National Rivers Authority

WATER RESOURCE PLANNING - STRATEGIC OPTIONS

Inception Report

May 1991

HALCROW

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For the attention of Mr J Sherriff

13 May 1991 Our ref WMG/WRP 17/017 Your ref

Dear Sirs

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

In accordance with the Brief for the above project, and further to recent discussions, we have pleasure in enclosing 15 copies of our Inception Report. The document describes progress to date on the study, and sets out our preliminary findings.

We understand that you intend to circulate copies to the 10 NRA regions, and would ask that you request them to review the report and comment back to you upon it at an early date, so that their views can be incorporated as the study proceeds.

We look forward to seeing you at the Progress Meeting here at 3.30 p.m. on 17 May. If you have any queries in the meantime, please do not hesitate to contact either myself or Patrick Hawker at this office.

Yours faithfully

J D Lawson

J D LAWSON

Encl.

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WATER RESOURCE PLANNING - STRATEGIC OPTIONS

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1 INTRODUCTION AND SUMMARY

1.1 Introduction

At the end of February 1991, the National Rivers Authority commissioned Sir William Halcrow and Partners Ltd to assess likely future public and private demand for fresh water in England and Wales up to the year 2021, and to identify and compare alternative strategies for responding to this demand. Such strategies are to include methods of demand management, as well as enhanced distribution and further source development.

Terms of Reference for the study are included at Appendix A. The work is to be carried forward by making maximum use of available data, rather than by undertaking extensive new analysis of a fundamental nature.

This Inception Report sets out progress to date on the study. It is focused principally on the collection and initial review of data from the various NRA regions. Data analysis continues, and any findings presented in this report are strictly preliminary, to be confirmed by further work.

The Inception Report will be followed in about three weeks' time by a Preliminary Report, in which the review of available resources will be presented in more detail. Presentation of both the Inception and Preliminary Reports during May allows time for the NRA regions to comment upon them, and for these comments to be incorporated in the Final Report of the study, which is due to be submitted at the end of July.

1.2 Summary

On the basis of the review of data completed so far, it appears that public water demand in England and Wales may grow from the present level of 17150 Ml/d to 20727 Ml/d by 2021. This takes no account of further measures which may be taken to control demand, other than achievement of currently published leakage control targets.

x 20%

Net private sector abstractions (excluding pumped storage electrical generating schemes) are currently estimated to total about 19700 Ml/d in a dry year, compared with the licensed entitlement of 38000 Ml/d. No forecast of future net private abstraction has been made yet; it is perhaps relevant that in the recent past there has been a decline in licensed entitlement, although the scope for further decline driven by the same forces - principally surrender of licenses by the power generating industry - must be limited. If an overall growth rate in private abstraction of 1% per year is assumed, net demand in 2021 will be 26550 Ml/d.

?

On the basis of a preliminary review of available resources and planned developments within each region, it appears that Thames and Anglian face major deficits in the future, whilst Welsh, North West and Northumbrian will continue to enjoy substantial surpluses.

This analysis has certain implicit presumptions about water quality, environmental impact and source yields which require further investigation. Indeed the question of present yields and potential for further development is seen as one of the more complex issues to be resolved by the study.

Whilst background reading to help identify and assess strategic options for responding to future demand is well underway, no firm conclusions have yet been reached.

2 DATA COLLECTION AND REVIEW

2.1 General

This project is steered by existing data on water demand and resources, which are generally available through the NRA regions. In order to make contact with representatives from the various regions, and to inform them about the objectives of the study and planned approach to it, a meeting was held in London on 5 March. All regions were represented, with the exception of Welsh Region, whose nominated delegate was unwell on the day.

In the course of this meeting, the background to the study was explained, and Halcrow's data needs were discussed. A questionnaire was circulated, with the request that the various regions start to pull together the data asked for in it, and send them direct to Halcrow. The questionnaire (see Appendix B) addressed various issues including:

(a) existing and forecast levels of public water supply and demand;

(b) extent of entitlement to private abstractions, and level of take-up of this entitlement;

(c) surface and groundwater resource commitment;

(d) environmental constraints on existing resources and future development.

As data from the regions were received by Halcrow, a meeting with each was held. In the course of these meetings, available information and issues of particular concern to the region were discussed. Notes of these meetings are included at Appendix C.

The range of data which have been provided so far by the various regions is summarised in Tables 1 - 4. As may be expected, there are differences between regions in both availability of data and the manner in which they are presented. Some information is still awaited, but in many cases it will be necessary to make inferences between regions in order to fill critical gaps.

The following sections of this report contain the findings of the review and analysis of the data provided so far. It is stressed that these findings are preliminary, and are subject to confirmation or amendment as work proceeds.

In parallel with the data collection exercise described above, an extensive literature survey is underway. This is directed primarily towards resource development and water supply and management practice in both the UK and overseas. Findings are being fed into the study as work proceeds, in order to help develop a sound understanding of such issues as the impact of various alternative demand management practices, the cost and

environmental implications of various strategic options, and the possible implications of global warming.

2.2 Existing Demand

2.2.1 Public Water Supply Demand

Existing public water demand data have been received for the water companies as average demand measured in megalitres per day, and overall figures are given in Table 5. Generally, the data have been broken down into umeasured, metered and unaccounted for water components, although in some cases only total consumption figures have been received so far. In a few instances, the unmeasured and metered components are further sub-divided into domestic, industrial and commercial usage (see Table 1).

Unmeasured domestic demand is a function of population connected to the public and consumption per capita. Population figures provided (Table 6) have generally been derived from county council figures, and appropriately allocated to the areas of supply by the water companies. The total population of 49.3 million excluding Northumbrian and Hartlepools Water Companies is slightly greater than is inferred from 'Waterfacts 1990' which gives an overall total of 50.4 million, including 1.2 million for Northumbrian Water.

Average consumption figures vary considerably, being for example 155 l/hd/day in the Wessex region and 125 l/hd/d in Yorkshire (see Table 7). These regional figures disguise even greater subregional variations; many water companies now assess per capita consumption by monitoring of sample areas and analysing the results across their areas according to the ACORN system of classifying residential property according to socio-economic grouping.

Which?

In considering per capita consumption it is interesting to compare UK experience with that of other nations. Figure 1 shows per capita consumptions for nine European countries, including Britain, in 1973 and 1983. Our 1983 use of 125 l/c/d is third lowest, and is less than half the highest figure, of 264 l/c/d, which relates to the consumption rate in Switzerland. It is perhaps gratifying that Swiss consumption actually declined between 1973 and 1983; however such a rate of use is difficult to contemplate for UK, given the extent of available resources. The background to the European figures is being investigated in order to form a better understanding of the circumstances surrounding them; it is understood that all supplies are fully metered, except in UK, Belgium and parts of the Netherlands.

Progress?

Unmeasured commercial demand data have been submitted either as a single value, or in some cases as a consumption figure measured in l/hd/day.

Where domestic metered demand is a significant proportion of demand, the metered population or number of dwellings is given. Extensive metering

trials are at present being carried out in various parts of the Southern Region, including Isle of Wight. With the transfer of domestic demand for Hampshire and Isle of Wight from the unmetered to the metered component, a 5% reduction has been made in anticipated demand, in recognition of early indications from the metering trials. During discussions with Southern Region NRA, it was suggested that this figure is conservative and that reductions in domestic demand of 10-15% are occurring as properties are metered (see Appendix C). Many companies require that meters should be installed at all new domestic properties, although the extent to which these are being used as a basis for billing is unclear.

The majority of industrial demand is now metered, and most companies intend to meter all present and future significant industrial and commercial consumers.

Source of data - 15 Aug. News or Business data.

Reported current levels of unaccounted-for water (UFW) are set out in Table 8 and range between about 11% (Hartlepools) and 31% (Southern). Comments made during discussions with NRA regions suggest that the lower figures should be treated with caution. It is certainly remarkable that some of the companies known to have devoted significant resources to metering and/or leak detection - and which may thus be considered to have better information than the others - report UFW figures which are among the highest. UFW is an area where there may be potential to reduce water demand significantly, and there is a strong public perception that more action is needed. Clearly, therefore, current as well as forecast levels of leakage merit further investigation as the project proceeds.

2.2.2 Private Abstractions

Private abstractions include all licensed abstractions not operated by water companies, except those relating to river regulations and catchment transfers.

Data obtained so far for each NRA region are shown on Table 2. Typically, the licence data are sub-divided into the use categories set out below. For the purposes of the study, the resource implications of each use type have been assessed as a percentage water loss, also indicated below.

	Use	Water Loss %
(a)	Evaporative Cooling	100
(b)	Industrial	30
(c)	Hydroelectric power, fish farming and water cress growing	0
(d)	Agriculture (excl spray irrigation)	~~20~~ 20 ~~100~~
(e)	Spray irrigation	100

Thus, for example, it is assumed that, on average, 30% of water abstracted privately for industrial use is lost to the resource system, and 70% is returned to it.

So far, four of the ten regions have been able to provide data on take-up of private abstraction licences. No clear pattern emerges, although overall the rate of take-up is about 50%. Based on the net loss figures quoted above, and the 50% overall take-up rate, preliminary estimates of existing net private abstraction demands have been prepared for nine of the NRA regions. These are presented in Table 9.

What about water undertakers - is this net loss?

Most regions have not specifically identified major private abstractors. This is often because no sector of private abstraction is dominated by a particular user. However, some regions have provided data from which significant individual abstractors can be identified.

2.2.3 Miscellaneous Abstractions

Data availability on abstractions for river support and (riverine) regional transfers, and by the British Waterways Board and the Crown, is indicated on Table 3.

Distinction is made between river support/riverine transfers and other types of abstraction, since the former do not strictly represent a resource loss, and the "same" water will usually be the subject of another abstraction downstream. In such circumstances it is important to avoid double accounting. For example, water abstracted via the Shropshire Groundwater Scheme and used to support the River Severn is subsequently abstracted from the river for, typically, public water supply.

British Waterways Board do not require licenses for canal feeders, which are usually diversions from rivers. Such abstractions do not represent a net loss in resource terms, although some diversions are inconvenient in that water is removed where it could very usefully be abstracted for other purposes, and returned where competing needs are less acute.

Crown properties are also exempt from licensing legislation. No detailed figures have been collected for such abstractions, as the amounts involved are believed to be small compared with other types of demand.

Not shown on Table 3 is data availability in relation to abstractions for dewatering of mineral workings, and abstractions which have been exempted from licensing procedures under Section 25 of the Water Resources Act, 1963.

Significant types of mineral working include:

(a) gravel excavation;

(b) quarrying below the groundwater table;

(c) coal mining.

The actual water resource implications of these activities are not fully known and are in any case likely to vary between sites. Generally gravel extraction does not entail significant dewatering, although evaporation losses occur from the open water surfaces both of current workings and of former workings which have been redeveloped for leisure. For present purposes, it is proposed to overlook these.

Recent planning consents governing quarrying below the water table usually require provision to be made for river flow support. However, the longer term implications of this activity are not known; in Wessex Region there are fears that the yields of Mendip spring sources may be being disrupted by quarrying below the water table.

Coal mine dewatering entails significant discharges to rivers in certain areas. It is unlikely that such water would otherwise reach surface streams, and to this extent the discharges may be seen as a gain in some cases. However, the water is often of very poor quality, and the activity is likely to decline further in the future.

? When does a stream go ?

There are Section 25 groundwater abstraction licensing exemptions in parts of South West, Severn-Trent and Welsh Regions. In the two former regions, the areas involved are underlain by strata which may be at best described as of very low permeability. However, there is no record of the numbers of boreholes being operated. For present purposes, it is assumed that the resource implications are negligible.

The exemption zone in Welsh Region includes West Pembrokeshire, which is underlain by more permeable strata. It is understood that some data exist on the extent of abstraction in this area, and details have been requested.

2.3 Forecast Demand

2.3.1 Public Water Supply

Data on future public water supply needs have been obtained from most of the water companies through the regional NRAs (see Table 1). Generally these forecasts extend to 2011, and are broken down into metered, unmetered and unaccounted for water. In the case of four water companies, only total consumption data have been obtained so far for the year 2011.

Typically the forecasts are based on a component approach, as follows:

(a) Unmetered demand: domestic component - county population forecasts and water company projections of per capita consumption; non-domestic component-growth indices for economic sector represented, or historic trend.

When from?

(b) Metered demand: As for unmetered non-domestic, with allowances for known changes (eg mooted major industrial developments).

(c) Unaccounted for water: achievement of published targets.

County population forecasts are not available after 2011, and projections beyond this data have been made by extrapolation.

A preliminary forecast for public water demand in the year 2021 is presented in Table 5 and typical data on population projections, per capita consumption and unaccounted-for water are included in Tables 6, 7 and 8 respectively. The overall total of 20727 Ml/d represents an increase of 21% over the current average daily public water demand of 17150 Ml/d in England and Wales. Regionally, significant increases on present demand levels are expected in Anglian (42%), Wessex (43%) and Thames (25%) with a decrease forecast for North West (5%). It is emphasised that the figures presented in Table 5 are very preliminary, and will be reviewed as the study proceeds. Sensitivity to a variety of factors will be tested, and ultimately it is anticipated that a range of values will be presented for 2021, rather than the single numbers shown in Table 5.

2.3.2 Private Abstractions

In recent years, the level of private abstraction has reduced due to de-industrialisation generally and the decline of coal-mining in particular.

Principal consumptive uses of private abstractions include the power industry and irrigators. The long-term trends in power generation are difficult to project following privatisation of PowerGen and National Power. These organisations have been circumspect in their public pronouncements, although it is clear that they intend to retain assets such as abstraction licences in the short to medium term.

Irrigation demand growth is also difficult to predict, particularly when the recent trends towards winter abstraction supported by storage as a condition of consent for new licence applications, and suspending irrigation during droughts, are taken into account. However, it is useful that the Region in which irrigation demand is most critical - Anglian - is one for which forecasts are available.

No regions besides Anglian have provided forecasts of private abstraction entitlements. For those other regions, therefore, forecasts will be prepared as part of the study, and this aspect has yet to be addressed. The approach will include a review of past trends and available literature, and take into account known development plans and work done by Anglian Region.

2.4 Existing Resources and Planned Developments

2.4.1 Existing Resources

Public and private fresh water needs are met by abstractions from ground and surface waters. The licensed entitlements for each region in 1987 are given in Table 10.

or are they actuals?

Groundwater abstraction may be used:

(a) directly, by piping the abstracted water to the point of demand;

(b) indirectly, by discharging the water to a stream in order to improve flows at a surface abstraction further down the catchment.

Surface water abstractions may be via intakes:

(a) on unregulated rivers

(b) in reservoirs or lakes

(c) on rivers regulated by groundwater abstraction or releases from a reservoir upstream.

The fundamental problem that needs to be overcome so that demand for water is greatest in summer when rainfall and river flows are low. Rainfall and flows are more plentiful in winter, but storage is required - in aquifers or lakes - to conserve them so that they can be used to eke out the more meagre resources which are available naturally in summer. Once a measure of storage is available, opportunities arise for conjunctive use of different source types - for example, an intake on an unregulated river can be operated conjunctively with a reservoir intake so that maximum use is made of the former in winter when natural flows are high, leaving the reservoir to fill up so that its full storage potential can be drawn upon through the summer. Because of the advantages of conjunctive use, and also for reasons of supply security, there has been a tendency towards improved source integration in recent years.

Comparison of the licensed data in Table 10 with the existing public and private demand data shows that commitment exceeds entitlement in some regions. Thus, significant transfers of water occur between regions, as shown in Figure 2. Such a comparison is simplistic, however, since there is no guarantee that water will be available at a given place and time to fulfil the licensed entitlement there. Alternatively, taking the full entitlement may lead to an unacceptable level of flow depletion.

These problems are endemic in the UK Water Industry, and reflect the history of abstraction licensing in this country. In particular, many public water supply licenses were issued for pre-existing schemes in the months immediately following Assent of the Water Resources Act, 1963; in order to avoid rendering past operating practice illegal, and to ensure that adequate entitlements were available whilst at the same time avoiding excessive delay in granting these Licenses of Right, many of the annual volumes authorised then paid scant regard to what the particular sources could actually yield. Furthermore, many Licenses of Right - and licenses issued in the normal way in the years following the 1963 Act - did not include any residual flow conditions to safeguard the river downstream.

In the case of groundwater, the relationship between abstractions and natural springflow is often complex, and there are several well documented cases where surface flows are severely affected by groundwater abstraction.

In defining resources, therefore, it is important to distinguish between entitlement and sustainable yield. Most regions can provide data on source outputs, but the manner in which these are assessed is not always consistent. This area will be investigated further as the study proceeds. Also, there are many instances where the current level of output is regarded as excessive in terms of environmental impact; problems on the River Darent in Kent can best be solved by reducing the level of abstraction (although this is not feasible until further resource development takes place elsewhere) and heavy over-abstraction of groundwater occurs in the Lower Trent area. In Wessex, resolution of various environmental problems would require an overall decrease in average annual abstraction across the region of perhaps 50 Ml/d. This is a significant proportion of the region's public water demand.

In summary, therefore,

any examples?

(a) further work is needed to determine the yields of existing sources on a consistent basis;

(b) when environmental needs are taken into account, it may be necessary to reduce the allowable yields of existing sources in some areas;

(c) such derogation will have implications for the rate of take-up, and thus timing, of future resource developments.

2.4.2 Planned Developments

All regions have some further resource development in prospect, whether to overcome localised supply difficulties or to meet growing demand. Mooted schemes are shown on Figure 3 and the accompanying table. In general terms, the developments comprise:

(a) limited further exploitation of some aquifers to overcome local problems (eg Northumbrian Region);

(b) groundwater augmentation schemes to improve summer flows (eg Vale of York; Shropshire; River Test);

(c) pumped storage of existing reservoirs (eg Wimbleball);

(d) dam raising (eg Darwell);

(e) new reservoirs (eg River Axe; Broadoak; Abingdon; Great Bradley).

Some enhancement of existing regional transfers is in prospect - eg to Bristol Waterworks via the Sharpness Canal, to Three Valleys Water Co from Grafham, to S Humberside via the Trent-Witham Ancholme scheme.

Significant further exploitation of groundwater in headwater areas or close to small or medium rivers is unlikely without special provision to safeguard surface flows.

Is this a function of the history of wet management/organisation

It is noteworthy that with the exception of extension of the artificial recharge schemes around London, all proposed developments are conventional schemes. No specific redeployments of effluent discharges, new strategic links, or desalination schemes appear to be in prospect.

A pertinent feature of the planned developments as indicated on Figure 3 is their distribution; only three out of forty-five schemes are identified north of a line linking the Humber and Mersey estuaries, with a further thirteen between there and the Wash-Severn estuary line. This is symptomatic both of demand growth patterns and resource availability.

2.5 Environmental Considerations

As an initial attempt to discover the extent to which environmental issues have influenced water resource development in the past, and how this is likely to change in the future, each region was contacted via the representative who attended the initial meeting. So far only four full responses have been received (Thames, NW, Wessex and Anglian), with holding replies from three more (Severn Trent, Wales and Southern). In addition, copies of policy/guidelines documents have become available for two regions (Wales and Yorkshire).

The four responses so far received have given a most valuable insight into the range of problems faced by the regions, and the varying perception of environmental issues. the following quotes illustrate this.

"Environmental issues are having a profound effect on resource planning" Terry Newman, Wessex.

"This region of the NRA has no comments to make on the extent to which resource planning has been influenced by environmental issues". Robin Mundy, North West.

"The main environmental concerns are, most usually, the impact of any development on conservation interests". Mark Diamond, North West.

"The main (environmental) issue in the South West... is fisheries and angling". Note of Patrick Hawker's meeting with South West.

Some of the other points raised by individual regions are of interest. These include:

Anglian

Policy statements/guidelines available. No formal MAF's have been set, but with the main environmental issues being water quality and saline intrusion, the concept of a minimum maintained flow is quite valid for rivers with highly artificial flow regimes, such as many of the larger ones in the region. In this case it is meaningful to consider the requirements for maintained flow as a demand on water resources rather than just a constraint. Large pumped storage abstractions at the lower end of most regions' rivers require flow protection that generally exceeds the environmental requirements. Groundwater abstraction on a major scale is considered a realistic future option as long as minimum river flows can be maintained by pumping. "The practice of trading diminution of medium to high flows for a guaranteed minimum is likely to increase."

Reduce P.F. at Denver sluice.

North West

No written policy or guidelines. No formal MAF's have been set. Protection of wetland sites is a major issue where water table levels may be affected.

Thames

No written policy or guidelines. Safeguarding of existing abstractions is the main issue. Prescribed flows will be imposed for all new schemes. There will be no further groundwater abstraction from the upper catchments of the Thames, Kennet, Wey, Lee, Wandle and much of the Colne. However, there may be scope for abstraction of groundwater near large rivers eg Thames, Lower Colne, if the water is recirculated ie returned upstream. Prescribed flow rules would apply where the water is effectively drawn from the river. The commitment to the alleviation of low flow programme (ALF) is likely to have implications for future resource development.

