

# REGIONAL WATER RESOURCES STRATEGY

## Severn-Trent Region



NRA

*National Rivers Authority*

*Severn-Trent Region*





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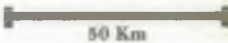
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# Regional Water Resources Strategy Severn-Trent Region - November 1993



## **1. EXECUTIVE SUMMARY**

- This Water Resources Strategy provides a policy framework for the development and on going management of water resources in the Severn-Trent region until 2021. It highlights the major issues and sets out the basis for decisions within the region. However, as factors influencing the planning process are continuously changing, the strategy will continue to evolve.
- By virtue of its location the region has a central role in the development of water resources nationally. The rivers Severn and Trent are already major resource providers to other regions and this could potentially increase. The strategy has therefore been developed in parallel with the NRA National Water Resources Strategy.
- The region's water resource objectives are set out in Section 3. The strategy itself describes the policies to be followed and current development proposals necessary to realise the objectives. Fundamental to the strategy is the need to protect and improve the environment. Having set the scene in the overview, the strategy then revolves around three key themes: Meeting Demands, Threats to Our Resources and Opportunities. The strategy concludes with a summary: The Way Forward.
- A number of demand forecast scenarios are explored for public water supply to assess the future balance between demands and available resources for a range of assumptions for growth in consumption, levels of leakage control and the extent of metering of supplies.
- Areas of current overexploitation which need to be addressed alongside meeting future additional demands are highlighted.
- The strategy illustrates how sensitive the timing of new resource developments is to the assumptions made in the demand scenarios. Under the medium scenario, demands can generally be met by current and planned resources up to 2011 - 2016, even including NRA identified reductions in areas presently overexploited.
- A number of initiatives are explored to meet demands in other sectors including spray irrigation. Strategic demands by industry are not considered to be generally significant. Hydropower development may, however, give rise to some issues of resource allocation.

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### **East Worcester Waterworks Company**

During the preparation of this strategy, East Worcester Water has been acquired by Severn Trent Water. For the purposes of this strategy the company has been considered as part of the Worcester District of the Severn Trent Water supply system.

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# Overview

## 2. Introduction

The planning of water resources is an ongoing process which requires a wide measure of participation from users and those affected by water use. The NRA produced a Preliminary Statement for the Severn-Trent region in October 1991 for consultation purposes. This was distributed to over 200 water users and other interested parties and over 60 responses were received. We have taken these comments into account and in many cases have established close liaison with relevant interested groups.



*"This strategy will ensure we meet the NRA's statutory duties and objectives with regard to Water Resources."*



**The river Severn  
at Bewdley**



### 3. Objectives

The NRA has a statutory duty to:

- a) conserve, redistribute or otherwise augment water resources;
- b) secure the proper use of water resources.

(Water Resources Act 1991, Section 19)

To meet this important obligation to manage the region's water resources, now and in the future, our objectives are to:

**Plan** to have a strategy to meet future water requirements of the region.

**Optimise** the use of water resources.

Ensure that use of water resources does not exceed that which is **Sustainable**.

Ensure that water demands are met in an **Environmentally Acceptable** manner.

Provide **Protection** to the quality of current water resources and future reserves from all forms of threat.

Ensure that all water resource users are considered in an **Equitable** manner while recognising the special need of public water supply.

**These will be achieved by:**

- 1 Taking a balanced view of the management of water resources to the best overall advantage of the environment.
- 2 Encouraging efficient water use, including re-use where possible and to encourage water companies and consumers to adopt water saving methods.
- 3 Ensuring that reasonable demands for water can be met in a cost-effective manner, in compliance with legislative requirements and policy guidelines, specifically by:
  - encouraging the augmentation or redistribution of water resources;
  - ensuring that before water is exported to other catchments, the best use of resources is secured in the demand catchment and that abstraction takes place as far downstream in the catchment as possible;
  - encouraging the conjunctive use of reservoirs, river abstractions and groundwater appropriate to local conditions and seasonal considerations;
  - taking appropriate opportunities to revoke unused licences and reduce under-used ones;
  - encouraging the reduction in licences from overabstracted resources.
- 4 Adopting a licensing policy which ensures that river flows or water levels are not reduced below environmentally acceptable levels, to protect river baseflows and support to pools and wetlands.
- 5 Implementing the NRA Groundwater Protection Policy and supporting the attainment of water quality objectives.
- 6 Actively participating in the land use planning process and liaising effectively with other regulatory bodies and water users over the implementation of policy as far as it might affect the quality, quantity and efficient use of water.
- 7 Imposing licence conditions to take account of all legitimate in-river uses.

