristic dwelling place of a species or community.

Hydrology The study of water on and below the Earth's surface.

In-river needs The totality of requirements for the water environment and effluent dilution before abstraction is taken into account.

Internal Drainage Boards (IDBs) Authorities responsible for dealing with land drainage within a district. They are primarily concerned with agricultural land drainage but also may be involved with water supply to their district for agricultural purposes.

Main River The watercourse shown on the statutory 'Main River Maps' held by the Agency and MAFF. The Agency has permissive powers to carry out works of maintenance and improvement on these rivers.

Office of Water Supply Regulator of Water Supply Companies.

Potable Water Water of a suitable quality for drinking.

Public Water Supply (PWS) The supply of water by companies appointed as Water Undertakers by the Secretary of State for the Environment under the Water Industry Act 1991.

Q_{95} The flow of a river which is exceeded on average for 95% of the time.

Raw Water Water in its natural state; before treatment.

Return Period Refers to the frequency of a rainfall or flooding event. Flood events are described in terms of the frequency at which, on average, a certain severity of

	flow is exceeded. This frequency is usually expressed as a return period in years: a 1 in 50 year flood event would be expected to occur, on average, once every 50 years.
Riparian (Owner)	Owner of riverbank and/or land adjacent to a river. Normally owns riverbed and rights to mid-line of channel.
River Corridor	The continuous area of river, river banks and immediately adjacent land alongside a river and its tributaries.
River Quality Objectives	The level of water quality that a river should achieve, in order to be suitable for its agreed use. Is being replaced by Water Quality Objectives (WQOs).
Siltation	Action of depositing silt at the bottom of a river or lake. A deposit of clays and silts can be difficult to remove naturally as it requires turbulent flow and high velocities.
Site of Special Scientific Interest (SSSI)	A site designated under the Wildlife and Countryside Act 1981 by English Nature or the Countryside Commission for Wales as a result of its nature conservation or geological value.
(candidate) Special Area of Conservation (cSAC)	Sites designated under the EU Directive on the Conservation of Natural Habitats and Wild Fauna and Flora (92/43/EEC). These sites are designed to protect important wildlife habitats or threatened species.
Special Protection Area (SPA)	Sites designated under the EU Directive on the Conservation of Wild Birds (79/409/EEC). These sites are designated to protect specified rare or migratory bird species.
Spray Irrigation	The watering of crops by spraying, which can have high evaporative losses when compared with trickle irrigation or use of sluices.
Strata	A term applied to rocks that form layers or beds. Can also be applied to successive layers of any deposited substance such as the atmosphere, or biological tissue.
Surface Water	Water collecting on and running off the surface of the ground.
Sustainable Development	'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland definition).
Telemetry	A means of directly collecting data from remote sites.
Watercourse	A stream, river, canal or channel along which water flows.
Water Quality Objectives (WQO)	Water quality targets to secure specific formal minimum quality standards for specific stretches of water by given dates. A new component of these is introduced by 'The Surface Waters (River Ecosystem Classification) Regulations 1994', a classification scheme to be applied by Agency to the rivers and watercourses of England and Wales. Other existing standards operate already to give effect to various EC Directives for water quality.
Water Resource	The naturally replenished flow of recharge of water in rivers or aquifers.
Water Table	Top surface of the saturated zone within the aquifer.
Wetland	An area of low lying land where the water table is at or near the surface for most of the time, leading to characteristic habitats.

Winter Storage Reservoir	Reservoirs built by farmers to store water during the winter months when there is generally more water available than in the summer. The water is used during the subsequent irrigation season.
1:10 Year Drought/Flood	A drought/flood event with a statistical probability of occurring once in a ten year period (other periods may be specified in a similar way).
95% ile Limit	A numerical limit, specified in a discharge consent, which must be achieved or bettered for at least 95% of a specified time period.

ABBREVIATION - ACRONYMS

AMP3	-------	Asset Management Plan 3
AOD	-------	Above Ordnance Datum
AWS	-------	Anglian Water Services Ltd
BFI	-------	Base Flow Index
AMS	-------	Abstraction Management Strategy
NAMS	-------	National Abstraction Management Strategy
CAMS	-------	Catchment Abstraction Management Strategy
DETR	-------	Department of Environment, Transport and Regions
g/m^2	-------	grams per square metre
GOGWS	-------	Great Ouse Groundwater Scheme
GQA	-------	General Quality Assessment
GW	-------	Groundwater
IDB	-------	Internal Drainage Board
Km	-------	Kilometre
l/s	-------	Litres per second
LEAP	-------	Local Environment Agency Plan
LQI	-------	Lincoln Quality Index
LTA	-------	Long Term Average
m	-------	Metre
m^3/s	-------	Cubic metre per second
MAFF	-------	Ministry of Agriculture, Fisheries and Food
mm	-------	Millimetre
NAMS	-------	National Abstraction Management Strategy
NGR	-------	National Grid Reference
OFWAT	-------	Office of Water Services
PWS	-------	Public Water Supply
RE	-------	River Ecosystem Classification
S.57	-------	Section 57 of the Water Resources Act 1991
SAC	-------	Special Area of Conservation
SPA	-------	Special Protection Area
SSSI	-------	Site of Special Scientific Interest
STW	-------	Sewage Treatment Works
SW	-------	Surface Water
tcmd	-------	Thousand Cubic Metres per Day
WLMP	-------	Water Level Management Plan