Wessex

No written policy regarding environmental issues and water resource development. A presumption against ground water abstraction from the chalk in river headwaters has been strongly signalled to the water companies. Surface water abstractions will be generally subject to "hands off flow" restrictions. A considerable problem is the cumulative influence of small, individually insignificant, abstractions.

Generally, it appears that any future groundwater developments will have conditions attached eg pumped augmentation of low flows, return upstream. Any new significant surface water abstraction is likely to involve a hands-off flow, requiring alternative sources, bankside storage or regulating reservoirs.

The next phase of the study will involve securing the completion of returns to the initial enquiry, analysis of the responses, review of the stated or written policy and guideline documents, and further discussion with individual regions. The environmental constraints on resource development must form a fundamental input into the consideration of future strategy.

3 PRELIMINARY RESOURCE BALANCE

3.1 Regions with Major Deficits

Of the ten National River Authority Regions, Thames and Anglian face the greatest difficulties in meeting future demands (see Table 11). Thames has a large and steadily growing population with a high per capita consumption. In the region as a whole, a small surplus exists based on average demand, but in the Greater London area there is already a deficit of 168 Ml/d. By the year 2001, demand will have exceeded the level of available resources - including planned future developments - by 16 Ml/d; by 2021 it is estimated that, if predicted trends continue, this will have increased to 700 Ml/d.

Although water management policies may help to reduce this imbalance, by the end of the century Thames will have to develop at least one new major resource. Geotechnical problems with some London reservoirs have exacerbated the region's problems.

Given that local groundwater and surface water resources will be fully developed by 2011, Thames will be looking for either a transfer of resource into the area, or additional surface water storage, or facilities to re-cycle sewage effluent. Mooted schemes include:

(a) Construction of a large surface water storage reservoir in the upper Thames capable of yielding 200-300 Ml/d.

(b) Transfer of water from the Severn to the Thames. Enlargement of the Craig Goch reservoir will provide water to augment flows in the Severn, which could be transferred to the upper Thames via an abstraction on the River Severn at Tewkesbury and a pipeline link. Yield 225-690 Ml/d.

How could this be used in Thames Anglian - elsewhere?

(c) Improvement and extension of the London reservoirs including the construction of a new reservoir. Yield 140 Ml/d.

(d) Treatment and re-use of sewage effluent from the major London treatment works. Estimated yields of 100-150 Ml/d per works.

The above schemes all have problems associated with them, whether it be economic, environmental or public acceptance, but Thames will by 2021 have to develop two, if not three, large schemes.

The Anglian region has the lowest recorded rainfall and the fastest growing population of all the regions. It will have problems in meeting both public and private future demands. Public demand is forecast to increase by 500 Ml/d by 2011, exceeding present resources by 175 Ml/d; this deficit is predicted to increase further to 542 Ml/d by the year 2021.

Do we need to look at projected improvements in quality & identify major constraints - could be a major issue

Possible resource developments include:

(a) Increase flows from the Trent via the existing Trent - Witham link to satisfy the region's northern area. This is potentially a large resource, but is limited by water quality problems.

(b) Increased yields from existing surface water abstractions, due to higher populations and therefore higher effluent flows. The estimated yield is 100 Ml/d but depends upon water quality.

(c) Various ground water schemes, including enhancement of Ely Ouse-Essex System, which potentially yield up to 460 Ml/d but are subject to environmental constraints.

(d) Increased abstraction from the Great Ouse. An EIA has been commissioned to examine the proposal.

(e) A new impoundment reservoir on the River Stour at Great Bradley with an estimated yield of 200 Ml/d.

The Great Bradley scheme is within the Essex Water Company area. The company at present receives 91 Ml/d from TWUL, and is likely to ask for further resources in the near future. Based upon demand forecasts, by 2011 Essex will have a deficit of 50 Ml/d. This scheme will not only guarantee Essex's demands but could help supply adjacent areas.

Dry year private irrigation demands in the region are likely to increase by an estimated 195 Ml/d by 2011. In 1988 the then Anglian Water Authority estimated that the potential irrigation exceed the existing practice by perhaps ten-fold. To limit the increasing demand, new licensees could be restricted to abstraction during the winter months, compelling them to provide storage facilities. In addition, Anglian NRA have restricted spray irrigation in recent dry years, although this policy is being resisted by farmers and associated interested groups.

Net industrial demand is estimated to increase by 59 Ml/d by 2021, based upon a simple 1% growth per year, but this figure could be grossly distorted by the arrival or closure of a single large water-using firm in the region. For example, if the 2000 MW power station at Denver were to proceed, a further 180 Ml/d net direct abstraction would be needed.

Demand from the electricity supply industry is difficult to predict, since in the recent past there has been a steady decline in electricity demand and raw water usage associate with the run down of heavy industries. Prediction of future demand is dependant upon not only the growth rate and type of industry in the region but also the form and siting of future power station construction.

3.2 Regions with Major Surpluses

The regions whose resource balances have been identified as being significantly in surplus ie reliable yield exceeds existing and forecast demands are (see Table 11):

(a) Northumbrian Region

(b) North West Region

(c) Welsh Region.

Even without taking into account any proposed new scheme, Welsh region is forecast to remain in surplus to 2021 (175 Ml/d) falling from the 1991 surplus of 300 Ml/d.

North West Region is forecast to have a surplus increasing from 450 Ml/d in 1991 to 575 Ml/d in 2021. This assumes only marginal surface water development and no further ground water development.

Northumbrian Region is anticipated to have the largest surplus. However, detailed assessment of yield and demand data is still to be completed. There is also uncertainty about whether and in what form British Nuclear Fuel's development plans in the north west will be realised, and from where the associated water demand would be met.

The confidence limits of the reliable yield of regions which historically have had a close demand/resource balance have been tested in prolonged periods of high demand. It is possible that a more detailed assessment of each resource within a region historically in surplus may show that the total resource has been conservatively estimated - that is, the surplus may in effect be significantly larger for the projected forecast demand.

Therefore, to ensure realistic relative cost/benefit study of possible transfer schemes, further detailed assessments of regions with surplus resources would be prudent.

3.3 Other Regions

The future resource position of other regions, as it is currently understood and allowing for planned developments, is presented in Table 11.

Severn-Trent

A preliminary review of available data suggests that the region has an existing surplus of 157 Ml/d which, with the commissioning of Carsington reservoir in the near future, will increase to 382 Ml/d. This major new resource plus additional groundwater developments in Shropshire, Staffordshire and Nottinghamshire and increased abstractions from the Severn will provide surpluses until 2021. Although there is no regional deficit, a sub-regional imbalance exists with a trend to transfer resources

from the Severn to Trent catchments. The water companies South Staffordshire and East Worcester both have resource problems. Further use by South Staffordshire of their 'local' resource, the Trent, is constrained by present water quality, and the company is proposing groundwater development. East Worcester has proposed an abstraction from the Severn supported by the NRA Shropshire groundwater scheme.

Southern

The region is predicted to remain in surplus until 2011, assuming development of Broad Oak reservoir, Darwell reservoir enlargement and various smaller schemes proceed.

Due to the highly fragmented nature of the region, local deficits will develop before 2011. In Southern Water plc the Isle of Wight, which at present receives piped water from Hampshire, will be made self-sufficient by construction of Chillerton reservoir in 2001. The Sussex coast area has already a deficit of 19.5 Ml/d but may benefit in future from local resource reallocation. Folkestone Water Company has limited existing resources and will be dependant upon the shared resources at Broad Oak and Darwell for further growth.

South West

Assuming planned schemes proceed, no resource deficits are predicted in the South West region up to 2021. The SW NRA consider that there is no scope for further significant groundwater development, indeed reduction of existing abstractions to protect river flows might be desirable. Planned surface water developments include the Axe Pumped Storage Scheme, Roadford reservoir and Pumped Augmentation of Wimbleball.

Wessex

Incorporating the proposed Wessex Water plc schemes at Blashford Lakes and increased river abstractions by Bristol Water Company, the region will be in surplus until 2021.

Bristol will need a new resource in the near future, and there are plans to increase the regional transfer from Severn-Trent via the Gloucester-Sharpness canal. This could yield a further 110 Ml/d in the future but will be dependant on consent from the Severn-Trent NRA. In the longer term, and subject to the NRA's approval, BWW intend to augment Chew Valley Lake via a new abstraction of the river Avon at Bath.

Yorkshire

Yorkshire region's predicted surpluses in 2011 and 2021 are heavily dependant upon the River Ouse Augmentation Scheme. Increased abstractions of possibly 300 Ml/d from the Ouse at York would be off-set by augmenting the river with groundwater from the Sherwood Sandstone aquifer. An environment assessment of this scheme is understood to be in preparation.

4 FURTHER WORK

4.1 Data Capture

Generally the response from Regions to requests for data has been excellent, and most of the information asked for has now been received. In the days following submission of this report, data availability and needs will be reviewed, and, where appropriate, regional representatives will be contacted by telephone to discuss outstanding items.

The general areas in which more data may be sought from particular regions may be inferred from inspection of Tables 1 to 4. The issue of available and potential resources requires more attention, and it is anticipated that continuing close liaison with regional NRA's will be needed, particularly in this area (see Section 4.3). However, it is accepted that in some cases specific information is not available, and best estimates will need to be made, based upon experience in other regions and upon the literature survey.

It is emphasised that this report is itself an integral part of the data collection exercise, in that comments upon it from NRA HQ and the Regions are invited, and will be taken into account as work proceeds.

The Study Final Report will include a full list of references consulted in the course of the literature survey, arranged according to subject.

4.2 Demand Forecasts

The formulation of demand forecasts is approached using a variety of methodologies based upon a broad array of statistics. From historical consumption data projections/forecasts are made upon various combinations of the following:-

(a) simple projection of total consumption from smoothed historical rates of growth;

(b) projection based upon trends in gross per capita consumption and assumed rates of population;

(c) forecasts based upon a sectorial assessment of trends in the main consumer categories such as public water supply, and the industrial, power and irrigation demand sectors;

(d) forecasts tied to projections of economic growth and regional/national development plans.

All of these forecasting techniques naturally differ one from another, since they represent differing scenarios of growth in consumption. All are subject to the limitations of predefined criteria and initial assumptions. Adoption of any one of the methods without reference to the others would be

imprudent, whilst the impact of uncertainties needs to be assessed in the form of upper and lower bounds to the estimates.

Extrapolation of trends can be seriously misleading unless the factors which govern them are well understood.

Increasing sophistication and re-evaluation of socio-economic data has had a dramatic impact upon projected growth in total water demand in England and Wales, as a review of past forecasts shows:

Year of Forecast	Estimated Annual Growth Rate 1986 to 2001
1973	3.1%
1978	2.6%
1982	2.1%
1986	0.9%

The above figures clearly indicate the dependence of forecasts upon socio-economic factors and industrial policy. The extrapolation of private demand (industrial, power generation, irrigation) is particularly uncertain and is clearly integrated with national economic planning issues.

There is a need therefore for rigorous sensitivity analyses to assumptions and projected scenarios and this approach will be adopted. Whilst population projections used by water companies in preparing forecasts of public water demand are based on OPCS data and may thus be taken to be "best available data", the implications of alternative population growth scenarios may be worth demonstrating - particularly as trends are governed as much by migration as by fecundity assumptions. Per capita consumption, with and without various forms of demand management, and alternative UFW projections also need to be tested in the framework of future public water demand.

natural growth

In the private demand sector, it will be necessary to examine a host of issues from the likelihood of power station developments taking place through historic national and international trends, to the likely impact on private users of abstraction charging policy and the growing interest in environmental audit.

Can this be stated on the record?

As far as is possible, demand will be broken down by sector and by region such that a comprehensive picture can be built up of the principal variables that influence each sector and region. Such reporting and analysis will also have to consider the increasing water demand for the environmental sector wherein water is not only viewed as a common economic asset available for consumptive use. For example, there are numerous demands upon groundwater resources for the alteration of critical low flows in rivers.

4.3 Available Resources

The quantification of available resources in a consistent manner between the NRA regions, such that comparative assessments can be made, is proving to be particularly troublesome. Although resources are evaluated in terms of some measure of yield, the concept is variously interpreted and estimated. Two principal approaches may be identified:

(a) Yield is taken as an indication of the long term substainability of the resource. For example, failure of supply will only occur during a 1:50 year drought of some critical duration.

(b) Yield is a measure of the ability to meet a short term peak demand - for example that during the critical 4 week period at the 1975/6 drought.

Evaluations for specific schemes often take into account additional information based upon operational experience, requirements for target levels of service for each demand sector to be evaluated separately, and constraints upon full yield potential linked to the capacity of treatment/ distribution works. In addition, there are various interpretations of what constitutes resource failure - for example, whether a surface storage is drawn down completely or reaches some prescribed level of deficiency. Objective measures of risk are inconsistent and often substituted for by a historical drought event whose severity provides a benchmark.

It is quite clear that a substantial effort will be required within the study to reconcile these various evaluations of resource potential. A particularly complicating issue is the increasing integration of resources into complex systems, the overall yield of which is often under constant review.

For the existing and potential strategic resources of each region it will be necessary to establish the nature of the yield computations by further liaison. These results can then be set against the potential regional resource available for exploitation. Estimates of this latter statistic will be made from surface water data and regional groundwater studies.

4.4 Strategic Options

The assessment of demands and resources is only a part of the project. The main thrust of the study is towards identification and evaluation of alternative strategies to respond to future demands. A number of possibilities are identified in the Brief (Appendix A). To these has been added movement of water by sea - this includes, for example, importing water from the continent by pipeline or shipping it round the coast from the North East.

Investigation of strategic options is at an early stage, and no definitive results are yet available. The general approach being followed is to:

(i) undertake a literature survey, including review of relevant past reports, in order to assemble background material on options;

(ii) assess the practicability of the various possibilities, and the appropriateness of each to the perceived future resource problems, given the location of surpluses and deficits;

(iii) review the envrionmental and cost implications associated with the more promising options.

It is already clear that long distance water transfer down the East of the country via the canal system is not practicable, due to the deep intrusion inland of saline estuaries which are an integral part of the navigation system, particularly around the Humber.

On the other hand, the scope to use desalination associated with power generation to meet peak water demands merits further study, because these peaks occur in summer, whereas power consumption for other purposes is greatest in winter.

The exercise is thus essentially to sift through the options, carrying forward for further study only those that are practicable and appropriate.

The Final Report will identify all options which have been considered, summarising the relative merits of the more promising ones and stating why the others have been discarded.

Table 1

Data Availability - Public Water Supplies

KEY

•	Data available	3	Detailed breakdown
O	Total consumption only	+	Sufficient data to calculate this value
1	Metered and unmetered	R	Regional target exists
2	Metered, unmetered, domestic and unmetered commercial		

Region	Water Company	Existing Demand					Forecast Demand and Populations						
		Year	Pop^n	Consumption Breakdown	Usage per Capita	7-Day Peaking Factor	1991	2001	2011	2021	Consumption Breakdown	Usage per Capita	% Leakage Target
Anglian	Anglian	1989	•	1	•			•	•	•	1		R
		1990	•	1	•			•	•	•	1		R
	Essex	1989	•	1	•			•	•	•	1		R
		1990	•	O	•			•	•	•	1		R
	Cambridge	1989	•	1	•			•	•	•	1		R
		1990	•	O	•			•	•	•	1		R
	Tendring Hundreds	1989	•	1	•			•	•	•	1		R
		1990	•	1	•			•	•	•	1		R
	Suffolk	1989	•	1	•			•	•	•	1		R
		1990	•	O	•			•	•	•	1		R
Northumbria	Sunderland and S Shields	1990		1				•	•	•	1		
	Newcastle and Gateshead	1990		1				•	•	•	1		
	Hartlepools	1990		1				O	O		1		
	North-umbrian	1990		O					O				

Table 1 Cont'd

Data Availability - Public Water Supplies

Region	Water Company	Existing Demand					Forecast Demand and Populations						
		Year	Pop^n	Consumption Breakdown	Usage per Capita	7-Day Peaking Factor	1991	2001	2011	2021	Consumption Breakdown	Usage per Capita	% Leakage Target
North West	NWW	1990	•	O	•	•		•	•		1		•
Severn Trent	Severn Trent	1990	•	O		•			O				
	S Staffs	1990	•	O		3-day			O				
	E Worcs	1989 1990	 •	1 1		• •		• •	• •	• •	1 1		
Southern	Southern	1988	•	3	•	•	•	•	•		3	•	+
	Portsmouth	1988	•	3	•	•	•	•	•		3	•	+
	Mid Sussex	1988	•	3	•	•	•	•	•		3	•	+
	E'bourne	1988	•	3	•	•	•	•	•		3	•	+
	W Kent	1988	•	3	•	•	•	•	•		3	•	+
	Mid Kent	1988	•	3	•	•	•	•	•		3	•	+
	Folkestone	1988	•	3	•	•	•	•	•		3	•	+
South West	SWW	1989 1990	•	2 O		+		• •	• •	• •	2 2		

Table 1 Cont'd

Data Availability - Public Water Supplies

Region	Water Company	Existing Demand					Forecast Demand and Populations				Consumption Breakdown	Usage per Capita	% Leakage Target
		Years	Pop^n	Consumption Breakdown	Usage per Capita	Peaking Factor	1991	2001	2011	2021			
Thames	Thames	1989		2		•	•	•	•	•	2		+
		1990	•	2		•	•	•	•	•	2		+
	Three Valleys	1989		2		•	•	•	•	•	2		+
		1990	•	2		•	•	•	•	•	2		+
	N Surrey	1989		2		•	•	•	•	•	2		+
		1990	•	2		•	•	•	•	•	2		+
	E Surrey	1989		2		•	•	•	•	•	2		+
		1990	•	2		•	•	•	•	•	2		+
	Mid Southern	1989		2		•	•	•	•	•	2		+
		1990	•	2		•	•	•	•	•	2		+
	Sutton	1989		2		•	•	•	•	•	2		+
		1990	•	2		•	•	•	•	•	2		+
Welsh	Dŵr Cymru	1990	•	1	•	•		•	•	•	1	•	
	Wrexham	1990	•	1	•	•		•	•	•	1	•	•
	Chester	1988	•	1	•	•	•	•	•	•	1	•	•

Table 1 Cont'd

Data Availability - Public Water Supplies

Region	Water Company	Existing Demand					Forecast Demand and Populations				Consumption Breakdown	Usage per Capita	% Leakage Target
		Years	Pop^n	Consumption Breakdown	Usage per Capita	Peaking Factor	1991	2001	2011	2021			
Wessex	Bournemouth	1989		3		+		•	•		O		
		1990	•	3		+		•	•		O		
	Bristol	1989		3		+		•	•		O		
		1990	•	3		+		•	•		O		
	Cholderton	1989		O				•	•		O		
		1990	•	O				•	•		O		
	Wessex	1989		3		+		•	•		O		
		1990	•	3		+		•	•		O		
	W Hants	1989		3		+		•	•				
		1990	•	3		+		•	•				
Yorkshire	Yorkshire	1989	•	3	•			•	•		3	•	•
		1990	•	3	•			•	•		3	•	•
	York	1990	•	1				•	•		1		

Table 2

Data Availability - Private Abstractions

Region	Existing			Future			
	Licensed Entitle-ment and Break-down	Major Users	Net Take-up (year)	2001	2011	2021	Break-down
Anglian	2		● (1986)	●	●		2
Northumbria	2						
North West	2	●	● (1989)				
Severn Trent	1	●					
Southern	1						
South West	1	●					
Thames	2		● (1989)				
Welsh	O						
Wessex	1		● (1989)				
Yorkshire	1	●					

KEY

●	Data Provided	1	Basic breakdown into major categories
O	No breakdown of demand	2	Detailed breakdown by activity

Table 3

Data Availability - Miscellaneous Abstractions

Region	River Support	Regional Transfer	British Waterways Board Abstractions	Crown Abstractions
Anglian		●		
Northumbria		N/A		
North West		●		●
Severn Trent	●	●	●	
Southern		●		
South West		●		
Thames	●	●	●	●
Welsh		●		
Wessex		●		
Yorkshire		●	●	

KEY

● Data Provided

Table 4

Data Availability - Resources

Region	Surface Water					Ground Water			
	Hydrometric Data	Effluent Returns	Licensed Commitment	Other Commitments	Development Potential	Annual Average Recharge	Licensed Commitment	Other Commitments	Development Potential
Anglian			•		•	•	•		•
Northumbria			•		•		•		•
North West		•	•	•		•	•	•	•
Severn Trent			•		•	•	•	•	•
Southern			•		•		•		•
South West	3	•	•		•		•		•
Thames	1	•	•	•	•		•	•	•
Welsh	1	•	•		•	•	•	•	•
Wessex	2	•	•		•		•		•
Yorkshire	3		•				•		

KEY

1 Rainfall data
2 River flow data
3 Rainfall and river flow data

Table 5

Preliminary Estimates of Public Water Supply Demand

Region	Estimated PWS Demand (Ml/d)		
	1990	2011	2021
Anglian	1850 *	2330	2640
Northumbria	1080	1220	-
North West	2420	2290	2290
Severn Trent	2400	2570	2710
Southern	1400 *	1570	1750
South West	490 *	600	690
Thames	4030 *	4710	5050
Welsh	1180 *	1240	1320
Wessex	870	1100	1240
Yorkshire	1430	1620	1740

* 1991

Total.