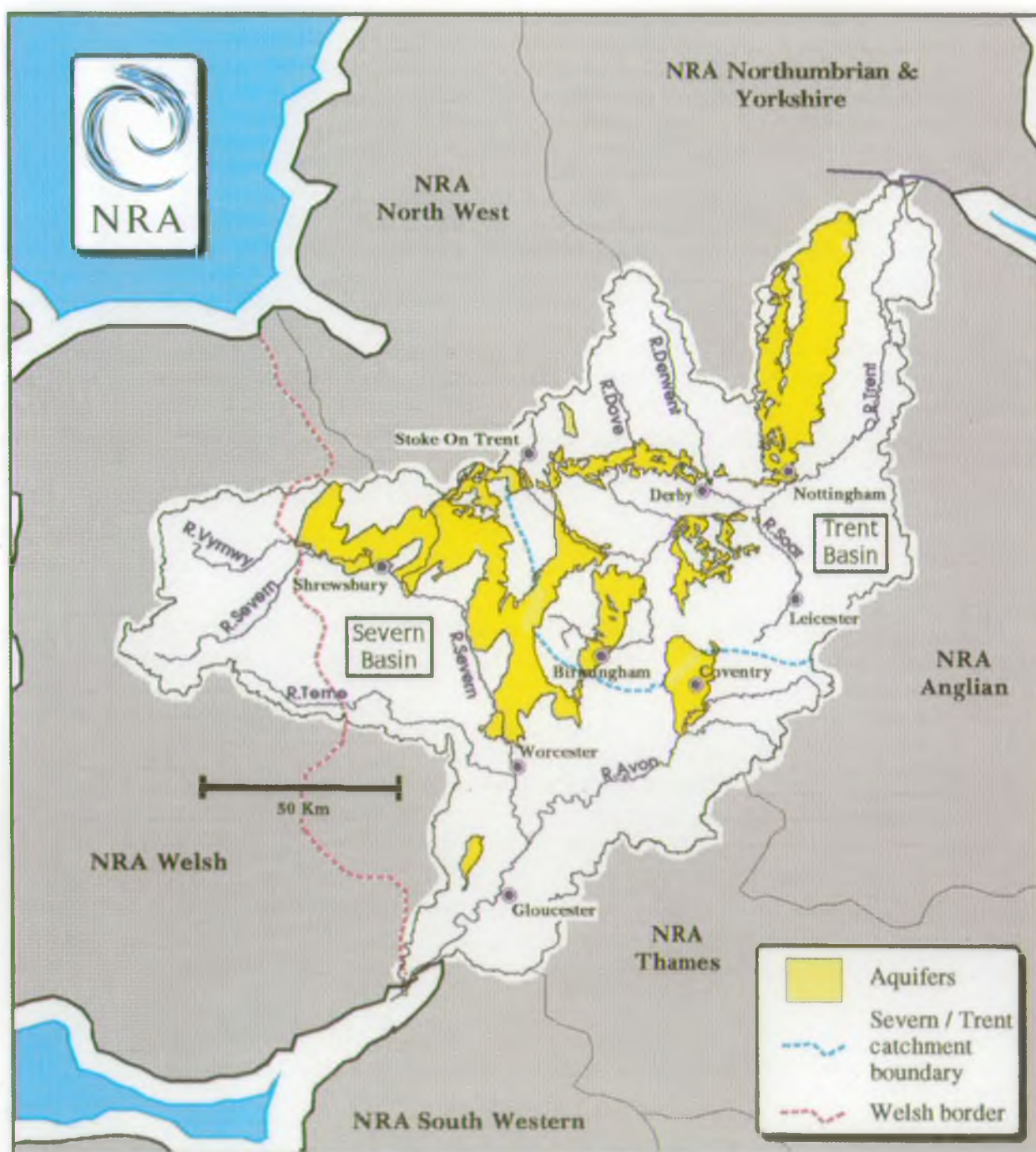


## 4. Regional Characteristics and Resources

### (a) Surface Water

Severn-Trent region comprises two major river basins, the Severn and the Trent. The rivers are distinctly different in water use terms and their potential untapped resource.