Table 6

Population Forecasts (Thousands)

Region	Company	1990	Compound growth rate pa %	2001	Compound growth rate pa %	2011
Anglian	Anglian	3714.77	0.82	4065.2	0.48	4286.1
	Cambridge	275.7	0.98	307	0.88	338
	Essex	1419.5	0.42	1486.3	0.11	1504.8
	Suffolk	245.3	0.89	270.5	0.77	294.3
	Tendring Hundreds	138.98	0.52	147.09	0.78	160.14
Northumbria	Hartlepools					
	Newcastle and Gateshead	761	0	761	0	761
	Northumbrian					
	Sunderland and South Shields	545	-0.43	520	-0.36	500
North West	North West	6787.7	-0.02	6771	-0.08	6710
Severn Trent	East Worcs	235.6	0.72	254.9	0.48	268.6
	Severn Trent	6879				
	South Staffs	1211				
Southern	Eastbourne	221.62	0.69	238.98	0.44	250.78
	Folkestone	147.81	0.60	157.91	0.47	166.2
	Mid Kent	523.14	0.53	554.48	0.34	575.5
	Mid Sussex	261.08	0.48	275.3	0.10	278.4
	Portsmouth	650.96	0.21	666.38	0.17	679
	Southern	2149.09	0.35	2234.24	0.20	2283.7
	West Kent	132.98	0.04	133.61	-0.07	132.6
South West	South West	1500	0.95	1663.7	0.68	1793

Population Forecasts (Thousands)

Region	Company	1990	Compound growth rate pa %	2001	Compound growth rate pa %	2011
Thames	East Surrey	323	0.39	337	0.16	343
	Mid Southern	717	0.89	790	0.46	831
	North Surrey	464	0.33	481	0.17	490
	Sutton	278	0.32	288	0.19	294
	Thames	7276	0.28	7501	0.16	7632
	Three Valleys	2558	0.35	2450	0.18	2498
Welsh	Chester	115	0.91	127	0.68	136.5
	Dŵr Cymru	2732.3	0.12	2770	-0.03	2760
	Wrexham	150.8	0.45	158.5	0.45	166.6
Wessex	Bournemouth	256	1.04	287	0.99	320
	Bristol	1032	0.57	1099	0.32	1138
	Cholderton	2	3.75	3	0	3
	Wessex	1105	0.40	1154	0.44	1211
	West Hants	170	1.02	190	0.65	204
Yorkshire	York	175	0.46	184	0.44	193
	Yorkshire	4380	0	4390	-0.08	4340
	TOTAL	49334.33[1]		42707.09[2]		43542.22[2]
	COMPANIES	35		33		33

1 Excludes Northumbrian and Hartlepools Water Companies

2 Excludes Northumbrian, Hartlepools, Severn Trent and South Staffs Water Companies

Table 7

Per Capita Domestic Demand for 10 Representative Water Companies

Company	Demand (l/h/d)			
	Current (Year)	1991	2011	Growth Rate % pa
Anglian Water	X	141	179	1.20
Newcastle and Gateshead Water	*155 (1989)		*166	0.31
North West Water	X	X	*158	-
East Worcestershire Water Company	*154 (1989)		*172	0.50
Southern Water	148 (1988)	161	192	0.88
South West Water	X	141 (*162)	*191	0.83
Thames Water	142 (1990)	144	182	1.18
Dŵr Cymru	X	142	165	0.75
Wessex Water	155 (1990)		X	-
Yorkshire Water	125 (1990)	126	146	0.74

KEY

X No figure supplied. Halcrow preparing estimates

* Represents total unmetered demand, not domestic demand

Table 8

Unaccounted-For Water as % of Total Into Public Supply

Region	Company	1990	2001	2011
Anglian	Anglian	22.90	19.97	18.60
	Cambridge		17.14	16.55
	Essex		14.87	14.69
	Suffolk		12.90	12.39
	Tendring Hundreds	16.36	13.70	11.74
Northumbria	Hartlepools	11.11	8.70	9.76
	Newcastle and Gateshead	14.61	14.66	14.29
	Northumbrian			
	Sunderland and South Shields	27.03	25.97	25.00
North West	North West	28.63	25.15	23.79
Severn Trent	East Worcs	24.24	23.11	22.78
	Severn Trent			
	South Staffs			
Southern	Eastbourne	19.65	17.70	16.51
	Folkestone	20.40	18.50	17.35
	Mid Kent	21.43	14.33	13.34
	Mid Sussex	22.25	20.89	19.40
	Portsmouth	22.36	20.89	19.45
	Southern	30.69	19.60	18.26
	West Kent	22.10	20.50	18.95
South West	South West		15.20	15.25

Unaccounted-For Water as % of Total Into Public Supply

Region	Company	1990	2001	2011
Thames	East Surrey	28.57	25.40	23.36
	Mid Southern	23.29	18.63	15.48
	North Surrey	26.21	20.78	16.97
	Sutton	20.31	18.57	17.81
	Thames	26.90	24.51	23.08
	Three Valleys	30.81	23.94	22.18
Welsh	Chester	22.00	21.00	20.01
	Dŵr Cymru	28.85	22.62	22.14
	Wrexham	16.81	16.80	16.80
Wessex	Bournemouth	14.14	21.95	21.05
	Bristol	18.56	17.51	15.42
	Cholderton			
	Wessex	17.14	17.58	17.77
	West Hants	5.14 *	6.06 *	5.66 *
Yorkshire	York	23.40	17.54	18.03
	Yorkshire	30.33	28.34	27.53

* Low figure due to supplies to Fawley Refinery

Table 9

Gross and Net Existing Private Demand (Ml/d)

Region	Type	Licensed Entitlement (Ml/d)	Uptake of Water	Resource Loss
Anglian	Electricity - Cooling	0	0	0
	Industry	500	230	92
	Agriculture excl Irrigation	43	15	7
	Spray Irrigation	311	250	250
	Fish/Watercress Farming	?	?	0
	Total	854	495	1349
Northumbria	Industry	9413	(4330)	(866)
	Agriculture excl Irrigation	3	(1)	(0.2)
	Spray Irrigation	2	(2)	(2)
	Hydroelectricity/Fish Farming	(36)	(36)	0
	Total	9454	4369	868
North West	Electricity - Evaporative Cooling		6	6
	Electricity - Cooling		50	15
	Industry		791	79
	Agriculture excl Irrigation		5	2
	Spray Irrigation		3	3
	Fish/Watercress Farming		36	0
	Hydroelectricity		280	0
	Total	-	1171	105
Severn Trent	Electricity - Evaporative Cooling	293	(147)	(147)
	Electricity - Cooling	2593	(1297)	(389)
	Industry	1619	(745)	(149)
	Hydroelectricity	508	(508)	0
	Canal Supply	240	(240)	(240)
	Total	5253	2937	925
Southern	Electricity - Cooling	16375*	?	(0)
	Industry	1080	(497)	(99)
	Agriculture excl Irrigation	29*	(10)	(2)
	Spray Irrigation	62	(50)	(50)
	Fish/Watercress Farming	229	(229)	0
	Total	17775*	786	151

SI

Table 9

Gross and Net Existing Private Demand (Ml/d)

Region	Type	Licensed Entitlement (Ml/d)	Uptake of Water	Resource Loss
South West	Electricity - Cooling	414	(207)	(83)
	Industry	1167	(537)	(107)
	Agriculture excl irrigation	20*	(7)	(2)
	Fish/Watercress Farming	129	(129)	0
	Fish/Watercress Farming/ Watermills	325	(325)	0
	Miscellaneous	421	?	(0)
	Total	2476	1205	192
Thames	Electricity - Cooling		104	31
	Industry		219	88
	Agriculture excl irrigation		13	3
	Spray irrigation		11	11
	Fish/Watercress Farming		189	0
	Total	-	536	133
Welsh	Electricity - Cooling	5855	(2928)	(1171)
	Industry	1186	(546)	(110)
	Hydroelectricity	7815'	(7815)	0
	Fish/Watercress Farming	39	(39)	0
	Total	14895	11328	1281
Wessex	Industry	2630	1978	396
	Commercial	11	42	8
	Agriculture excl irrigation	489	151	30
	Spray irrigation	163	47	47
	Total	3304	2218	481
Yorkshire	Electricity - Cooling	1471	(736)	(294)
	Industry	1229	(565)	(113)
	Agriculture excl irrigation	18	(6)	(1)
	Spray irrigation	52	(42)	(42)
	Hydroelectricity	559	(559)	0
	Total	3329	1908	450

Gross and Net Existing Private Demand (Ml/d)

KEY

* Unreliable Figure
' Excludes Dinorwic Scheme

Figures in brackets are Halcrow estimates, based rates of uptake as given for other regions, and net loss estimates as follows:

Use Type	Water Loss %
Evaporative cooling	100
Industrial	30
Hydroelectric power, fish farming and cress growing	0
Agriculture (excluding spray irrigation)	20
Spray irrigation	100

Table 10

Licensed Water Abstractions 1987
(Ml/d)

Region	All Licenses			PWS Licenses (Surface and Ground)
	Surface Water	Groundwater	Total	
Anglian	1038	994	2032	1725
Northumbrian	953	108	1061	1012
North West	3324	422	3746	1819
Severn Trent	5213	1135	6348	2374
Southern	643	1044	1687	1280
South West	811	103	914	531
Thames	2744	1765	4509	4007
Welsh	2414	121	2535	2149
Wessex	587	422	1009	7.54
Yorkshire	2707	298	3005	1593
Totals	20434	2412	26846	17244

Are these actuals?

Table 11

Resource Balances

PWS only.

REGION	FORECAST WATER RESOURCE BALANCE Ml/d			
	2001	2011	2021	
Anglian	70	-164	-471	(1)
Northumbrian	To be confirmed			
North West	525	585	575	(3)
Severn Trent	382	464	277	
Southern	182	99	-77	
South West	465	383	294	
Thames	-16	-282	-742	(2)
Welsh	335	285	210	
Wessex	139	34	-89	(4)
Yorkshire	203	103	117	

Negative balances indicate deficits.

This table represents preliminary estimates of resource balances which accounts for the major planned future developments except for those in the preliminary investigation stages or where no yield figures have been supplied. Omitted schemes include:

(1) Increased Trent - Witham transfers and Great Bradley Reservoir

(2) Improvements to London reservoirs, major new pump storage reservoir in the upper Thames and Severn-Thames transfer.

(3) Developments at Morecombe Bay, Hawswater and Cheshire holes.

(4) Increased abstraction from Gloucester - Sharpness Canal by Bristol Water Works.

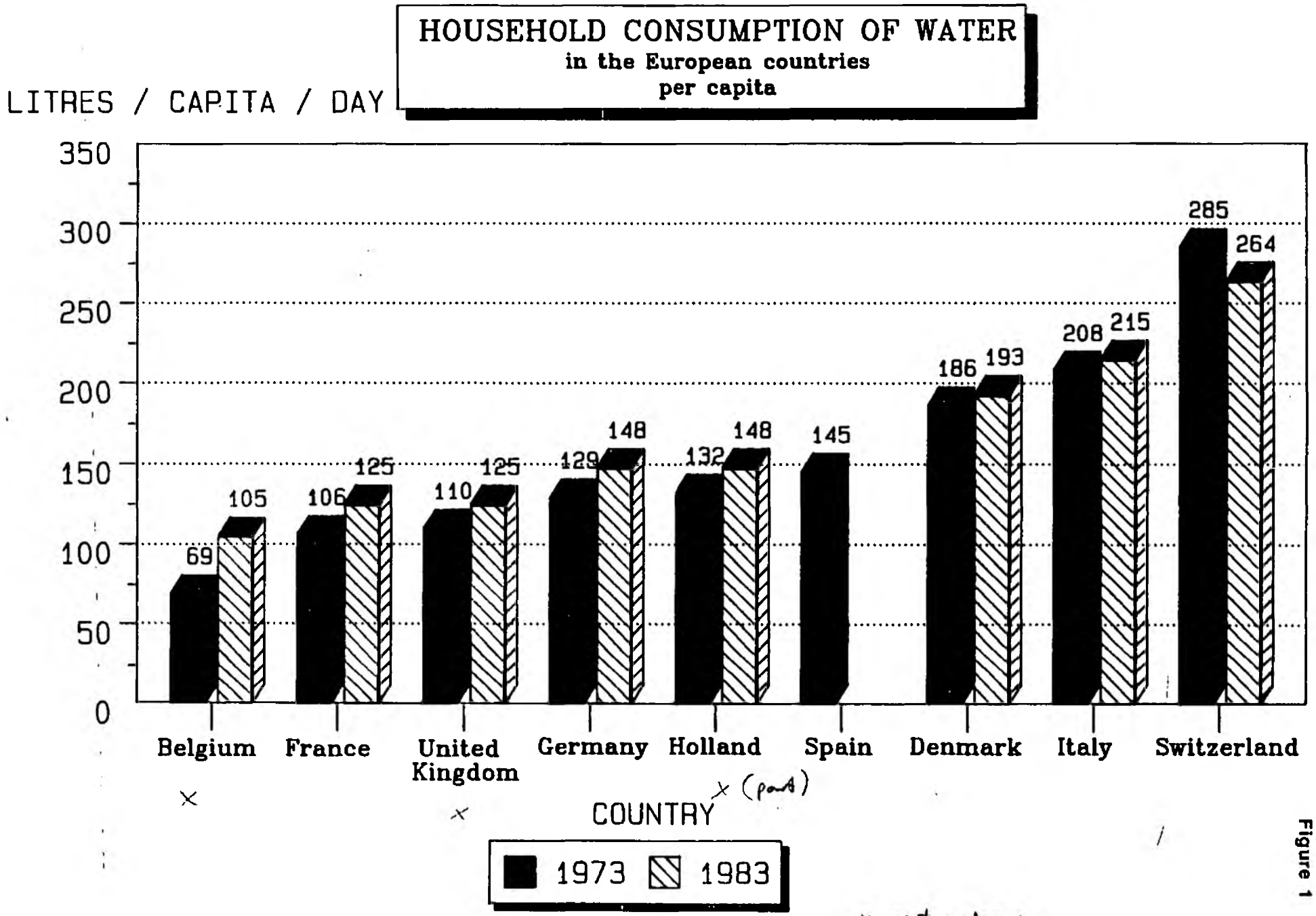

HOUSEHOLD CONSUMPTION OF WATER
in the European countries
per capita
LITRES / CAPITA / DAY
350
300
250
200
150
100
50
0
69
105
106
125
110
125
129
148
132
148
145
186
193
208
215
285
264
Belgium
France
United Kingdom
Germany
Holland
Spain
Denmark
Italy
Switzerland
COUNTRY
1973
1983

Figure 1

Key to Figure 2

Inter Regional Water Transfers

Reference (Fig 2)	Transfer From	Transfer To	Entitlement (Ml/d)
1	South West (Wimbleball)	Wessex (Demand Centres)	32
2	Wessex (W Hants)	Southern (Fawley)	45
3	Southern (Darent Boreholes)	Thames (Demand Centres)	
4	Thames (Chigwell?)	Anglian (Essex Water Co)	91
5	Anglian (Grafham)	Thames (DC's) Lee Valley	45
6	Severn-Trent (Glos Docks) Gloucester and Sharpness Canal	Wessex (DC's) Bristol WC	165
7	Welsh (Elan Valley)	Severn Trent (Frankley Res and DCs)	360
8	Severn-Trent (Vrynwy)	North West	200
9	Severn Trent (Derwent Resrs)	Yorkshire (Ogden Res/DCs)	50-60
10	Severn Trent	Anglian	59
11	Severn Trent Sandstone	Anglian Axhaline/	70
12	Welsh River Wye Wyelands	Stroud/Glos/Cheit	?

Notes on Table Dee

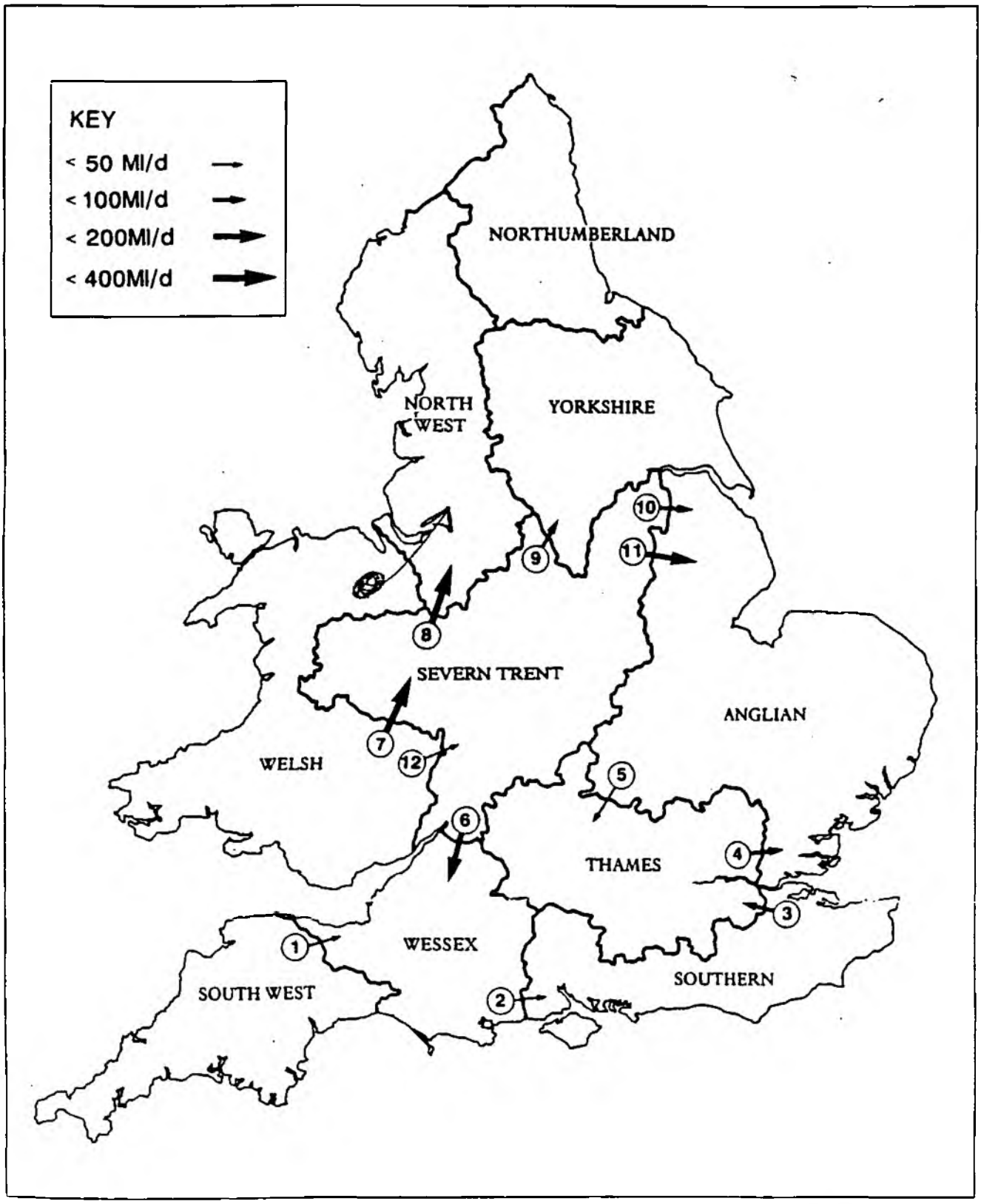
Table excludes transfers within four regions due to:

(a) Engineered inter-catchment transfers - eg Devonport Leat (SW); Ely-Ouse Scheme (Anglian)

(b) Effective catchment transfers due to water supply of sewerage system operation (eg Elan sourced supply to water drains to River Trent in Birmingham; Southern NRA sourced supply to Crawley drains to Thames.

(c) Transfers due to canal feeds/overflow.

Figure 2



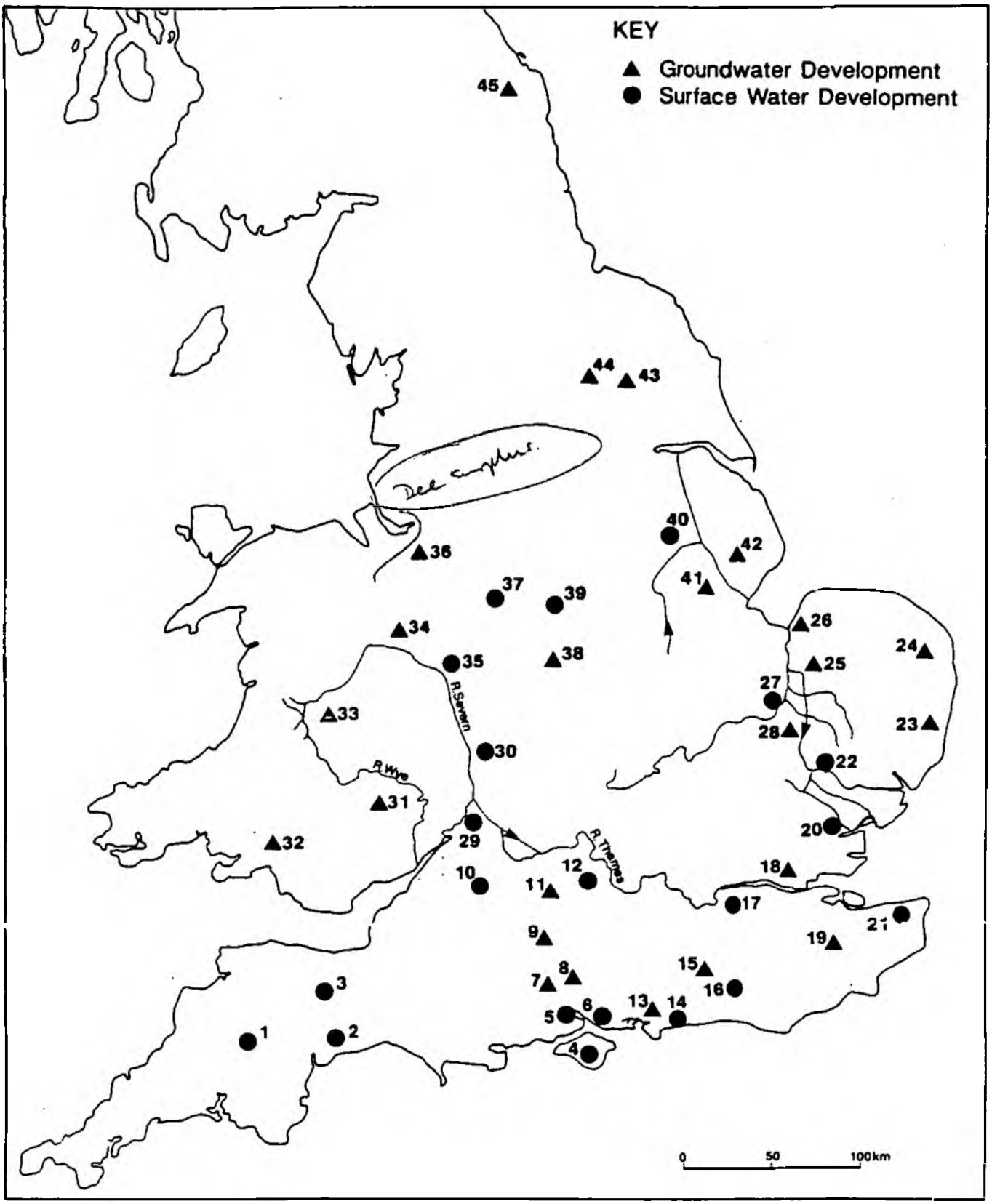
INTER - REGION TRANSFERS

Key to Figure 3

Possible Resource Developments

NUMBER	POSSIBLE RESOURCE DEVELOPMENT OPTION	ESTIMATED YIELD (Ml/d)
1	Roedford Scheme - Further Development	92
2	Axe Scheme	27
3	Wimbleball Pumped Storage Development	80
4	Chillerton Reservoir	8
5	Yalding Intake	19-27
6	Geters Mill	22
7	Test Groundwater Scheme	20-30
8	Itchen Groundwater	N/A
9	Cholderton Groundwater	<1
10	River Avon at Bath	55
11	Thames Groundwater	N/A
12	Potential New Reservoir - Wantage	200-300
13	Slindon/Easthampnet	<5
14	Crowhurst Bridge	4
15	Herdham Conjunctive Use Scheme	N/A
16	Darwell Reservoir Enlargement	40
17	Review of Various Thames Water Licences	≤ 500
18	Artificial Recharge Schemes (London)	180
19	Various Boreholes Mid-Kent	N/A
20	Chelmsford - Witham Effluent	≤ 40
21	Broad Oak Reservoir	94
22	Great Bradley Reservoir	200
23 24	} E Norfolk and Suffolk Crag and Chalk }	100
25	W Norfolk and Cambridgeshire Chalk	≤ 70
26	Sandringham Sands	≤ 15
27	Enhencement to Ely-Ouse-Essex System	250
28	Great Ouse Groundwater Scheme	N/A
29	Gloucester-Sharpness Canal/NRA Shropshire Groundwater Scheme	110
30	New Intake on River Severn at Ombersley	24
31	Enhancement of Local Supplies - Herefordshire and Radnorshire	5-20
32	Local Supplies for Dyfed, Clywd, Meirionnydd and Gwynedd	≤ 80
33	Direct abstraction from river gravels - Upper Severn	10
34	Shropshire Groundwater Scheme	N/A
35	Direct Abstraction from River Severn at Hampton Loade	15
36	Various Developments for North West Water	30
37	Direct Abstraction from River Trent	15
38	Local Groundwater Developments - Severn Trent: S Staffordshire, E Worcestershire, Shropshire, Nottinghamshire and Coventry	≤90
39	Carsington Reservoir	225
40	Trent - Witham - Ancholme Scheme	≤500
41	Lincolnshire Limestone	≤20
42	Spilsby Sandstone	10
43	Local Boreholes in N Yorkshire	20
44	Vale of York Groundwater Scheme	200
45	Groundwater Developments in Fell Sandstones and Magnesian Limestones	≤12

Figure 3



POSSIBLE RESOURCE DEVELOPMENT OPTIONS

Appendix A

LETTER OF INVITATION AND TERMS OF REFERENCE

HALCROW

NRA

HALCROW DEPT. M.H.			
FILE:		RESP.	
RECD: 12 DEC 1990			
ACTION DATE:			
ACTION COMPLETED BY:			
CIRCULATION		1 SMC	2. PJH
3.	4.	5.	6.

Mr. J. Lawson
Sir William Halcrow & Partners
Burderop Park
Swindon
Wilts SN4 OQD

11 December 1990

Dear Mr. Lawson,

Water Resources Planning - Strategic Options

1. You are invited to submit proposals in accordance with the enclosed technical brief and as further detailed below.

2. Three copies of the proposal are required by 12 noon on Friday 18 January 1991.

3. Minimum requirements for the proposal are that it should contain:-

   - A summary of the consultant's understanding of the scope of the study
   - How the consultant proposes to carry out the study
   - An indication of the proposed extent and form of liaison with NRA regions
   - Programme of key activities
   - Staffing proposals with CV's of key staff
   - Information relating to similar or relevant studies carried out by key staff who are included in the proposal.
   - Proposed method of payment
   - Proposed contractual basis

4. In addition you may make comments on the technical brief and include suggestions on how the study may be improved.

5. You are asked to prepare your bid assuming a fixed price of £80,000 + VAT. The successful consultant will be selected on a comparison of these bids but subsequently the NRA may wish to amend the technical brief in the light of comments or suggestions made by the consultant, and then negotiate a contract with the successful consultant.

6. The proposed duration of the study is 6 months and it is intended to let the contract to the selected consultant in January or February 1991.

National Rivers Authority

30-34 Albert Embankment London SE1 7TL Tel: 071-820 0101 Fax: 071-820 1603

NRA

7. Brief progress reports will be required on a monthly basis.

8. 20 copies of progress and study reports will be required.

9. Please confirm your intention to bid within 3 days of receipt of this invitation.

Yours sincerely,

J. Sherriff

J. SHERRIFF
Water Resources Manager

NATIONAL RIVERS AUTHORITY
WATER RESOURCES DEVELOPMENT OPTIONS

Technical Brief for Consultancy Project

1. Introduction and Objective

1.1 The National Rivers Authority (NRA) is required under S.143 of the Water Act 1989 to publish water resources strategy proposals.

1.2 The objective of this Consultancy Project is to provide the general basis and feasible water resource development options to enable the NRA subsequently to formulate a National Water Resources Planning and Development Strategy, following consultation with other parties on the issues and options identified.

2. Terms of Reference

The Terms of Reference for the Consultancy Project are:

2.1 Carry out a review of the prevailing development and use of water resources in each NRA region of England and Wales in meeting existing demands for water. The review would be based principally on information and data provided to the Consultants by the NRA.

2.2 Collate and review estimates of future demands for water in each NRA region for all requirements involving abstraction up to the year 2021 in 10 year steps. The Consultant is required to consider the basis and consistency of the estimates which would be based principally on information and data provided to the Consultant by the NRA.

2.3 On the basis of the reviews of current development and use of water resources (2.1) and of future demand estimates (2.2), consider the scope and options available to the NRA to formulate a sustainable policy and plans for developing and augmenting water resources to meet existing and estimated future demands for water in England and Wales to 2021.

2.4 Assess and review the balance of advantages and disadvantages of the various options and proposals considered, together with the extent and circumstances in which they may be appropriate. These assessments would take into account environmental requirements and other relevant criteria (including in-situ needs in terms of water level, quantity, quality and environmental aspects) whilst also giving due weight to cost and economic considerations.

2.5 The broad scope and steps envisaged in the Project are set out in the remainder of this Technical Brief.

2.6 Submit an overview report on the foregoing assessments, forecasts and options by 28 June 1991 with two interim reports at agreed prior dates on the provisional assessments in respect of 2.1 and 2.2 respectively.

3. Present Resource/Demand Balance

3.1 The objective of this part of the study is to identify and quantify the use of abstracted water in each of the NRA regions (or sub-regions as appropriate) and quantify the resources presently available for meeting the abstraction demands, including identification of circumstances of surplus or deficits.

3.2 It is emphasised that the purpose of this part of the study is to obtain a meaningful overview of the balance between resources and demands rather than seeking detail and precision.

3.3 Information should be presented on the broad categories of use within the region or sub-region [eg. public water supply, industry, agriculture, (excluding spray irrigation), spray irrigation] including estimates of total abstraction, net abstraction, re-use and discharges to tidal waters. A breakdown between surfacewater and groundwater abstractions should be included.

3.4 The Consultant is required to collate information on the level of existing resources available within each NRA region (or sub-region) which would include reliable yield estimates of the major sources/systems. However the Consultant is not intended to undertake his own reliable yield estimates.

3.5 The views of the Consultant are sought on the magnitude of the major existing source/system yield estimates in the light of their capability to operate effectively during drought conditions and of their environmental impact.

3.6 Information for this part of the study will be made available by the NRA and will include abstraction licence data, resource estimates and miscellaneous reports relating to resources and demands.

4. Future Demands and Resulting Deficiency of Existing Abstraction and Resource Capability

4.1 The first step in this "future" stage of the Project is to obtain a broad overview estimate of future likely demands for water that is meaningful and consistent without being detailed or aiming at second order precision.

4.2 The NRA through its regional units will endeavour to collect public water supply forecasts as seem appropriate following consultation with the Consultants who will be required to collate and review the forecast data thus obtained.

4.3 It is envisaged that the Consultants will be required to make his own forecasts of net abstractions for industry and agriculture including spray irrigation.

4.4 The forecasts are required as far as possible for the years 2001, 2011 and 2021 at least for each region of the NRA as a whole for the above categories of use. Where sub-regions within a region are adopted for data collected under Section 3 above, every effort should be made to collect the future demand data for the same areas. However this may

not be feasible in all cases and some aggregation into regional forecasts may be necessary.

4.5 Considerable advantage is seen in making alternative higher and lower trend forecasts to produce a future demand envelope. This would make it possible to test the robustness/sensitivity and also the timing of potential solutions for meeting the range of demands postulated.

4.6 The Consultant will be required to collate and review the range of forecasts obtained as set out in paragraphs 4.2-4.5 above, identifying the catchments, use categories, net call on resources, date the forecast relates to, and whether high or low trend. Graphic presentation will be favoured wherever practicable. The Consultants will be required to identify any anomalies. If these cannot be accounted for by particular circumstances they will be asked to put forward alternative data more consistent with similar data applying elsewhere. The aim must be to present broadly consistent demand forecasts relevant to resource use and development, avoiding significant double counting or double omissions of foreseeable needs for abstracted water.

4.7 From the foregoing collation of future demand estimates/trends, the Consultants will be required to deduce the resulting deficiency of (a) existing abstraction and (b) resource capability in meeting such future demands and thus derive the scale of resource development required to meet estimated future demands.

5. Review of Options for Future Resource Strategy

5.1 The Consultants will be required to identify and review various potential options for meeting the deficiencies identified under Section 4 above, i.e. the future excess of demands at various future dates for abstracted water over existing actual and potential resource capacity in each NRA region as broadly quantified by the steps outlined above.

5.2 The following are regarded as options that require to be considered, reviewed and commented upon by the Consultants. It is recognised that they may not all be considered as technically, environmentally or economically feasible and would not therefore merit subsequent more detailed consideration. The following list is not intended to be either exhaustive or mutually exclusive. Indeed the likely eventual outcome following conclusion of the Project is seen as a strategy including a combination of options and proposals as appropriate for the various circumstances and requirements to be met.

(i) Enhanced general development of "local" sources within a region or catchment

This option envisages a continuation, where feasible, of meeting increased future demands within a region or main catchment by a general enhanced development of river abstraction, surface reservoir and/or groundwater sources as appropriate. In all cases the NRA regional water resources managers will be able to identify the nature and extent of future resource development considered to date together with the constraints and limitations likely thereon. This should be the main focus of the Consultants' review of this option, although they will be

expected to put forward any additional proposals as candidates for inclusion in this category. The Consultants are not expected or required to carry out any detailed hydrological/yield assessment or cost studies - only those sufficient to satisfy general output capability, technical feasibility and cost range.

(ii) Inter-Regional Transfers

This transfers option would be applicable where resource capacity, environmental and/or economic considerations appeared to favour transfers from regions with existing or potential surplus water resources capacity to provide imports to those regions/catchments where resource development is required.

5.3 Within these basic options of "regional" or "inter-regional" development are several potential subsidiary options as set out below which relate to one or other or both of the above and which relate to means of storage, means of transmission, or means of influencing demand levels:

(iii) Demand Management

Given, as is believed to be the case, that Demand Management alone, however energetically pursued would in itself be insufficient to meet future resource deficiencies, it is necessary to consider this as a contributory or off-setting factor to be adopted to an appropriate level in association with resource development. The main aspects to consider in this project are (i) those elements of demand management likely to be most effective and viable and (ii) the extent that feasible and cost effective demand management may contribute to closing the resource output/demand balance. Principal elements of demand management thought to be relevant in this context are leakage/wastage reduction, increased re-use and re-cycling of water, and tariff structuring.

The Consultants are asked to consider and comment upon the extent of demand reduction that seems realistic and appropriate to take into account following investment in this course, and to ensure a reasonably consistent approach between regions in corresponding circumstances.

(iv) Groundwater Development

The Project should include consideration of the scope for further development of groundwater in the light of constraints relating to natural recharge, environmental consequences of abstraction, and water quality for use as drinking water. In particular the Consultants should consider the feasible scope for artificial recharge as a means of extending the use of aquifers and off-setting the above constraints.

(v) Strategic Surface Water Storage

This would be seen mainly as a likely component of option (ii), transfers, for wide deployment. There are both advantages and disadvantages in concentrating storage in a strictly limited number of larger sources. The Project should include a review of the scope,

suitable general locations, general costs and output as well as main advantages and disadvantages of this contributory option.

(vi) Multi-Source Interlinking and Conjunctive Use

This contributory option envisages continuation of a trend now well established in several regions whereby sources of different categories, size and characteristics are interlinked into a catchment wide or inter-catchment resource system, collectively meeting demands in various locations and for several purposes. In some respects this may be regarded as a regional "water-grid". The Consultants should review the advantages and disadvantages of this approach and the scope and desirability for extending it. Such an approach is capable of inclusion in both main options (i) and (ii) above.

(vii) Re-use of sewage effluents

Considerable quantities of sewage effluent are discharged to locations which make the water unavailable as a future water resource. Opportunities should be sought for re-use of such effluents as a water resource either by diverting such discharges to a water resource or by direct use of the effluent. The advantages and disadvantages of the re-use of sewage effluent should be included in the Consultant's report.

(viii) Review and Update of Other Previous Options and Proposals

Several options and proposals have been considered in the past by the Water Resources Board, or advocated by other parties in relation to a national water resources strategy.

These include:

- Desalination of sea water;
- Barrage storage in the Wash, Dee Estuary and elsewhere;
- Use of the canal system for long distance conveyance of water.

The Consultants are asked to update previously published leading data on the desalination and estuary storage proposals, particularly with regard to need, costs and environmental impact. In the case of the use of canals, feasibility for conveying water as well as costs and environmental aspects should be briefly considered and commented upon.

(ix) National Water Grid

This may include co-ordinated interlinking of existing and possible future multiple source systems, including inter-catchment links and transfers to the extent that such an interconnected system covers the regions of England and Wales as a whole. The Consultants are asked to review and comment upon the need for and viability of such an option - regarded as a limiting case of basic option (ii) - with an indication of feasibility and costs. The main purpose of this part of the study is to objectively respond to enquiries from the media and others on the feasibility of a 'national water grid'.

6. Environmental Considerations and Constraints

6.1 The project should include a review of the weight and implications of environmental requirements and constraints attaching to the various options and proposals, with a view of these being built into the overall evaluation of each. It is not envisaged that the Consultants should be involved in extensive enquiries or canvassing of opinions from environmental groups or other third parties. The exercise should be limited generally to collating information from the NRA regional and Head Office staff concerned with Environmental Quality and Conservation, together if necessary with limited consultation with other parties on specific proposals if so agreed with the NRA.

6.2 Environmental aspects include:

(i) Minimum residual flows necessary whether as statutory MAF's or otherwise;
(ii) Groundwater levels, especially the effects of abstraction on these and influence on base flows. Effects of changes at ground level such as on springs, ponds and lakes;
(iii) Groundwater quality - critical trends and influence of enhanced abstraction;
(iv) River water quality especially towards downstream of rivers and suitability for treatment for potable supplies;
(v) Environmental impact constraints on resource development eg dams, groundwater abstraction, estuarial impoundments, lowered flows and water levels, changed water quality effects.
(vi) Fisheries, Conservation, Recreation and Amenity and Navigation implications

7. Climatic Change

7.1 Traditionally water resource planning has been based on estimates or projections of future demand set against resources output derived from analysis of historic hydrological data, i.e. assuming future weather will be essentially of similar severity and variability as in the past. However, recent predictions of the possible effects of global warming in particular give cause for questioning this basis in future. It may be that within the time horizon of the review, perceptible changes will have occurred to the climate and sea levels for England and Wales having a bearing on the water resources strategy.

7.2 These changes may include:

(i) possible greater weather variations with time between seasons;
(ii) possible greater variations with location between the north and west on the one hand and south and east of England on the other;
(iii) sea level variations affecting estuarial impoundment requirements and tidal/freshwater interfaces;
(iv) possible impacts on demands for water.

7.3 The project should build such considerations into the evaluation of the options and the report should indicate the likely significance of these effects on the nature and timing of implementation of a development strategy.

8. Economic/Cost Assessments

The project is not intended to entail detailed costing or economic assessments but rather "broad brush" meaningfully consistent comparisons sufficient to categorise costs of development as low, medium or high per unit of source output capacity. The Consultants are asked to consider and define the thresholds used for these cost indicators, and to put forward a simplified basis for broadly consistent costing appropriate both for cost comparisons between differing proposals and also to facilitate a consideration of costs in relation to benefits. An indication of timing of expenditure would be useful, but in this project no "present value" comparisons discounting future expenditure or benefits are required.

NRA
December 1990

SHERRIFF\PAPER.N15

Appendix B

DATA COLLECTION QUESTIONNAIRE SENT TO NRA REGIONS

HALCROW

NATIONAL RIVERS AUTHORITY

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

FRAMEWORKS FOR DATA COLLECTION

Sir William Halcrow & Partners Limited
March 1991

WATER RESOURCE PLANNING - STRATEGIC OPTIONS

DATA COLLECTION FRAMEWORK FOR EXISTING DEMAND

(Sheet 1 of 2)

1. NRA Region .....

2. Resident Population .....

3. Please attach tariff structure and target levels of service details for Region's water companies

4. Are any changes to above documents planned? .....

5. Please state average daily demands for the following categories of public supply use in 1989 and 1990, in megalitres/day (Ml/d)

Category	1989	1990
Metered demand :		
industrial		
commercial		
agricultural (non-irrigation)		
agricultural (irrigation)		
tourism		
Sub-Total :		
Unmetered demand :		
domestic		
industrial		
commercial		
tourism		
miscellaneous		
Sub-Total :		
Unaccounted for water		
TOTAL :		

6. Please state details and basis of any peaking factor applied to average daily public supply demand for resource planning purposes in your region.

WATER RESOURCE PLANNING - STRATEGIC OPTIONS

DATA COLLECTION FRAMEWORK FOR EXISTING DEMAND

(Sheet 2 of 2)

7. Please state estimated average daily demands for the following categories of private supply use in 1989 and 1990.

Category	1989	1990
industrial		
commercial		
agricultural (non-irrigation)		
agricultural (irrigation)		

8. Please state locations of significant public or private demand within Region (e.g. major industrial user [state industry type] town of population > 100,000 [state population]).