Figure 1: NRA Severn-Trent Region - Groundwater and Surface Water Features.



## **The Severn Basin**

The river Severn has been developed as a regulated river since the construction of Llyn Clywedog in the mid 1960s. The control point for management of the system is at Bewdley where a flow of 850 Ml/d (850 million litres per day) is maintained. Although only 3% of the catchment to Bewdley is reservoirised, the river is a highly developed source of water for public water supply. The system supports abstractions of 2300 Ml/d for all uses.

Because the catchment has prolific winter rainfall it potentially offers significant scope for further development of winter resources. Major development would, however, need careful reconsideration of how regulation is controlled, especially having regard to estuary flows.

## **The Trent Basin**

The Trent also has a high winter rainfall area in the Peak District and Staffordshire Moorlands. This is less than half that in mid Wales with the Lower Trent area experiencing especially low rainfall. It has not been developed as a regulated river and, except for reservoirs in the Dove and Derwent valleys, it is largely undeveloped as a public water supply source for historical quality reasons. The basin is highly urbanized and therefore flows are heavily modified by effluent discharges from the Midlands. It receives around 450 Ml/d of imported water via this route.

Although currently having only limited use for public water supply, the river Trent has other significant demands - such as power stations and established in-river uses - which place a limitation on development. There is no flow based control of abstractions direct from the river Trent and no prescribed flow to the Trent or Humber estuaries. Both would be necessary should the river be considered for significant water resource development.

## **Raw Water Exports**

As well as meeting demands within the region, the Severn and Trent rivers are also being considered for export of water elsewhere in the country. Investigations are proceeding, firstly, into the viability of new transfers from the lower reaches of the Severn to the river Thames and, secondly, into the viability of new and enlarged transfers from the Trent to the river Witham and beyond in Anglian region.

The quantities exported from the Trent might exceed the surplus in that basin. One option would be to consider means to increase Trent flows. This is being done by assessing the feasibility of a raw water transfer link from the river Severn near Ironbridge to the river Trent near Stafford. Another possible option is the abstraction of groundwater in the Birmingham area which is then discharged to the river Tame. This would also alleviate the problem of rising groundwater levels affecting basements in that area.