9. Please give breakdown of use at significant demand centres.

WATER RESOURCE PLANNING - STRATEGIC OPTIONS

DATA COLLECTION FRAMEWORK FOR FUTURE DEMAND

1. NRA Region .....

2. Please give forecast public supply demand as follows :

Category	2001	2011	2021
Population (no)			
Metered Demand (Ml/d) :			
industrial			
commercial			
agricultural (non-irrigation)			
agricultural (irrigation)			
tourism			
Sub-Total :			
Unmetered demand (Ml/d) :			
domestic			
industrial			
commercial			
tourism			
miscellaneous			
Sub-Total :			
Unaccounted for water			
TOTAL :			

3. Please attach details of method of forecasting.

4. Please give details of any planned new centres of significant demand, not identified in Section 8 of Existing Demand Framework.

WATER RESOURCE PLANNING - STRATEGIC OPTIONS

DATA COLLECTION FRAMEWORK FOR RESOURCES

(Sheet 1 of 2)

1. NRA Region .....

2. River System/Aquifer.....

3. Please give abstraction details as follows :

Use Category	No. of Licences	Annual Amount Licensed (Ml/d)	Estimated dry-year take-up of licences (Ml/d) (Specify Year)
Private Industrial			
Private Commercial			
Private Agricultural (Non-Irrigation)			
Private Agricultural (Irrigation)			

4. For each abstraction entitlement exceeding 10 Ml/d (3650 Ml/yr) please state :

- location (NGR and river system)
- type (groundwater, impoundment, regulated river abstraction [state means of regulation/name of regulating reservoir], unregulated river abstraction)
- purpose
- where water is used
- how water is disposed of after use
- how operated (seasonally conjunctively etc. - please give details)
- yield and basis of estimate
- constraints on increasing yield
- details of any specific problems associated with the abstraction (e.g. wq, environmental)

5. Please give locations of dry weather flows (DWF) of public and private returns of used water to the resource system, for each case where DWF > 10 Ml/d, together with details of any known constraints on the re-use of such effluents.

WATER RESOURCE PLANNING - STRATEGIC OPTIONS

DATA COLLECTION FRAMEWORK FOR RESOURCES

6. Please give details of any planned changes to present wastewater disposal strategy, and likely dates for implementation.

7. Please give catchment details :

- area (km^2).....
- average annual rainfall (mm).....
- average daily flow (Ml/d).....

8. Please give details of any know resource development plans which will affect the catchment/aquifer.

9. Please give details of any known or anticipated constraints (e.g. water quality, fisheries etc) on further resource development of the catchment/aquifer for any particular purpose (e.g. public water supplies - please state).

10 Details of any relevant studies/research carried out on the resources of the catchment/aquifer.

Appendix C

NOTES OF MEETINGS WITH NRA REGIONS

HALCROW

APPENDIX C

Notes on Meetings with NRA Regions

Contents

Typical Agenda
C1 Anglian Region
C2 Northumbrian Region
C3 North West Region
C4 Severn Trent Region
C5 Southern Region
C6 South West Region
C7 Thames Region
C8 Welsh Region
C9 Wessex Region
C10 Yorkshire Region

TYPICAL AGENDA FOR MEETINGS WITH NRA REGIONS

1. Data already sent to Halcrow.

2. Demand forecasting methodology.

3. Forecast demands in relation to resource planning (safety margin).

4. River support/catchment transfers.

5. Net direct abstractions.

6. Water quality considerations.

7. Environmental considerations.

8. Surface and ground water resource development potential.

9. Future developments/policies.

10. Reports and references.

11. Any other business.

12. Programme for additional data transfer.

C1 ANGLIAN REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Anglian Region, 28 March 1991

1. **PRESENT :**

Roger Cook (part-time), David Evans, Peter Grainger (part-time) (NRA); P J Hawker (Halcrow).

2. **AGENDA**

Copy attached.

Generally the meeting was informal, and revolved around discussion data already sent to Halcrow and then filling any gaps which remained in the questionnaires circulated to all regions on 5 March.

3. **DISCUSSIONS**

3.1 Demands

NRA passed Halcrow copies of demand forecasts prepared in 1988. These set out demand forecasting methodology in the region, and also address non-abstractive demands such as in-river water need. Note that the 1990 forecasts provided by Anglian Region to Halcrow rely fairly heavily on the 1988 version, due to lack of reliable more recent abstraction data.

For the purposes of the present exercise, it was agreed that the Anglian categories of demand should be allocated as follows between different uses :

- unmetered public approximately equal to miscellaneous, domestic and commercial demand;
- metered public, plus industrial direct abstractions approximately equal to industrial demand including power;
- general agricultural direct abstraction approximately equal to agricultural non-spray demand;
- agricultural spray equals agricultural spray demand.

Within Anglian Region, the main industrial concentrations are on Humberside, where a significant amount of demand is met by non-potable water from the Trent-Witham-Ancholme Scheme, and North Thames, where demand is mostly met through the mains supply system. Some industries, particularly on Humberside, do their own treatment, because either :

a) their standards differ from public water supply standards, or,

b) treated water is not available.

Some 600-700 farmers already use storage to support irrigation, and Anglian Region is pushing others that way.

For the purposes of the study, it should be assumed that 100% population is connected to the public water supply system as far as domestic demand is concerned.

Projection of demand beyond 2011 has been carried out by the NRA, on a pro rata (linear) basis.

The ultimate target for unaccounted for water is 15% of total into supply. This was seen as slightly optimistic (especially for Essex Water Company). It should be noted that leakage inland may be seen as returned resource.

The demand forecasts provided by Anglian Region exclude a margin of safety for planning purposes. What this should be, and whether to apply it across the board or to some components of demand only, is a national rather than a regional issue in Anglian Region's view.

Anglian Region provided a paper on water use by source type.

3.2 Resources

Anglian Region agreed to review the data included in the tables on ground water resources already sent to Halcrow, by the end of Easter week.

The Trent-Witham-Ancholme Scheme was explained with the aid of a map which was then passed to Halcrow. The River Witham is supported by the Trent, and in turn supports the River Ancholme. The latter has one public water supply abstraction and several private water abstractions along its length. In addition to providing for these abstractive needs, the scheme also increases river flows for their own sake, to control saline intrusion of estuaries.

In resource terms, the scheme means little apart from upsetting 'natural' hydrology. The Trent abstraction represents a resource commitment on that river, but is effectively located at the head of tide (minimum natural flow in the Trent here was quoted as 1,600 Ml/d +).

The suitability of Trent-derived water for public supply was briefly discussed. It is admittedly a poor quality - although this is improving - but Anglian Water Services Limited (AWSL) will shortly be using it for public supply in the Scunthorpe area, after blending with water derived from other sources. The transfer shown on the resources map from Rutland to the Grantham area is small, and may be entirely by pipeline.

Note that the transfers to Fen areas from the Rivers Ouse and Nene are a resource loss. The water is used for spray and sub-surface irrigation; in summer, virtually all of the River Nene flow (approximately 30 Mg/d or 140 Ml/d) goes to the Middle Level.

The considerable capacity of the transfer system between the River Ouse Cut-Off channel and the headwaters of the Stour, Colne and Blackwater is constrained by flows in the Cut-Off channel, and can only be used intermittently due to salinity and navigation considerations. Theoretically at least, freshwater flows in the Cut-Off channel could be improved by a tunnel from the River Witham, which in turn can be further regulated from the Trent.

A (controversial and expensive) reservoir site was identified and studied by Binnie in the 1960's at Great Bradley in the Upper Stour. If this were to be developed, in association with increased augmentation of the Stour, it would give some relief to Essex Water, whose resource development options are otherwise very limited.

Reference was also made to the proposal to increase the augmentation of Grafham water by reducing the prescribed flow at Offord or developing and installing the infrastructure for AWSL's as yet unused licence to abstract from the Ouse at Brownshill.

Anglian Region undertook to send a letter setting out in more detail their surface water resources position by the end of Easter week.

Note that Anglian Region are publishing an important document on their local resource development strategy on 8 April. They undertook to send a copy of this to Halcrow.

3.3 Transfers

There is an inward transfer of about 70 megalitres per day of water derived from the sandstone in the Severn Trent region, in the vicinity of the Isle of Axholme/Lincoln.

A further 91 Ml/d is transferred to the Essex area. The water is provided by Thames Water Utilities Limited, and is derived from Lee Valley Reservoirs, via Chigwell.

3.4 Other Comments

Refer to annotations etc. on tables and figures provided by Anglian NRA.

4. REPORTS AND REFERENCES

It was suggested that Halcrow should get in touch with John Simpson of Lee Valley Water Company, who has done some basic work costing out water resources from icebergs.

P J HAWKER

C2 NORTHUMBRIAN REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Northumbrian Region, 3 May 1991

1. **PRESENT**

John Mawdsley (part-time), Dave Archer, Martin Kershaw (NRA; Patrick Hawker (Halcrow).

2. **AGENDA**

No agenda had been forwarded to the NRA in advance; the agenda used for a similar meeting with Southern Region was therefore tabled as a framework.

3. **DISCUSSION**

3.1 Data Received

In advance of the meeting, Halcrow had been sent :

- schedule of licences exceeding 10 Ml/d entitlement, showing annual entitlement, grid reference, river or aquifer from which the abstraction is made, and estimated yield. Spaces on the table relating to abstraction type, purpose, use, disposal and operation had not been filled in;

- schedules showing use category, number of licences, and annual amount licensed by river system/aquifer. A column for estimated dry year take-up had not been completed.

In the course of the meeting, Halcrow were given :

- an updated schedule of licences greater than 10 Ml/d, with all columns on the tables completed except where the water is used;

- demand forecasts for Hartlepools, Newcastle and Gateshead, and Sunderland and South Shields Water Companies, broken down into metered, unmetered and unaccounted for water;

- a paper entitled 'River Regulation : A Regional Perspective - Northumbrian Water Authority', by P Johnson (paper presented at a conference 1988 entitled Regulated Rivers : Research and Management);

- an A4 plan showing how Kielder water is passed between the Tyne, Derwent, Wear and Tees catchments;

- an A4 map showing main water resources and trunk mains in the northern part of the region.

Data from Northumbrian Water Company on existing and forecast demand have been requested, but are still awaited.

In discussion of the foregoing data, it was agreed that NRA would provide :

- a summary of 1989 abstraction returns for the various catchments, as available;

- an indication of licensed entitlement excluding abstractions from tidal waters.

They would also check :

- with Hartlepools Water Company, population forecasts and whether or not the stated forecast for metered demand is correct;

- whether Sunderland and South Shields Water Company forecast includes the bulk transfers from Newcastle and Gateshead and Sunderland and South Shields to Northumbrian Water.

NRA also undertook to press Northumbrian Water for their public demand forecasts, and Halcrow will check whether they can make use of data provided in confidence by water companies during the preparation of asset management plans, for the purposes of the Water Resource Planning Study.

Note that Newcastle and Gateshead Water Company has effectively merged with Sunderland and South Shields.

3.2 Demand

NRA stated that public supply is by far the largest component of demand in their region. Note, however, that a proportion of the water is supplied either untreated, or partially treated, as well as fully treated. There is negligible irrigation demand, and only four private industrial abstractions exceed 10 megalitres/day (see tables).

There was some discussion on future water needs of BNFL; they are currently understood to be considering constructing two nuclear reactors at Chappel Cross to generate 1200-1500 MW each. These would have a net water demand of 90-110 megalitres/day each, and be on line in about 2010. Water could come from either :

- the River Annan, in which case reservoirs would be needed (but note the geology for these is believed to be poor), or

- the Esk, regulated by a catchment transfer from Kielder via a tributary, the River Liddel, or by direct supply from Kielder, in which case a new intake in the reservoir would be needed.

Note that neither, either or both reactors could be built at Chappel Cross or at Sellafield.

NRA were unaware of any other significant new industrial demand on the future horizon.

In relation to peaking factors for resource planning purposes, Halcrow were referred to the Section 143 report prepared by NRA HQ before Easter.

There are no hard data held by the region on net private abstractions (such as Kimberley Clarke); the amounts involved are small.

River support and transfers are picked out on the schedule of major licences. Kielder is the only scheme to which they relate.

3.3 Resources

The region has a massive and under-used resource in the form of Kielder Reservoir, which regulates the River North Tyne. An abstraction at Riding Mill, on the main River Tyne, enables transfers to be made to the Rivers Derwent, Wear and Tees.

The civil works associated with Kielder are owned by Northumbrian Water; however, the reservoir contents are 'owned' by the NRA. Facilities exist at Teeside docks to fill seagoing tankers with treated water. This was done in 1984, to serve Gibraltar, when the Spaniards temporarily shut off mains supplying the Rock from Spain. NRA noted that on that occasion, tanker filling was achieved without exceeding the constraints imposed by abstraction licences. It was suggested that the operation only just about broke even, being more successful as a public relations exercise than as a commercial venture.

Kielder yield calculations have not been re-visited since the early 1970's. Halcrow should refer to the relevant IWES paper, or, if required, to public inquiry documentation relating to Kielder promotion, which NRA could open up if necessary.

Due to the resource surplus, Kielder releases are currently dictated principally by hydro needs, although in 1989/90, public water supply needs dominated the release pattern. Information on Kielder control rule priorities is given in the 1988 paper on river regulation (see 3.1 above).

Kielder has also been used for additional releases when, for example, fish are distressed or a pollution incident has occurred, and the pollutant needs to be flushed out of the catchment. Such deployment is usually of short duration, and has negligible impact on the available resource of the reservoir.

River abstractions benefitting from Kielder generally are not supported by bankside storage. A pollution incident which occurs upstream of Riding Mill can thus get well around the southern part of the region, if it is undetected. This could perhaps be mitigated with better monitoring, although detection of some pollutants - such as phenols - is not straightforward.

Note that Kielder tunnel can also support the River Derwent below Derwent Reservoir, and Mosswood Treatment Works nearby.

Halcrow asked for details of sewage treatment works with dry weather flows exceeding 10 megalitres/day, which discharged to inland waters.

As far as surface water resources are concerned, potential reservoir sites exist on the River Tees, the South Tyne, and the Northumbrian rivers, inter alia. However, it was suggested that there may have been an undertaking (legal or moral) that no more reservoirs would be developed in the Tees catchment after Cow Green. In summary, there is scope for further reservoir development in the region, but caution - and environmental assessment -is needed. Northumbrian NRA have available the Section 14 and Section 24 reports prepared by their predecessor bodies, if required.

There is some - very limited - scope for further development of the limestone and vale sandstone aquifers. In resource terms, the amount available would only be appropriate to strictly local needs.

There are no Section 25 exemption areas in the region, nor are there believed to be any significant unlicensed abstractions.

At this stage, no future resource developments are planned, other than small groundwater schemes to meet strictly local needs (see Section 143 report prepared by NRA HQ).

3.4 Water Quality and Environmental Considerations

Water quality is not a constraint on resource development in the region, as NRA are spoilt for choice. The main rivers are generally Class 1A. The objective is for migratory fishing to be restored and/or further encouraged on the Rivers Tyne, Tees and Wear. The problems are all in the estuaries, and these are being gradually overcome. The River Tyne is an important salmon fishery once again, and the Northumbrian rivers are also satisfactory in this respect. In the River Wear, the situation has been improved sufficiently for sea trout to spawn, and no doubt salmon could also be supported, subject to stocking. Measures to improve the water quality in the Tees estuary are also well under way.

The River Wear 'benefits' from a significant mine dewatering discharge which varies diurnally. The water has a much greater hardness than the natural river flow, and so the daily water quality variations occur which cause problems for the treatment

of water abstracted downstream by Sunderland and South Shields Water Company. In the future, the mine dewatering patterns may alter to a steady discharge, or cease altogether; this depends upon whether the four large coalmines on the coast, for whose benefit the dewatering is carried out, are closed. Note that, prior to the promotion of Kielder, some schemes were investigated which used mine water as a resource.

3.5 Policies and Local Issues

Environmental policy in the region is embraced in the operating agreements for the various water sources. Generally, water is made available if needed for specific environmental problems; this is possible because of the surplus within the region.

The charging basis for water generally - and Kielder water particularly - is a litigious issue in this region. So far, Northumbrian consumers have met the bill for Kielder; this is despite the fact that not all consumers within the region can benefit directly from it (e.g. Hartlepools consumers cannot). If the resource surplus brought about by Kielder were to be mobilised outside the region, it is likely that local consumers would expect their previous and exclusive contributions to the Kielder debt to be recognised in the method of charging for the regional transfer.

3.6 Reports and References

See 3.1 above. Note that Section 14 and Section 24 reports, and Kielder promotion/public inquiry documents, can be inspected if required. Note also that clearance to use AMP information may help to mitigate the shortage of data for this region.

The publication 'Water Resources - A Decade of Change' by John Brady and available from him at Northumbrian Water plc was also commended. It covers the period 1970-1980.

3.7 Programme for Transfer for Additional Data Needs

NRA Northumbrian Region undertook to provide all further information requested by 10 May, except for data on Northumbrian Water plc demands, which would be forwarded as soon as they are available.

P J HAWKER

C3 NORTH WEST REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA North West Region, 12 April 1991

1. **PRESENT**

Robin Mundy, Paul Cray, Meg Owens, Mike Knowles (Principal Hydrologist) (NRA);
Patrick Hawker (Halcrow)

2. **AGENDA**

Copy attached.

The general form of the meeting was to go through data already provided by North West Region, and then to discuss Halcrow's further data requirements, and how these could best be met.

3. **DISCUSSION**

3.1 General

North West Water is the only public water supply company in the region. Their boundary coincides approximately (but not exactly) with that of NRA North West Region.

In the course of the meeting, an A4 map of the region entitled 'NWWA Regional Aqueduct System', and an A3 map entitled 'Map of Bulk Water Movements - North West Region' were passed to Halcrow.

3.2 Demand

NW NRA provided Halcrow with a copy of the DOE return setting out water abstracted for public and private use in the North West Water Authority area to the year ended 31 December 1989, and had annotated the data collection framework to show forecast population to 2001, 2011, 2021, and unmetered demand forecasts for 2001 and 2011.

The DOE abstraction return was annotated to indicate the proportion of abstracted water which may be regarded as a total loss, for all uses except public supply.

Demand forecasts sent to Halcrow are the same as those sent to Jerry Sherriff (NRA HQ) for his Section 143 report, and are based on Binnie's report 'Water Authorities of England and Wales Final Report Capital Expenditure Projections'. This document is an amalgam of asset management planning study data collected by

Binnie's, and the demand information presented therein is based on forecasts prepared in 1986. No further forecasting has been done since that date, although there are plans to review the figures in the next year or so.

Halcrow asked for :

- details of assumptions used for forecasting populations, growth in per capita demand, growth in unmetered non-domestic demand, growth in metered demand and assumptions made and targets adopted for control of unaccounted for water;

- total volume of water put in the public water supply system from 1989, broken down into :

  - metered;

  - unmetered;

  - unaccounted for water;

- breakdown of 1989 metered public supply (industrial use) by broad use type, and details of any single industry taking more than 10% of the total (i.e. 70 Ml/d);

- proportion of population connected to public water supply system, and clarification of whether the population figures quoted to Halcrow are resident population or population connected to the system.

North West Water have adopted the policy that all new houses should be fitted with water meters; otherwise, the proportion of the domestic sector which is on metered supply is very small.

For supply purposes, peak demands in North West NRA Region are assumed to be 10% above normal average demand levels.

NW NRA have provided details of private abstraction licence entitlements by catchment. Note that no areas in the region have been granted exemption from licensing procedures under Section 25 of the 1963 Water Act; in addition, crown exemptions are not thought to be a significant issue in the area. Halcrow requested the locations (if not the quantities diverted) of significant abstractions into BWB canals. Note that significant abstractions from canals are included in the licence details provided to Halcrow (identifiable by Source Code 6).

It is understood that BNFL may be looking for a significant additional supply of water in the near future; they have apparently approached both North West and Northumbrian Regions of the NRA. Halcrow requested further details.

3.3 Resources

Halcrow had been sent an excerpt from a return to OFWAT entitled 'DG1 - Raw Water Availability'. This sets out, inter alia, the yields of the principal sources through the region. In reviewing these data, it should be noted that critical drought periods assumed for the River Dee and Lake Vyrnwy are 1 in 100 years, and for the Lake District sources, 1 in 200 years. It was noted that this differed significantly from the general 1 in 50 year drought return period criterion applied in other regions; NW NRA were requested to provide corresponding 1 in 50 year data for the above-named sources, if possible. Those (other) NW sources which have been assessed on the basis of a 1 in 50 year drought have 5 year refilling built into the simulation. Thus, if the reservoir would take longer than 5 years to fill after meeting a specified demand of approximately 1 in 50 years frequency, the demand applied in the simulation would be reduced, until refilling within 5 years after the drought is achieved.

Halcrow were provided with a schedule of all the major sewage works in the region, together with the dry weather flow and discharge location data. Note that an interceptor sewer is being constructed along the north bank of the Mersey, to pick up numerous raw sewage discharges into the river from Liverpool. It is understood that NW NRA Water Quality Offices are now following the Municipal Waste Water Treatment Directive as a matter of policy.

It is understood that coalmine dewatering is not an issue in the North West area, either in terms of demand on available resource or as a contributor to usable resources.

Generally, availability of water resources is not seen as a problem in the North West Region; in recent years, effort has been directed more towards optimisation of use of existing sources, rather than identification of further resources to be developed. There has thus been a trend towards the integration of public water supply sources, which is continuing.

Halcrow asked for details of :

- gauging records from main surface water catchments, showing the proportion of the catchment which is gauged;
- average annual recharge and licensed quantities from each groundwater unit;
- details of future reservoir options, including their approximate yield implications, net of unpopular existing sources (i.e. allowing for environmental gain of renegotiating some damaging existing licences on the back of negotiating for a new licence).

It is understood that groundwater resources are fairly fully committed in the North West Region.

Some estuarine barrages are either being actively studied or have been studied in the past in the region. The Mersey barrage is under active study at present, and is intended primarily for power generation and amenity purposes. It may adversely affect water resources through moving the tidal limit upstream and causing water quality problems at existing intakes. The Morecambe Bay barrage was studied extensively in the 1970's by Water Resources Board and was intended as a water resources scheme. If required, a report on the studies is available from NW NRA.

3.4 Water Quality

Nitrates in groundwater are not a problem in the North West, although concentrations are rising. There are no designated nitrate-sensitive areas in the region.

The lower reaches of the River Mersey are grossly polluted, putting the river within Class 4. Halcrow requested a list of rivers in the region which are at present unsuitable for raw water sources for public supply schemes, indicating how this list may change in the future.

3.5 Environmental Considerations

There is no written regional policy relating to environmental practice in licensing policy, although Q95 is taken into account. There is a significant fisheries interest in the area with many important rivers. The region embraces the Lake District, Peak District and parts of the Yorkshire Dales National Parks, the Forest of Boland AONB, and miscellaneous national nature reserves and sites of special scientific interest.

There are some localised over-abstraction problems. These include the Crossends catchment in the Southport/Holsgate/ Liverpool triangle, where irrigation is widely practised. Abstraction for irrigation is also causing problems in the Weaver and Storridge catchments, so that all new licences in the three rivers just named require that irrigation abstractions are supported by winter storage.

There is a different low flow problem in Hallswater tributaries, due to a catchwater system with no prescribed flows. However, the 1919 Act under which this system was set up is understood to allow renegotiation of licences if fisheries are being adversely affected. Accordingly, the NRA propose to use this provision to bring in prescribed flows on the affected tributaries.

NW NRA provided Halcrow with a copy of the list of rivers in the region with low flow problems, as sent to NRA HQ last autumn.

Over-abstraction - particularly in association with licences of right - is believed to cause problems in other areas, but the scope and scale of the problem has not yet been quantified.

3.6 Reports and References

There are no particular formalised regional policies, (i.e. nothing in writing).

NW NRA agreed to send a copy of their list of references relating to water resources.

Other data held by the NRA which may be borrowed if required includes :

- Section 14 Water Resources Report;
- Section 25 Land Drainage Report;
- miscellaneous reports on water resources in the north by WRB/Binnies, including Solway Barrage, and Morecambe Bay Barrage etc;
- survey of existing surface water resources NWWA 1981-86;
- economic operation of Lake District sources.

3.7 Data Transfer

NW NRA agreed to forward data requested by Halcrow in the course of the meeting, as it becomes available, with the programme of sending all data by the end of April. It was requested that faxes should be followed up with 'hard copy'.

P J HAWKER

C4 SEVERN TRENT REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Severn Trent Region, 8 April 1991

1. **PRESENT**

Andrew Skinner (part-time), Roger Goodhew, Gordon Davies (NRA); Patrick Hawker (Halcrow).

2. **AGENDA**

Copy attached.

General form of the meeting was to go through data already provided by Severn Trent Region, and then to discuss Halcrow's further data requirements, and how these could best be filled.

3. **DISCUSSION**

3.1 Overall Licensed Entitlements

ST NRA have provided tables showing overall entitlements by use type for both the Severn and the Trent basins. Halcrow copies of these tables have been annotated to show how they should be interpreted.

3.2 Level of Service/Tariff Data

ST NRA had provided copious information on this; its value was acknowledged but it was not discussed.

3.3 Demands

Data on existing and future demand for public water supplies had been provided for East Worcestershire Waterworks Company (now owned by Biwater plc). Demand was sub-divided into metered, unmetered and unaccounted for water for 1990, 2001, 2011 and 2021. All these data were provided by the water company. 1989 figures were also quoted for metered demand, unmetered demand and total demand; these were seen as less reliable than the 1990 figures and give no indication of unaccounted for water. Halcrow requested details of how the forecasts were prepared, particularly in relation to :

- per capita water consumption;
- basis of metered forecasts;
- unaccounted for water target levels, and the anticipated

achievement of these targets (for resource planning purposes).

Little information was provided on present use of water and forecasts for both South Staffordshire Waterworks Company and Severn Trent Water plc. NRA agreed to provide details of :

- existing demands, broken down into at least metered, unmetered and unaccounted for water consumption;

- forecasts of future water demand for both companies, including supporting information as requested in respect of East Worcestershire Company (see above).

The point was made that the Severn Trent NRA boundary is seldom coincident with any water company boundary along its edge.

Data on private demand for water in the region are included in the tables of overall amounts licensed (see 3.1 above) and, in the case of large sources, individual licence details (see below). No forecasts are available for private users; some work is being done at present on forecasting demand for spray irrigation use, and this may become available in the next 1-2 months.

Both (the former) CEGB and National Coal Board were singled out as significant single industry large users of water. In the case of the former CEGB, it is important to note that the River Trent ('Kilowatt Valley') is theoretically over-licensed, mainly due to entitlements for power stations. In the days of one, public sector, generating organisation, this was not a problem, as all power stations were not operated flat-out simultaneously. However, the situation may change now that - roughly speaking - alternate power stations down the valley are operated by National Power and Powergen, who are in competition with each other. The implications of this are unclear at present, as are the two companies' preferred future method of generating power. The accepted view is that Powergen and National Power will hang on to their existing sites, possibly redeveloping them to generate power by different means; by the same token therefore, it is likely that they will wish to retain their present entitlements to abstract water.

The National Coal Board is a relatively small user of water compared to 'CEGB'. Its demand for water is also shrinking, due to pit closures etc. NCB is in any case perhaps more important as a provider of water to the surface system, through their mine dewatering operations. Note that closure of a mine does not necessarily mean that dewatering will stop; continued working of adjacent mines may mean that dewatering of redundant pits has to continue to avoid flooding problems at working pits.

ST NRA undertook to give Halcrow details of any individual industry whose demand represented 10% or more of the total private licensed entitlement, or of the metered sector of public water demand.

3.4 Existing Commitment of Resources

3.4.1 General

The over-licensing of the River Trent (see above) has hitherto not been an important issue, as CEGB and other private users had not encountered any problems in fulfilling their needs from the river, and there was little interest in it for public supply purposes. However, the need to develop it further for public water supplies is now becoming apparent; South Staffordshire Waterworks Company and Anglia Water Services Limited (Lincoln Area) both have fairly pressing resource problems for which the River Trent offers the only reasonably 'local' solution. Although its gross conventional water quality deficiencies may be improving, the subtle presence of exotic pollutants is likely to present problems in treating the water to potable standards. Also, the chloride loading on the river is likely to increase significantly in the future, due to the combined effects of flue gas desulphurisation, mine dewatering and denitrification at water treatment works.

ST NRA had sent Halcrow details of the licensed commitment by use type of their various rivers, according to groups of sub-catchment. A map showing the locations of the sub-catchment groups was requested by Halcrow to support these data. Some care is needed in the interpretation of the computer print-outs giving details of individual licences greater than 3650 megalitres/year; generally, items marked 'no charge' should be ignored, as these relate either to river support or to a sub-set of a larger licence whose total entitlement has already been accounted for in the row above. Great care is needed when summing entitlements; only annual entitlements should be summed, and the charging base column should be carefully checked as above to avoid double counting. In reading the computer print-outs it should also be noted that :

- exports across the regional boundary are seen as total resource losses from ST NRA's viewpoint; although the purpose is usually public water supply (PWS) the use is noted as 'evaporative cooling'! This is because the computer understands evaporative cooling as a total loss. Note also that although the beneficiary of such transfers may be Yorkshire or Anglian Water, the billing address is usually Severn Trent Water, as they operate the licences in question.

- A complication arises in relation to abstractions from canals owned or operated by British Waterways Board; licences for such abstractions apparently have to be held by BWB - this is exemplified by the Purton abstraction from the Gloucester-Sharpness Canal, which is actually operated by Bristol Waterworks Company.

- As a general guide to the resource implications of particular use types, the following figures were quoted :

  - evaporative cooling : total loss

  - industrial process : 20% volumetric loss (+ 20% quality loss)

  - hydro-power : 0% loss

  - washing, circulation, cooling etc : 5% loss

  - public water supply : depends on where the water is taken, and where it is used.

Note that Severn Trent Region have an exemption zone from the viewpoint of groundwater licensing. This relates to the hard rock area to the west of the region, which is seen as being of negligible value in resource terms. River gravel areas etc. within the exemption zone are excluded from the exemption (i.e. they require licences).

ST NRA received some 85 applications for licences of entitlement. Of these, 20 have been issued, 30 do not qualify for such licences for one reason or another and the remainder have yet to be processed. The resource implications are understood to be minor, although NRA undertook to provide details of any individual LOE exceeding 10 Ml/d.

NRA undertook to confirm why the carboniferous limestone and Jurassic limestones were excluded from the list of groundwater resources provided to Halcrow.

The groundwater resource column in the summary tables of licence commitment of aquifer units equates to average annual recharge. Note that it is a gross figure, and no adjustment has been made to it for spring flow contributions etc. In this context, the unit classification as set out in the right-hand column of the tables is relevant.

3.4.2 British Waterways Board Abstractions

See Table 1 attached.

3.5 River Support/Catchment Transfers

Lake Vyrnwy is a dual purpose reservoir owned by Severn Trent Water with a direct supply yield to North West Water of some 200 Ml/d, via an aqueduct to Liverpool. It is also used to support the River Severn (water bank system - 75 Ml/d average yield approx.). Thus it affects both North West and Severn Trent NRA Regions.

Clywedog Reservoir is owned by Severn Trent Water and used entirely by NRA to regulate the River Severn, enhancing yields of downstream abstractions by about 500 Ml/d overall.

The Shropshire Groundwater Scheme (SGWS) is also used to regulate River Severn flows, and will have a net yield of 225 Ml/d when fully licensed. So far only phases 1 and 2 have been commissioned, giving 80 Ml/d when used conjunctively with Clywedog and Vryrnwy. Phases 3 - 8 of SGWS will be built to match demand growth; the present programme assumes it will be fully utilised by 2016.

Various public water supply schemes lead to catchment transfers (See Table 2 attached).

3.6 Resource Developments

3.6.1 River Severn - Surface Water

A new intake is proposed at Ombersley on the River Severn for East Worcestershire Water Company. This would counter problems with an unreliable transfer from Severn Trent Water, supplant groundwater over-exploitation and help meet demand growth in Redditch/Bromsgrove areas.

A treated water-main linking the Severn Valley sources (the Mythe, Upton, Trimpley etc) is proposed to provide security against pollution incidents, failures etc. It would also allow closure(?)/refurbishment(?) of the obsolete intake at Worcester(?).

There is an as-yet unsubstantiated need for further resources for South Staffordshire Water Company, which would not necessarily be met from Hampton Loade Treatment Works, but would be surface derived (see below, ref. nitrates).

Further abstractions may be needed by Severn Trent Water to secure (a) Telford area and (b) Upper Trent demand area. These are not formalised or in public domain, i.e. CONFIDENTIAL.

Additional treatment capacity proposed for Draycote (fed from River Leam) will help meet rising demand in Coventry.

Note that management of the River Severn is under review. This could lead to the SGWS timetable (see above) being advanced.

3.6.2 River Severn - Groundwater

Additional needs in the Powys Vale will be met from Garth Myl Groundwater Scheme.

There are no further groundwater resources available in East Worcestershire Waterworks Company supply area. Elsewhere in the Severn basin, additional groundwater take is constrained by high nitrate levels/blending needs. This is particularly so in South Staffordshire supply area - the company faces reduced groundwater source yields because of this problem.

Two Cotswold-edge spring sources - Chelford (Severn Trent?) and Broadway (East Worcestershire) - are 'not noted for their reliability'.

3.6.3 Remainder of Region

The trend for West-East supply is strengthened by the Strensham (River Severn) - Oldbury - Hallgates (Leicester) aqueduct. ST NRA undertook to provide Halcrow with their assessment of future surface water development opportunities in the region.

See also notes taken at the time of the meeting (PJH) for additional points of detail about water supplies to some of the larger towns in the region.

3.7 Environmental Issues

Groundwater in the lower Trent area is being heavily over-abstracted. The problem is exacerbated by links between the confined and unconfined strata. High nitrate and chloride levels are also a problem.

Numerous spray irrigation licences in Shropshire can complicate control of River Severn flows if they are brought into operation simultaneously. A similar problem exists with the Upper Trent. Gravels in the Vale of Evesham are over-licensed.

Note also earlier comment about groundwater quality (e.g. South Staffordshire) spring flow reliability (Cotswolds) etc.

Flue gas desulphurisation and water denitrification plants may cause higher chloride levels in the R Trent in future.

4. TRANSFER OF DATA

ST NRA agreed to fulfill all additional data needs (identified above) by the end of April.

P J HAWKER

TABLE 1

Severn Trent Region : Significant British Waterways Board Abstractions

REF	CANAL	FEEDERS	OPERATION	CAPACITY (Ml/d)	NET LOSS (Ml/d)	REMARKS
1	Montgomery	R Severn R Tanat	Gravity	No data	~ 7 ~ 5	
2	Gloucester-Sharpness	R Severn at Glos. Docks; R Frome R Cam etc.	Pumps Gravity Gravity	305 + 373 = 678 No data No data	280 (summer)	Includes Purton support (BWW). Current Purton take 175 Ml/d, further 75 Ml/d being sought
3	Grand Union	U. Avon	Gravity via Naseby, Sulby and Welford reservoirs	Most of river flow	Not stated	3 & 4 both affect inflow to Stanford reservoir, used to regulate flow to river intake at Brownsover, which feeds Rugby. (Rugby also fed from Draycote reservoir)
4	Oxford	R Swift	Gravity	All available flow near Churchover	Not stated	Leads to low flow/effluent dilution problems
5	Caldon	R Dane (NW Region)	Gravity via Rudyard Reservoir	Not stated	- 4 Ml/d	Resource gain to Churnet/Dove system
6	Cromford	R Derwent	Gravity	Not stated	Unquantified	
7	Unspecified	R Erewash	Gravity?	Not stated	10 (v. approx)	
8	Chesterfield	R Idle	?	?	?	More information can be provided if required
9	R Soar Navigation	Soar/Mid + Lower Trent	Gravity	?	Unquantified	
10	Fossdyke Navigation	R Trent	Gravity?			See information on Trent-Witham Ancholme Scheme (Anglian Region)
11	Birmingham	Numerous canal feeds - no specific information				

TABLE 2

Severn Trent Region : Catchment Transfers via Public Water Supply systems

INTAKE	SUPPLY AREA	PART DRAINING TO	REMARKS
R Severn : Hampton Loade	Wolverhampton & Black Country	R Trent	NRA to quantify transfer
R Severn : Upton	Coventry (via Strensham TW)	R Avon	
R Severn : The Mythe	Tewksbury, Cheltenham & Gloucester	R Severn	Gloucester drains to d/s of tidal limit
R Teme : Whitbourne	Bromyard	R Wye	
R Wye : Elan Valley (Welsh Region)	Birmingham	R Trent	IMPORT - 360 Ml/d
R Wye : Wyelands	Stroud/Cheltenham/Gloucester (via Micheldean TW)	R Severn	IMPORT
R Wye : Hereford	Ledbury	R Severn	Return below tidal limit
Peckforton Abh (NW Region)	Stoke-on-Trent	Upper Trent	
Howden, Derwent & Ladybower Reservoirs	Yorkshire Water (Sheffield)	Yorkshire NRA	50-60 Ml/d export. Reservoirs have secondary purpose to regulate R Derwent, after DVA requirement is met - see below
Howden, Derwent & Ladybower Reservoirs via Bamford TW and Derwent Valley Aqueduct (DVA)	Chesterfield	Yorkshire NRA	Export - quantity to be advised. NB : Additional export to Chesterfield via Ambergate abstraction/Ogston reservoir
Howden, Derwent & Ladybower Reservoirs via Bamford TW and Derwent Valley aqueduct	Derby (mostly) - Nottingham and Leicester	Derwent, Trent & Soar respectively	180 Ml/d less Chesterfield supply
Rutland Water via Wing TW (Anglian Region)	Anglian Water area within Severn Trent NRA Region	Soar	
R Trent : Torksey	Lincoln/Scunthorpe, Humberside	Witham & Ancholme (Anglian Region)	Trent-Witham-Ancholme Scheme

C5 SOUTHERN REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Southern Region, 9 April 1991

1. **PRESENT**

Geoff Burrow, Peter Shaw (NRA);
Patrick Hawker (Halcrow).

2. **AGENDA**

Copy attached.

The format of the meeting was to go through data already provided by Southern Region NRA (SRNRA), and then to discuss additional data needs for the study, and how these might best be met.

3. **DISCUSSION**

3.1 Demand

SRNRA had already sent Halcrow details of forecast public water supply demand by water company area to 2011; they agreed to send Halcrow a map showing the water company boundaries, to support these data. As no information is available about population etc beyond 2011, it was agreed that Halcrow should extrapolate the forecasts to deduce 2021 demands.

It was noted that the tables showed upper bound estimates of future demand; it was therefore seen as unnecessary to apply a peaking factor to the forecasts when comparing them with future resource availability. 'Median' estimates of future demand had not been produced. (These comments relate to the domestic component of demand). Population data for domestic demand forecasts are based on OPCS, via County Council structure plans (i.e. not district structure plans) for the period up to 2001. For 2011, population trends are derived from the pre-2001 data, and projected up to 2011 on a district-by-district basis. The sum of district projections to 2011 for the county is then compared with the OPCS projection of the county population in 2011, and pro rata adjustments made to the district forecasts so that the county totals match.

Per capita domestic consumption is based on an analysis of water use in groups of properties - there are 70 control areas within the region - and the application of Acorn Socio-economic Profile Data which are available for each water company within the area.

An assumed annual growth rate in per capita demand of 1% has been applied for forecasting purposes; this is based on a historic trend in domestic water use, and is taken as an upper limit for projection purposes.

The projection for metered domestic demand is more complex, and SRNRA agreed to send an 'idiot's guide' sample calculation. Note that metering is highly relevant in Southern, where nearly all domestic properties on the Isle of Wight, and many mainland properties, are already metered. The main point to note about forecasts for metered domestic demand is that connection to a meter is assumed to result in a 5% reduction in per capita consumption. As more results from the meter trials have become available, this 5% figure is seen as pessimistic; actual reductions following connection by meter are seen to be in the range 10-15%.

Forecasts of unmetered commercial demands are based on water company figures. These figures are in fact typically steady throughout the forecasting period, the underlying logic being that most commercial properties which are likely to be metered are already on meters, but there will always be a hard core of offices etc where metering is impracticable.

Metered commercial and industrial use has been assumed to grow at a nominal rate of 1% per annum. This is based on past trends. For the upper bound forecasts presented here, forecasts produced in this way have been inflated by 5%. SRNRA have no knowledge of the makeup of industries within the commercial/industrial metered demand sector; such information is held with the billing organisations - i.e. the water companies.

Significant industrial/commercial users of public water supplies seem to be :

- Fawley Refinery, which has a non-potable supply from a Southern Water plc source;
- farmers in East Kent who grow salad crops, which they irrigate with potable water from the mains;
- farmers in West Sussex who irrigate fruit with potable water from the mains as a form of frost protection.

The irrigation demands are not seen as particularly significant in the context of the overall figures; however, NRA agreed to provide more information about the amount of water taken by Fawley Refinery.

Halcrow requested details of licensed daily and annual abstractions (private as well as public) together with guidelines to assess the resource implications of these sources. In the case of public water supply licences, SRNRA agreed also to indicate the actual yield which could be achieved from the particular sources.

SRNRA had done no forecasts recently for future levels of private abstraction in their region.

(Unlicensed) British Waterways Board abstractions are not an issue in this region. There are some crown exemptions - Parkhurst and Albany prisons were mentioned - but these are probably not significant in overall resource terms within the region.

SRNRA agreed to provide Halcrow with details of :

- exports out of the region by companies under SRNRA's wing;
- imports into the region by companies under SRNRA's wing;
- exports to companies under SRNRA's wing who operate partly outside the region, so that the water is lost from the region's resource system - Crawley was mentioned in this context, as it is supplied by a water company within the region but drains via a sewage works to the River Thames system.
- internal transfers within the region between companies were noted on a table provided to Halcrow under cover of a copy letter to Jerry Sherriff dated 14 August 1990.

3.2 Resources

SRNRA undertook to send Halcrow a copy of their Water Resource Policy Document.