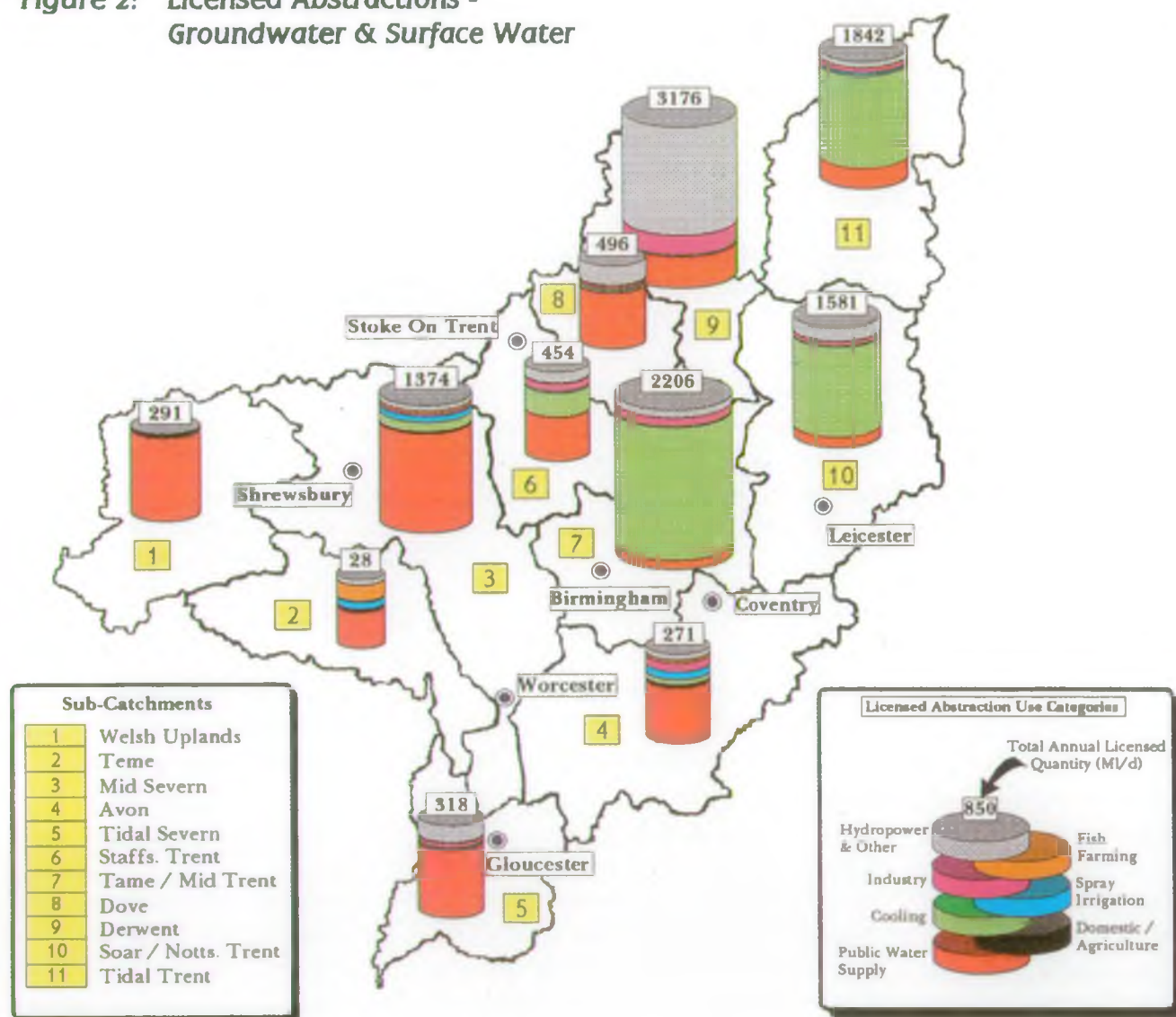
These proposals for major transfers of water, either across the basins or to other regions, require careful assessment. This is to ensure that an appropriate balance is maintained between local and external impacts on the rivers concerned. In this way the best net solution taking into account the conditions on both rivers can be reached as part of an integrated planning investigation.



## (b) Groundwater

The major aquifers in the Severn-Trent region are the Sherwood Sandstones, Lower Magnesian Limestone, Carboniferous Limestones and the Permo-Carboniferous Sandstones in the Coventry area. These are divided into a total of 76 groundwater management units whose boundaries are based on geological and hydrogeological criteria. In the Severn-Trent region groundwater sources account for 18% of all abstracted water, but more significantly 39% of the regional public water supply is obtained from groundwater, principally the Sherwood Sandstones.

**Figure 2: Licensed Abstractions - Groundwater & Surface Water**



## Licensed Abstractions

Figure 2 summarises the total groundwater and surface water use across the region. The quantity of water licensed in each area can be seen. The profile of water use and how it varies from area to area can also be seen, for example, the large licences held by the power generating companies on the river Trent.



## 5. Regional Licensing Policy

In considering new proposals to abstract water, the regional policy is to ensure that reasonable needs are met whenever possible. There are however constraints, and the NRA must protect both the rights of existing users and the needs of the environment.

*"When determining any licence application we will:*



NRA

- ensure the abstraction will not be in excess of the renewable resources;*
- consider the effects on other abstractors and will not allow abstractions which derogate existing licence rights and other protected rights to abstract unless suitable arrangements are agreed;*
- consider the impact on river flows, especially ensuring flows are not reduced to unacceptably low levels;*
- consider the potential effect on wetlands and pools, and not allow abstractions which would be damaging or otherwise unacceptably affect them."*

To ensure these criteria are met, the region has adopted the following practices for licensing resources.

### (a) Surface Water

Prescribed flows at appropriate NRA river flow gauging stations have been determined for most of the region's medium and larger rivers. Control points are likely to be established for abstractions direct from the river Trent. These thresholds are used to restrict new surface water abstraction licences which could otherwise have a significant effect on stream and river flows.

Initially licences were tied to the base (primary) threshold designed to protect the river regime but as demand increased the thresholds in many catchments were progressively raised to protect the rights of existing users as those rights developed. As a result, there are now many watercourses across the region which are subject to multiple threshold levels. This is illustrated in Figure 3 which shows the pattern of restriction thresholds for sub-catchments. When first set in the 1970s these threshold levels were derived by a statistical analysis of flows and may not now be appropriate to fully meet the specific environmental needs of all the rivers. The NRA is currently engaged in a number of research projects to improve the quantification of the impact of low flows on aquatic ecosystems. The existing flow restriction thresholds will be reviewed in due course in the light of this research.

Figure 3 shows that there are currently two subcatchments where there are four levels of restriction, the river Meese in Shropshire and the river Torne in Nottinghamshire. It is now regional policy not to permit abstraction from the larger rivers beyond a third level (tertiary). This step has been taken because restrictions at these higher thresholds are in force too often to provide a viable water resource and because they can lead to an environmentally unacceptable extension of the low flow period.

Figure 3 therefore gives a general indication of where there is a potential shortfall in resources should there be further demands in those areas of high level restriction.

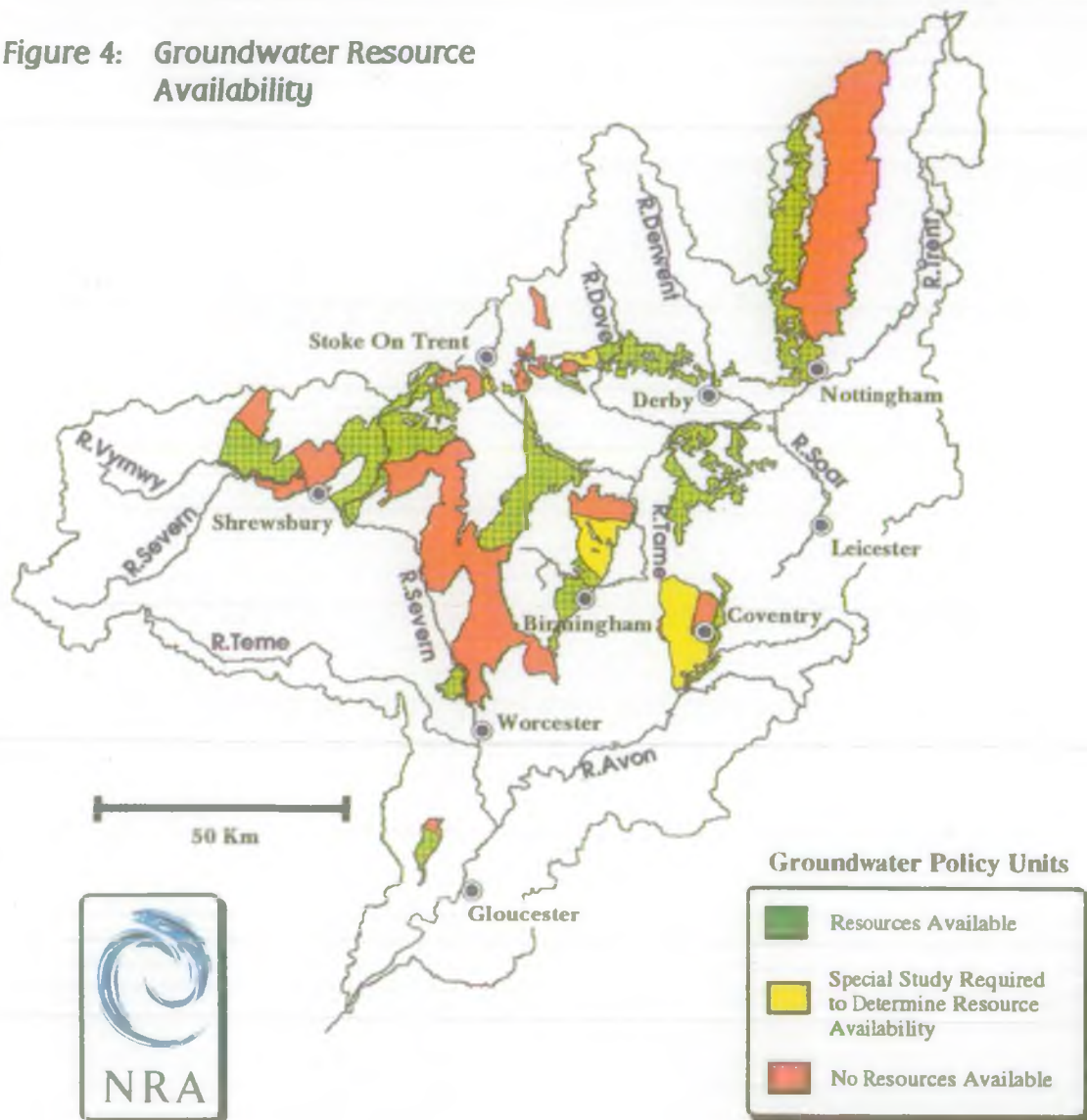




## (b) Groundwater

For each groundwater management unit the long term rate of recharge into the aquifer has been assessed. The licensing policy for each unit has been established and is reviewed annually. The objective is to achieve overall licensed abstractions in the long term which are less than recharge. For the majority of units the acceptable degree of development is unlikely to be more than 70% of the long term recharge but can be more or less than this in particular cases. If abstractions exceed

**Figure 4: Groundwater Resource Availability**



or approach the recharge this results in mining of the resource leading to falling borehole yields, depletion of baseflow to streams and a drying out of wetlands dependent on a high water table. Licensed abstractions must therefore be less than recharge in order to afford protection to baseflow and environmentally sensitive areas.

Using the above criteria, many of the region's management units are already overlicensed and overabstracted. The reason for this is largely historical and a result of the introduction of the Water Resources Act 1963, when groundwater abstractions existing at that time were given 'Licences of

Right', based on actual use rather than on sustainable yield. The current policy has therefore been imposed on a regime that was developed with little regard for good aquifer management, concentrating mainly on water supply demand requirements. Figure 4 indicates the degree to which the management units are licensed with reference to long term recharge. A detailed breakdown of the categories of units is given in Appendix 1. This indicates where resources are still available for development and also where a reduction in the use of groundwater is an objective.