They would also provide Halcrow with aggregated dry weather flows for sewered populations within each of their water resource areas, so that an assessment can be made as to how much water is being returned to the surface system, and how much is being lost totally - e.g. by disposal at sea.

SRNRA also agreed to provide brief details of the various groundwater augmentation schemes (e.g. Andover Scheme) including licensed quantities etc.

The main reservoirs in the area are :

- Ardingly (Ouse); Bewl Water (Medway); Bough Beech; Weir Wood; Darwell; Powdermill; Arlington (Pumped Storage).

Ardingly and Bewl Water are operated principally to regulate their respective catchments to surface water intakes at the tidal limits; however each also has a small direct supply abstraction from it - of about 1 Ml/d in the case of Ardingly, and 10 Ml/d in the case of Bewl Water. The other reservoirs named above all operate as direct suppliers of water.

SRNRA undertook to give Halcrow an indication by resource area of the scope (or lack of it) for further groundwater exploitation within the region. This should particularly identify the areas

where cutbacks in groundwater exploitation are desirable. As far as future resource development potential across the region is concerned, Halcrow should refer to the recently published NRA Section 143 Report, Page 15 (copy attached). Note, however, that inclusion of a scheme thereon does not imply NRA approval of it. The main schemes are considered in outline below.

1. Test groundwater augmentation. This will regulate the Summer flow of the River Test to support the existing abstraction at the tidal limit at Testwood. It parallels the Candover Scheme on the River Itchen, which is reasonably successful, although some complaints are received regarding falling groundwater levels.

2. The Yalding intake proposal on Medway will increase the pumped inflow to Bewl Water (this is already a part-impounding, part-pumped storage reservoir).

3. Crowhurst Bridge Scheme. This entails augmentation of the middle reaches of the Waller Haven, also in support of the surface abstraction lower down.

4. Mid-Kent Boreholes. These were seen as the most questionable of the schemes on the list; Mid-Kent Water Company are carrying out investigations at the moment, but have yet to find sites suitable for development.

5. Hardham. This scheme will also provide for more security of the surface source during summer, on the River Rother.

6. Broadoak Reservoir. The quoted yield for this source of 94 megalitres/day may be high, and is also a gross figure. NRA will certainly be seeking environmental gain from this project in the form of cutbacks at damaging groundwater abstractions elsewhere, so that the net increase in available resources may be significantly less.

7. Darwell. Investigations for this dam raising are in progress. 40 megalitres/day was seen as a reasonable assessment of the likely increase in yield.

8. Arle. This is an extension of the Candover Scheme, by which groundwater abstraction is used to augment the River Itchen.

9. Chillerton Reservoir. This is a new impounding reservoir on the Medina river, on the Isle of Wight.

10. Test Reservoir. This is essentially bankside storage for the existing abstraction at Testwood, and offers no resource gain.

11. Gaters Mill. Portsmouth Water Company's surface water abstraction here will be increased, as a result of the groundwater support offered by the Candover Scheme.

Aside of the above-mentioned schemes, SRNRA were unaware of any other conventional opportunities in their area.

A measure of effluent re-use is already practised in the region, for example treated effluent from the Herne Bay area is transferred to the Stour catchment. Also, effluent from Canterbury is returned to the Stour and re-abstracted at Pluck's Gutter, and Medway towns treated effluent is returned to Bough Beech via Burram intake at the tidal limit. SRNRA would like to see the effluent from Crawley returned to their regional river system, rather than the Thames; beyond this, further effluent re-use would involve collecting effluent from the coastal towns and returning it higher up the catchments.

Limited aquifer recharge also occurs in the area, at Winchester and Andover. Use of further effluent recharge schemes was not seen as an opportunity; nor was the use of mains water to recharge the aquifers in winter seen as useful, as some 70% of the treated water in the area is derived from the ground originally anyway.

Other resource options were identified as desalination; a tidal barrage on the Stour; importing water by land or sea; reducing demand, especially by better leakage control.

The Stour was seen as the most appropriate river for a tidal barrage, to the large downstream abstraction at Richborough Power Station. The residual flow requirement downstream of Richborough must be slight, and installing a barrage was seen as a more efficient way of meeting this than the alternative of leaving some theoretical amount in the river upstream to meet both Richborough and residual flow requirements. Many of the other more significant rivers have intakes at the tidal limits which are operated according to appropriate residual flow conditions and therefore would benefit little from the installation of tidal barrages.

3.3 Hydromet Data

It was agreed that, for the time being at least, Halcrow would work from the hydrological yearbook to obtain hydrometeorological data relating to the surface catchments within Southern Region; SRNRA could provide further data if called upon to do so.

3.4 Quality Problems

Three specific problems were identified :

- iron in water derived principally from green sand boreholes of West Kent, Mid-Kent and the Eastbourne areas;
- nitrates in the Thanet boreholes (small localised problem);
- high chlorides due to mine water discharge, which has affected about 10 megalitres/day of resource in Kent. Pumped discharges from coalmines in the area have now

stopped, and it may be that the affected resources become useable again in 15-20 years' time.

3.5 Environmental Policy

NRA undertook to send Halcrow a copy of their Darwell Reservoir EIA requirements, which they saw as a reasonable statement of their environmental policies (attached).

It was noted that there is tremendous riparian pressure over the River Test, and, to a lesser extent, the River Itchen. Although the River Test is not particularly exploited for water resources upstream of the tidal limit abstraction at Testwood, the public perception is otherwise, and NRA expressed the view that no further public water supply abstraction upstream of the tidal limit could be contemplated on this river.

3.6 Reports and References

SRNRA have a copy of the Southern Water Authority Section 24 Report on future resource development in the area. This was produced in 1979. Halcrow may borrow it later on if they so wish; in the meantime, SRNRA undertook to send Halcrow a copy of the Contents List.

3.7 Programme for Additional Data Transfer

SRNRA agreed to forward data identified above as it becomes available. They anticipated that Halcrow should have received all the information asked for by the end of April.

P J HAWKER

C6 SOUTH WEST REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA South West Region, 10 April 1991

1. **PRESENT**

Dr Janet Cochrane, Natasha Fellowes (NRA);
Patrick Hawker (Halcrow)

2. **AGENDA**

Copy attached.

Generally the discussion revolved around data already sent to Halcrow, and what their additional needs for the WRP study are; it is acknowledged that Halcrow already possess a significant body of data on demands, resources and environmental problems in the South West, through their work on the recently completed Low Flows Study and the South West Resources Study and other work in the South West.

3. **DISCUSSION**

3.1 Demands

Halcrow already have a significant amount of data on demands, and are reviewing SWWSL forecasts, as part of their South West Water Resources Study. SWNRA are waiting for some additional figures on existing demand from Dave Moulder of SWWSL, and also for abstraction details by use type; the former data are continually promised, while the latter data await the return of the officer concerned from sick leave (probably around 22 April).

SWNRA provided a copy of SWWSL's charging policy for 1990/91.

3.2 Resources

NRA undertook to provide Halcrow with quantities for the main discharges to non-tidal waters. These could be expressed from returns by the operators of the consented discharges, dry weather flows or, if all else fails, the actual amounts referred to in the consent (licence) itself. It was noted that there were no significant sewage treatment works inland in the South West Region; effluents from most of the larger towns are disposed of to tidal waters.

The data sent by SWNRA includes a short statement on a future consent policy for waste water disposal, drafted by Nigel Morris (Quality Regulation Officer).

Halcrow agreed to check for themselves the meaning of stall yield analysis (see note by Neil Whiter on basis of yield estimates).

SWNRA consider that there is no real scope for further significant groundwater development for public water supply in their region; although there is a scheme for further development of the Otter Valley aquifer, this is designed to achieve the existing licensed quantity from boreholes in this area, rather than increase the resource base. Halcrow should refer to their own Low Flow Report to identify areas where a cutback in groundwater abstraction might be desirable (e.g. Taw Marsh).

Surface water resource development potential in the region was seen to include the Axe Pumped Storage Scheme, Roadford, and Pumped Augmentation of Wimbleball. Regarding the Axe Scheme, it should be noted that NRA have changed their position in relation to the prescribed flow required for the river; originally they had suggested that a prescribed flow of 0.6 cumecs would be acceptable, but now they are looking for 1.2 cumecs, which is equivalent to Q95. Clearly, this will have implications for the viability of the Scheme and may be challenged by SWWSL. At this stage, there is no information on the impact on scheme yield of this proposed change.

Besides the above schemes, SWNRA were unaware of any further new major reservoir development potentials; the view was expressed that further supply problems could be better overcome by improved leakage control, integration of sources etc. - i.e. improved management, rather than further source development. It was suggested that the demand growth to support a further major reservoir was not in prospect for the region.

Dick Beardsall is due to address the NRA Water Resources Group regarding SWWSL capital programme as it affects their area. This is likely to take place around the end of April; Halcrow asked for feedback from that meeting.

3.3 Environmental Considerations

The main issue in the South West, as Halcrow are well aware, is fisheries and angling. Further development of the Exe catchment as studied in Halcrow's Exe Resources EIA is contingent upon the study of estuarine water quality, and likely impacts thereon of development proposals.

The conservation officer is concerned about the implications of pumped augmentation of Wimbleball on the flow regime in the River Exe.

Note also comments in the Low Flows Report on locations where a cutback in abstractions is desirable (e.g. Tavy).

3.4 Water Quality

Principal concerns here revolve around pollution from farms, heavy metals taken naturally into solution (Crackington Ford, Meldon Reservoir), and isolated industrial discharges.

Note that Barry Milford has produced a document on water quality objectives in relation to resource development for the Axe Scheme. This may be developed towards a National Policy Document. It is based on the Warn-Brew method of assessing discharge consents.

3.5 References

SWNRA undertook to send Halcrow a copy of their abstraction licensing policy document and their list of references on demand management. They also have available the South West Water Authority's Section 24 Report produced in 1979(?), and reminded Halcrow of the National guidelines and policy documents being produced by NRA HQ. Halcrow may also find the CPRE response to OFWAT's paper on demand management of interest.

3.6 Programme for Additional Transfer of Data

Apart from data on existing demands and abstraction licence details by use, most items requested could be provided in the next few days. Demands and licence data would be forwarded when available, and before the end of April if possible.

P J HAWKER

C7 THAMES REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Thames Region, 4 April 1991

1. **PRESENT**

Brian Arkell, Michelle Doyle (NRA);
Patrick Hawker (Halcrow)

2. **AGENDA**

Copy attached.

Generally, the formal of the meeting was to discuss data already sent to Halcrow and, in so doing, identify additional data needs and how these may best be met.

3. **DISCUSSION**

3.1 General

Halcrow queried the meaning of 'confidential', since much of the data sent to them had been so stamped. It appears that in effect, the data cannot be quoted explicitly, but can be used implicitly - with caution. At present, many of the water companies are wary of allowing their 'competitors' sight of specific information, and are thus inclined to ask NRA, OFWAT etc. to treat such information in confidence.

3.2 Levels of Service etc.

Refer to annotations on Table 1 provided by TR NRA.

3.3 Demand

TR NRA to check whether data presented on their Table 2 - regional growth in the components of water demand - includes for areas of the water supply companies lying outside the region.

The basis of the calculation for unaccounted for water is :

- for companies excluding Thames Water, a future target set on the basis of existing night flows;
- for Thames Water, an extrapolation across the supply area of local leakage assessments in the distribution system, together with allowance for leakage in the trunk main system and 'other unaccounted for water' (e.g. metering discrepancies etc).

TWUL's forecasts are based on (an underachievement of) pre-set targets, principally for control of leakage from the distribution systems.

The London water ring main will lead to a reduction in leakage, as it will allow some zones to be operated at a lower supply pressure. On this basis, a 3% reduction in leakage has been assumed - see Table 2.

The metered component of demand is principally industrial/ commercial based. Only about 1-2% is domestic based. Forecasts for metered demand assume that it will stay substantially the same; this is a compromise between historic trends which show a decline in demand in this sector, and economic forecasting techniques, which show an upward trend.

TWUL have a problem with commercial properties; the number of office blocks in the Thames Valley has grown considerably in recent years, and they are major users of water. However, the policy in the late 1970's in the then Thames Water Authority was to remove unremunerative meters and revert to rateable value as a charging basis in such cases. Owners/occupiers of office blocks now know that RV is a comparatively cheap basis for water charging, and are resisting being put back onto meters. TWUL's policy to overcome this difficulty is unclear at present; new properties go onto meters automatically, and they may also put office blocks on meters when the ownership changes (and the opportunity to do so presents itself).

Note that the demand forecasts do not allow for switching from unmetered to metered sectors.

The basis of forecasting other unmeasured components of demand is as follows :

- domestic unmeasured : per capita consumption : all companies have an estimate of the current per capita water usage in their area; this generally lies in the range 130-160 litre per capita per day, with an average of 140 lcd. TWUL use the ACORN residential classification system to assign varying per capita consumption rates across their area, based on pilot observations of usage by different social groups. Some of the other water companies use detailed local surveys to assess per capita consumption;

- domestic unmeasured : per capita consumption growth : derived by trend analysis within TWUL, using an ACORN residential classification base, and trend analysis by the other water companies. New growth is around 2 litres per capita day per year into the future;

- population : there is a joint Thames Water/NRA population data base, which uses OPCS forecasts sensibly modified by local authority plan considerations; (county and district);

- commercial unaccounted for water : growth area is within Thames Water Utilities supply area. Unit use is based on consumption as reflected by recent transferees from the unmeasured to the measured charging base for this sector, and is expressed per capita of resident population. Outside London, the commercial allowance is 6 - 7 litres per capita per day; inside London it is over 40 lcd. The 'inside London' figure is said to be higher due to the demeterisation policy for commercial properties in the late 1970's (see above). NRA have per capita equivalent figures for commercial unmetered use for all water companies within their area.

  Thus, as forecasts of commercial use are based on population, they tend to increase into the future. Note that TWUL have used the Cambridge Econometrics calculation for relative growth of the commercial sector within the overall region employment base;

- 2016 projections : these are based on linear extrapolation of the trend between 2006 and 2011. Therefore, to estimate 2021 demands, the same trend should be projected further. However, TR NRA agreed to review whether any particular components within the demand sector being forecasted should in fact stay steady;

- peaking factors : see Table 3. These should be applied by strategy area; TR NRA can provide a breakdown of demand forecasts in this format. Alternatively, an overall peaking factor of 1.25 could be used for the whole of the Thames Water area, and individual figures used for each water company in accordance with the table.

Actual abstractions by water use type (public and private) for 1989 are set out in Table 4. This is in the format submitted to the DOE, and is based on abstraction returns by licence holders. Note that although returns by some abstractors may be inaccurate, the amount of water represented is thought to be minor in proportion to the overall total.

The proportion of the abstraction thought to be lost to the resource system is noted on the table, according to use type. TR NRA undertook to verify the total loss component of water abstraction by conventional coalfired power stations such as Didcot.

Demands and reliable resources by company area are summarised in Table 5. TR NRA undertook to provide a breakdown of the demand forecasts shown on the table.

Discrepancies between Table 2 and Table 5(i) relate to revisions to forecasts as work developed.

3.3 Resources

Table 5(ii) shows future resource options for the various water companies within the Thames NRA Region. Some of these are quantified; however, options for Sutton District, North Surrey, East Surrey and Mid-Southern Water Companies are less straightforward.

Sutton effectively rely on bulk transfers to meet future demand growth.

North Surrey have abstractions on the Thames at Egham, Chertsey and Walton. They have an agreement to supply Mid-Southern with water from (one of?) these sources, but would probably prefer to be able to use them entirely for themselves. Mid-Southern have an entitlement to abstract water from the Thames at Bray, but have yet to use this, preferring to stay with their agreement with North Surrey. If commissioned, the Bray entitlement would satisfy Mid-Southern's needs until about the year 2000.

Note that North Surrey is owned by General Utilities (CGE) who also own Three Valleys Water Company. It was suggested by TR NRA that Three Valleys and North Surrey may possibly be moving towards a joint resource development on the Thames. The NRA is not particularly keen on this, as much of the water used by Three Valleys is returned to the main river downstream of Teddington Lock, and is thus lost as a freshwater resource.

East Surrey currently receive a part of their water from Bough Beech Reservoir (discussed with Southern Region NRA). In the longer term their deficiency is to be met by bulk transfer but it is not clear where from. It would need to be from either Thames or Southern.

The mooted Great Bradley Reservoir, at the head of the Stour in Essex, could possibly provide the additional benefit of regulation of the Stort and Lee as well as the Stour. In this way it would help Three Valleys and Thames Water, as well as Essex Water Company. (Refer to Resource Map provided by Anglian Region).

Generally, yields of sources have been calculated on the basis of operational experience for the water companies. For River Thames sources, TWUL have a system model from which source yields can be assessed.

There are understood to be some opportunities for further groundwater development in the middle Thames and Kennet. A tentative figure of 100 - 200 megalitres/day was put on this; any licences granted for further groundwater abstraction need to be flow constrained. Artificial recharge of aquifer systems can and does work, at least in the Thames area using treated water. Table 5(ii) suggests a yield of 180 megalitres/day for future groundwater recharge schemes in the London area; this is made up of 90 Ml/d in the Lee Valley (Enfield/Harringey and existing scheme) plus 90 Ml/d in South London. Halcrow asked for papers

on costs, operating experience etc. Rising groundwater in London is not believed to be a usable resource, as it occurs in isolated pockets, so that access is a problem. In addition, quality is understood to be poor.

Forecasts of population growth by water company are given in Table 6. It was confirmed that effectively 100% of the resident population in the region are connected to the public water supply system. TR NRA undertook to confirm whether the figures in Table 6 relate to the entire water company areas, or just those proportions of these areas that lie within Thames NRA's region.

TR NRA undertook to provide effective rainfall figures in addition to the actual rainfall figures given in Table 7 for their region by catchment.

Appendix A of the data sent to Halcrow comprises documentation on the Thames Region Water Resources Strategy. This is in the form of two separate reports, the first being a distillation of the second. The document has been through the management team, and has come back with questions and requests for alterations, which have not yet been implemented. There is no detailed programme for public release of the strategy.

Appendix B contains details of authorised abstractions by catchment and by purpose. TA NRA undertook to provide Halcrow with corresponding information about actual amounts abstracted in the recent past.

It was agreed that any individual industry with a particularly high water use could be identified through the user code. Individual high volume users connected to the public supply system were considered not worth identifying.

Appendix C contains details of discharges from major sewage works in the region. TR NRA are to provide details of dry weather flows from the works, and details of the receiving water courses.

Returning to Table 5, yield data for the Lee Valley Water Company groundwater sources is based on operational rather than hydrological experience. See the recent paper presented by Ken Clarke to the Institution of Water and Environmental Management Annual Conference in 1989.

The Lambourn groundwater scheme is the only river support project in Thames Region. Catchment transfers include :

- 90 Ml/d exported to Essex Water Company;
- 30 Ml/d imported from Bough Beech to East Surrey Water Company area. (This reservoir is on the River Eden, which is within Southern Region of the NRA);
- minor exports to Severn Trent Region (not exceeding 10 Ml/d) via Slough/Wycombe/Aylesbury;

- 54 Ml/d import to Lee Valley Water Company from Grafham Water - note that this is due to rise by 91 Ml/d.

Halcrow should also refer to the Thames Region resource map given to them at the meeting. (It was suggested that Halcrow should also ask Jerry Sherriff for similar maps for the other regions).

3.4 Environmental Problems

The public perceive environmental or low flow problems in the following areas :

- Cotswolds (groundwater abstraction);
- ALF rivers (groundwater abstraction);
- River Cherwell at Banbury (surface water abstraction);
- River Churn in the Cotswolds (groundwater abstraction possibly).

Some respite for the Banbury abstraction is theoretically in view due to the resource development at Gatehampton.

3.5 References

Thames NRA agreed to provide Halcrow with their reference list in relation to :

- aquifer recharge;
- 'exotic' water resource scheme.

Halcrow may also find it worthwhile talking to Graham Sharp of Howard Humphries, about his scheme to move surface water about in the sea using butyl rubber tanks. In addition, Halcrow themselves hold data on the Teddington low flow proposal, and Craig Goch scheme including the Severn/Thames transfer.

P J HAWKER

C8 WELSH REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

ACTION MINUTES

LLANDINAM, 11th APRIL 1991

A t t e n d a n c e

Patrick Hawker	Project Manager - Halcrow Consulting Engineers	
John Mosedale	Acting Water Resources Manager	NRA
Jean Frost	Divisional Hydrologist, South West	NRA
Vaughan Hughes	Divisional Hydrologist, Northern	NRA
Bob Vaughan	Water Resources Planner	NRA
Terry Spierling	Water Resources Co ordinator	NRA

N o t e s

ACTIONS

R & D Project :
The R & D project underway is similar to the 1973 Water Resources Plan and will aim to project availability of Water Resources and the Demands placed upon them up to the year 2021. RV will co - ordinate response for the Welsh Region. Target dates for the data are : RV

Raw data to Halcrows by end of April 1991
Regions to edit draft in June 1991.
Final Changes early July 1991.
Final Report by end of July 1991.

Demand Forecasting :
Details are required up to 2021 on Per Capita Demands, Population, Metered and Unmetered consumption, Unaccounted for Water, and Percentage of Population connected. RV to approach Water Companies to obtain data from them as soon as possible. RV

Major Discharges :
Details on location, where water originates (i.e Catchment), and quantity involved - Dry Weather Flow and/or population served would suffice unless more detailed data is available (such as actual gaugings). TS & RV to obtain NRA details on discharges, and to approach Dwr Cymru. RV & TS
RV to circulate results to JF, VH, & JM for comment. JF,VH,JM

Licence Data :
TS to supply data on current non PWS licences and abstraction for 1989 & 1990, split by agricultural and industrial type. No attempt will be made to classify between Commercial and Industrial; this

will be left to Halcrows. Only Freshwater are to be included. TS
Large areas of the South West and Northern Divisions are exempt from licensing under Section 25 of the 1963 Water Resources Act. JF,VH will provide a list of major exempt abstractions grouped by aquifer/subcatchment and split into type. Small unlicensed sources will be ignored but a lumped figure will be produced. JF & VH

Large Water Consumers :
JF,VH & JM will list the quantities used in industry, both in terms of PWS demand and Raw water, by region. This will identify the impact should these industries close, or change. JF,VH,JM

Large Towns :
This is to be ignored.

Other Consumers :
JF,VH, & JM will provide a list of and quantities used by Dock Feeds, Crown Exempt, British Waterways Board etc. in their Division. JF,VH,JM

River Regulation :
Due to the possibility of double counting, all river regulation licences and inter basin/catchment transfers should be highlighted. TS to check this. TS

Principle PWS Sources :
For schemes such as R. Dee, a description of what they are and how they work is required. JF,VH & JM will provide operationg manuals etc for these schemes. JF,VH,JM

Hydrometric and Hydrogeological Data:

a.) **Groundwater.** JF,VH & JM will provide notes on each 'Aquifer Unit' outlining current usage, potential for development, or over development. JF,VH,JM

b.) **Surface Water.** JF, VH, JM & TS to produce Q95% for each catchment in region. JF, VH
JM, TS

Water Quality Considerations :
RV will liaise with Water Quality Planner to produce list of Rivers and/or river stretches which are suitable only for Non Potable supply and those Grossly polluted. RV

Environmental Considerations :
Richard Howells, the Welsh Region Conservation Officer will be asked to comment on the impact of developing new Resources. This will include views on SSSI's, National Parks, RSPB reserves, the effect of Acid Waters, and Navigation. RV & RH

Identification Of Possible New Water Resource Sites :
Some will have been identified in the Section 14 reports. RV to obtain reports and draw up a new table. RV
JF,VH & JM to edit and update options. JF,VH,JM

Policy Statements :
TS to provide detail on Fully Utilised Rivers. **TS**

Transfers :
Quantities and destination of Transfers in and out of region will be provided by RV. **RV**

New Developments :
JF, VH and JM will comment on the likelyhood and impact of developments such as Barrages. **JF,VH,JM**

Literature :
Any publications refering to Water Resoures which the Region is aware of are to be listed by RV. JF,VH,JM & TS to notify. **ALL**

RAV/12/4/91.

C9 WESSEX REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Wessex Region, 18 April 1991

1. **PRESENT**

Terry Newman, Richard Symonds (NRA);
Patrick Hawker (Halcrow).

2. **AGENDA**

Copy attached.

Data already sent by Wessex were discussed in detail, and any remaining queries on the agenda were taken up after that. Outstanding data needs, and how and by when they may filled, were then discussed.

3. **DISCUSSION**

3.1 Demand

WNRA confirmed that Cholderton & District Water Company is very small, being an old estate supply which essentially looks after only two villages.

The comment that 1990 demands run to 30.11.90 on the table of existing demands applies to West Hampshire Water Company only. WNRA undertook to update this figure to the full year. The supply to Fawley Refinery noted on the same table is a raw water supply, made available by West Hampshire Water Company. Otherwise, the figures in the table relate to treated water for public supply. Thus the raw water supply to the ICI factory in Bristol, made available from BWW's Littleton works, is not included; WNRA undertook to advise Halcrow of the quantity involved.

Wessex and Bristol Waterworks Company have long established, active leakage monitoring programme; Bournemouth & District Water Company are understood to be 3 years into a 10 year programme, in which 30% of their supply area is monitored and subjected to pressure control. It is understood that West Hampshire Water Company monitors leakage over their whole network. Further information was requested of WNRA regarding the apparently very low leakage figures for West Hampshire and Bournemouth & District Water Companies. It was agreed that Bristol Waterworks and Wessex figures reflect their efforts to control leakage in the past; note however that Bristol Waterworks at least, and possibly also Wessex, exclude leakage from raw water mains in their assessment of unaccounted for water.

Population figures quoted in the information sent by Wessex relate to those connected to the public water supply system, not resident population. It is estimated that 99.5% of the population is connected to the public supply.

For planning purposes, WNRA generally proceed as follows :

- forecast average daily demand;
- apply peak week factors as advised by water company (e.g. 1.74 for West Hampshire);
- apply a 3% mark-up for planning purposes to both average daily demand and peak demand;
- ensure average resources are greater than average daily demand + 3%, and peak resources are greater than or equal to peak demand + 3%.

WNRA gave Halcrow a copy of their own Section 143 report detailing demand forecasts of available resources. This is more detailed than the information sent to NRA HQ. Note that :

- demand forecasts are as provided by the water companies - they have not be rationalised by WNRA;
- the document encloses a map of the region, showing the water company boundaries within it.

Generally, the 1990 forecasts included in the Section 143 report prepared by WNRA are an adjustment of the 1985/6 figures produced by Wessex Water Authority'. The latter organisation use component-based demand forecasting, assuming measured sector demand growths as forecast by Cambridge Econometrics. Halcrow should therefore refer to the 1985/6 document (with data held under South West Resource Study Project?) for information on per capita consumption, breakdown between measured and unmeasured demand etc. Forecasts for populations are based on county figures generally, not district figures.

As noted above, the 1990 forecasts exclude raw water supplies to Fawley and ICI Bristol. The Fawley allocation is a part of one licence held by West Hampshire Water Company, and is limited to 45.6 Ml/d.

To extend demand forecasts to 2021, WNRA agreed that Halcrow should simply extrapolate available data.

Halcrow asked for confirmation of the apparent 50% growth in industrial use between 1989 and 1990, as recorded on data sent to them. They also asked for information to indicate the net loss implications of all private abstractions, by industry-type.

The tidal abstraction for (the then) CEGB has no resource implications for this study, as it is not from an inland water.

Note that no forecasts have been prepared for likely future levels of private abstractions.

Halcrow requested details of level of service etc. for water companies. It is understood that Bristol and Wessex have recently stipulated that new properties should be fitted with water meters. It is not clear whether they are to be billed by meter, or by rateable value; WNRA to check.

Halcrow requested that abstraction details from catchments should be further sub-divided to show how much is from groundwater, and how much from surface water sources.

3.2 Resources

Halcrow asked that the future sewage disposal strategy be checked, particularly in relation to South East Dorset.

Halcrow asked for average daily flow data for downstream gauging stations on all significant rivers, together with an indication of the catchment area to the gauging station, and proportion of the overall catchment size which this area represented. Such data were not necessary for small catchments, where it was known that there was little or no resource development potential (e.g. West Somerset rivers). When using ADF data to assess surface water resource development potential, Halcrow should not overlook in-river water needs - e.g. for moors area in the Parrott basin.

Halcrow also asked for average annual recharge for main aquifer units.

The table of sewage effluent returns provided by WNRA may include discharges to tidal estuaries. The figures should therefore be treated with some caution. However, discharges to sea are excluded.

Halcrow asked for a map showing the catchment areas for which ADF data had been provided.

Halcrow requested details and locations of river support licences, in order to ensure that there is not double counting of exploited resources. Note that the Blashford Scheme has two abstraction licences - one from the river, and one from the reservoir. From a resource exploitation viewpoint, only the latter licence needs to be taken into account; WNRA agreed to check whether the former (from river) licence has been excluded from the total public water supply licence entitlement in the River Avon. Generally, other reservoirs in the region are impounding, and operate by direct abstraction.

The following imports and exports of water resources were noted :

- imports : 32 Ml/d approximately from Wimbleball to West Somerset;

- from Sharpness Canal at Purton (refer to Severn Trent notes for quantity).

- export : 45.6 Ml/d licensed raw water export to Fawley via West Hampshire Water Company. There are also some export implications associated with the boundary 'glitch' in the vicinity of Lymington (refer to NRA Region vs Water Company Boundaries Figure in Wessex Section 143 Report).

There are no significant resource implications of navigation/British Waterways Board abstractions, apart from that noted above associated with Purton. The Kennet and Avon Canal turns into the river in Bath, so water flowing along it could be abstracted at Newton Meadows. The Bridgwater and Taunton Canal is not navigable at present, and already has a water supply abstraction on it towards the downstream end (already taken into account in abstraction licences).

3.3 Groundwater Resource Development Potential

Generally, there is perceived to be no scope for further resource development in the conventional sense (by direct abstraction). However, if boreholes were used instead for river regulation to surface abstractions downstream, there is potential. This applies particularly in the Cotswolds. Note that such a redeployment would usually mean resiting boreholes, as many operate by 'interception' rather than developing aquifer storage - i.e. they are located close to the rivers.

It would be possible to abstract directly from the Dorset coastal chalk (Lulworth area), but this could only reasonably be done in Winter, and therefore would need to have storage associated with it.

In the Mendips, the nature of the aquifer is slightly different, and water sources are usually associated with adits and springs rather than boreholes. Storage - such as Chew Valley Lake, Line of Works to Barrow treatment works - was usually associated with this aquifer. Therefore, further development there can only be achieved with support from storage.

3.4 Planned Resource Developments

Wessex speak only of minor groundwater development of the Salisbury Plain chalk. WNRA are very cautious about this, and would wish to know exactly what is proposed, and where; so far, Wessex plc have only suggested a minor development near Amesbury, which WNRA are not particularly keen on.

At Blashford, the appropriate prescribed flow in the River Avon could become an issue in realising significant further yield.

Bournemouth & District Water Company could obtain more water from the River Allen if their surface water intake at Longham was supported by storage. However, their more immediate proposals to put in storage as security against pollution are understood to be in abeyance.

Bristol Waterworks have already declared their intention for further development of the abstraction and treatment works on the Sharpness Canal at Purton. Beyond that, they are likely to return to the lower Bristol Avon catchment where there is scope for pumped augmentation of Chew Valley Lake. Apparently, the recent study by the Institute of Freshwater Ecology has shown that there are no significant water quality problems associated with this proposal.

Wessex Water also plan to exploit further the lower Bristol Avon, with an abstraction at Newton Meadows pumping to Monkswood Reservoir.

Generally, WNRA are very anxious about future resource development in the region, largely because investigations in progress are likely to show that licences may need to be modified in order to mitigate adverse environmental impact. Thus, more resource development may be needed than has currently been allowed for by the water companies, in order to overcome the shortfall arising from licence modifications. In very general terms, the figure involved amounts to some 50+ Ml/d of currently licensed resources across the region.

3.5 Policies

Halcrow were referred to WNRA's own Section 143 Report, Section 6, and to NRA National documents. Some interest was expressed in time limiting of licences, particularly in relation to groundwater sources, where the effects of abstraction are not easily predicted.

3.6 Environmental Issues

Priority areas with low flow problems are the Wiltshire and Dorset chalk, and the Cotswold oolitic limestone. WNRA are aware of six locations where detriment is alleged, and there is a credible case for urgent action. There also were several other instances where there is a case for action, but it is less pressing.

There are some fears of declining source yields in the Mendips, due to sub-water table mineral extraction which may be disrupting the spring supplies to Bristol Waterworks; this issue is seen as potentially significant, and strategically important.

Water quality is not an issue in the region.

3.7 Reports and References

In addition to the Somerset reports produced by Halcrow, documents are available on Blashford Lakes Scheme, the Lulworth Groundwater Scheme, and general resources in the area as described in the Section 14 Reports (or which there are 3 for the Region) produced in accordance with the requirements of the 1963 Water Resources Act.

Note that, in the run-up to privatisation, Wessex Water applied for a licence of 40 Ml/d in respect of the Lulworth chalk. This was cut back to 20+ Ml/d to the then Wessex rivers, because :

a) summer yield is only about 18 Ml/d, and no storage was proposed to support the scheme;

b) the timing of the application reflected the water company's desire to go forward to full privatisation with a sound future resource base.

3.8 Basis of Yield Estimates

Quoted yields have been estimated on the basis either of operational experience, or modelling of the 2% drought reliable yields. They are believed to be broadly OK.

4. ANY OTHER BUSINESS

WNRA requested that Halcrow's report should cover NRA's difficulty in determining local development strategy without information on alternative scheme costs to enable them to set an economic perspective on the environmental implications.

WNRA support the national line on metering - i.e. that it should be targeted to those areas where it will be most effective in controlling demand.

5. PROGRAMME FOR TRANSFER OF DATA

It was agreed that all data requested in the course of the meeting would be passed to Halcrow by 30 April.

P J HAWKER

C10 YORKSHIRE REGION

WATER RESOURCES PLANNING - STRATEGIC OPTIONS

Notes on Meeting with NRA Yorkshire Region, 5 April 1991

1. **PRESENT**

Dick Franklin, Peter Towlson, Ian Barker (NRA);
Patrick Hawker (Halcrow).

2. **AGENDA**

Copy attached.

Generally the form of the discussion was to go through data already provided by YNRA, and then to consider additional Halcrow data needs, and how these might best be met.

3. **DISCUSSION**

3.1 Water Companies in YNRA Region

Within the region, York Water Company supplies the City of York itself and its immediate surroundings, while water supply over the remainder of the region, and sewage disposal services are provided by Yorkshire Water. Water demand in the York Water Company area amounts to about 3% of that in the Yorkshire Water supply area.

3.2 Demand

YNRA had sent Halcrow a document entitled 'Yorkshire Water Demand Forecasts 1990', which sets out forecast demand for public water supplies up to 2011 in the Yorkshire Water supply area. Forecasts are broken down into use-type, and the method of forecasting is described. In addition, Halcrow have a copy of the Section 143 Report on future demands for public water supplies in England and Wales by region, prepared by NRA HQ.

No demand forecast data had been provided for York Water Company.

Various points arose in discussing public water supply demand in the region, viz :

- NRA agreed to provide a breakdown of the figures presented in the NRA HQ Section 143 Report, into measured, unmeasured, and unaccounted for water, including projections of these for 2001 and 2021;

- demand in the Yorkshire Water supply area to the year 2021 should be estimated by Halcrow, by straight extrapolation from the 1990 demand report for the water company;

- Halcrow would pursue further the matter of high and low forecasts presented in the Yorkshire Water document, if appropriate;

- for resource planning purposes, a peaking factor to average day demand forecasts of 10% should be applied (1551 divided by 1410);

- the current 'peak' resource value for Yorkshire Region is not known - column 4 of Table 2 in the Section 143 Report relates to peak achievable yield, not peak reliable yield (i.e. stated yield is operationally rather than hydrologically constrained);

- hosepipe bans and reduced compensation flows from reservoirs were introduced in 1990, at an estimated annual average demand equivalent of about 1450 Ml/d, despite the fact that the current estimate of reliable yield is 1500 Ml/d;

- YNRA lent Halcrow a report on the 1989 drought in the region;

- it should be noted that unaccounted for water does not address losses from raw water mains, such as links between reservoirs and treatment works. Some of these are quite long in Yorkshire Region, and leakage from them may be significant.

Turning to private abstraction, there is significant demand in the region for irrigation water. Licence determination for new applications is made by reference to a report prepared by Howard Humphries; in North Yorkshire, there is 100% take-up of estimated available resources, so all new licences have to be supported by winter abstraction and storage. In the area generally, sugar beet and potatoes are irrigated; in the Vale of York, there is a thriving turf industry ('Rolawn'), which has a high irrigation demand.

No major new sites are planned by either power generating company, although they may wish to redevelop existing sites, e.g. for combined cycle gas turbine generation. They therefore will want to retain the abstraction licences that they currently hold. Flue gas desulphurisation may also change the pattern of water demand by generating companies, although it is thought that the overall licence commitment of this sector is unlikely to increase.

British Coal is not a major net user of water in the region.

YNRA agreed to provide Halcrow with details of any individual industry which holds a licence commitment for more than 10% of total private industrial demand.

YNRA undertook to provide Halcrow with a schedule of surface water licences exceeding 10 Ml/d average entitlement, by 17 April. This would be annotated to show use-type and percentage resource loss represented by each such use. Groundwater licensing and abstraction data were provided in the form of a photocopied extract from the 1986 Howard Humphries Report; the whole report was also lent to Halcrow. Copies of maps showing sub-catchment boundaries etc. were passed to Halcrow, annotated where appropriate to show the approximate location of the tidal limits.

3.3 Transfers and River Augmentation

Various transfers into and out of the region were noted, as follows :

- average of 59 megalitres/day imported from Severn Trent plc Derwent Reservoirs to River Lyn Reservoir (Yorkshire Water) to serve Sheffield. This is a 99-year agreement dating from 1985 - note that the resource value may only be about 40 Ml/d in a drought year;

- import of about 92 Ml/d from NRA Severn Trent Region to Yorkshire Water, to the south of Doncaster;

- local sources used in West Yorkshire where water company boundary runs into NRA North West Region.

Regarding river augmentation schemes, Halcrow were referred to the River Ouse Proposal. It was also pointed out that Grimwith? Reservoir effectively operates by river regulation of the River Dib, a tributary of the Wharfe, whence water is abstracted at Lobwell intake for pumping to Challow treatment works. This is effectively a 'put and take' scheme, as most of the water released from Grimwith can be abstracted at Lobwell. Note that Grimwith has no compensation flow other than that arising from embankment drainage. In addition, excess flows from the adjacent aqueduct system are passed to Grimwith Reservoir, which is large in relation to its catchment.

3.4 Resources

YNRA had provided extensive flow data from their principal gauging stations. They agreed to provide catchment areas to these gauging stations and for the main sub-catchments, by reference to Table 1 of the Section 14 Report. In interpreting such data, Halcrow were reminded that Section 14 Report catchment areas were quoted to confluences, rather than to tidal limits. Thus, if a tidal limit occurs upstream of a confluence, the quoted catchment area includes a proportion affected by tides.

Surface water resources in Yorkshire cannot be developed further without either groundwater support or storage.

Main water demand in Yorkshire is towards the south of the county, and surface resources in this area have been steadily developed since the industrial era. In 1973, Binnies carried out a study to identify alternative potential reservoir sites. Ten possible, and forty-seven marginal sites were identified, mostly in North Yorkshire; it was suggested that nowadays, all would be seen as environmentally unacceptable. YNRA have a copy of Binnies report for Halcrow to refer to if required; it includes estimates of available storage, but no yield data.

Yorkshire Water have looked at mobilising Kielder water by pumped transfer from the Tees to the Swale system. However, they found this to be vastly more expensive than alternatives. It is likely that further growth in the predominantly rural North Yorkshire area will be met by additional groundwater development; Mott McDonald have been retained by Yorkshire Water to look at yields, resource development options etc.

Aquifer recharge has not been looked at in the region. It could possibly be tried in the Doncaster or Selby areas.

Yorkshire NRA undertook to provide Halcrow with the locations and flows of their top 10 sewage treatment works, including consent conditions. Note that at present, effluent from Scarborough is pumped to sea untreated. In theory, it will be possible to treat this, and return it to the Middle Derwent catchment.

3.5 Environmental Issues

Problems are caused for migratory fish by two leet abstractions on the Wharfe, and one hydropower scheme serving a paper mill.

In the Upper Derwent catchment there is a sinkhole into the limestone. The river used to re-emerge (some 100 years ago) via springs, away from the main river valley bottom. Re-emergence is less reliable nowadays, and the problem may well be exacerbated by public water supply abstractions.

There are national parks within the regional boundaries.

Environmental policies are to protect tributary rivers from over-abstraction, to ensure time of travel allowances for regulation of the River Ouse upstream of the existing abstractions are correct; and to ensure the Voy Scheme does not cause problems with agricultural interests. There are no formalised regional policies; Halcrow should refer to National documents. Generally, YNRA would look for the imposition of hosepipe bans before considering applications for drought orders.

3.6 Water Quality

Quality in the River Rother is very poor. Generally, the River Wharfe and others to its north are of reasonable quality; south of the Wharfe, river water quality is questionable, due to the presence of exotic pollutants etc. Outflow requirements to the Humber estuary should not be overlooked, as these help to ensure that pollutant slugs are carried out to sea.

British Waterways Board operates abstractions for navigation requirements, but is exempt from licensing procedures. In this way, the River Aire downstream of Leeds, Don downstream of Doncaster, and Lower Calder are all affected.

Severn Trent NRA would like to see a cutback in abstraction from boreholes supplying Yorkshire to the south of Doncaster.

The YNRA passed Halcrow a copy of the Yorkshire Water Standards of Service, and promised to send a copy of the York Water Company tariff structure.

Halcrow requested the population data details for Yorkshire Water.

P J HAWKER