This forms a background for identifying where additional resources may be available for licensing but is subject to any overriding local considerations. The region will adopt a policy of not renewing time limited licences in over-exploited units where there is evidence of unacceptable environmental impact.

Significant reductions in abstractions from over exploited units have already been achieved in recent years. The NRA has further objectives for long term reductions as detailed in Appendix 1.



*"In those units which are already overlicensed the NRA will take opportunities to redress the imbalance."*

The need to reduce abstractions in some areas will in effect place an additional demand on the system for new resources and will have to be a consideration when seeking the availability of alternative resources from other sources.

## **6. Climate Change**

Climate change, due to the enhanced greenhouse effect, could have major implications for all aspects of water resource planning. The areas of most concern for the Severn-Trent region are:

- increased saline intrusion in estuaries due to sea-level rise and the potential impact on surface water abstraction points near to tidal limits;
- the possibility of reduced groundwater recharge;
- changes in the rainfall-runoff regimes in the region;
- changes in domestic and agricultural demands.

Currently it is not proven that artificially induced global warming is taking place, nor, if a change occurred, whether there would be an adverse effect on water resources in this region. Nevertheless, the possible impacts of any change are great enough to warrant attention. This plan will be reviewed in the light of new and more focussed research into any changes.





## Section A: Meeting Demands

Demands for water resources comprise those from within the region and those at a national level.

### 7. Regional Water Resources Demands

This section describes the current and predicted future demands for water resources that arise from within the region.

The potential changes in demand in the future are identified and the way in which it is proposed that these demands are met. Demand for some uses is not necessarily increasing but existing demands can often be met in a more resource efficient and environmentally acceptable way.

The particular needs of each type of demand are discussed and the policies set out for licensing these needs, both now and in the future. Individual proposals to meet future demands are at different stages of the planning and approval processes, from concept, through evaluation, to pending implementation. This plan identifies the status of proposals as they are described. Some are close to implementation. Proposals to meet national demands are being evaluated as part of the National Water Resources Strategy. More details about these schemes can be found in Section 8 on P. A22.

#### 7.1 Public Water Supply

##### Overview

The two water companies, Severn Trent Water and South Staffordshire Water, meet about 95% of water supply needs in the Severn-Trent region which average over 2,400 Ml/d. In addition, six neighbouring water companies have an interest in the region's water resources. Anglian Water and Yorkshire Water supply a total of around 100 Ml/d in the Lower Trent area and also benefit, together with North West Water and Bristol Water, from substantial exports totalling up to 700 Ml/d. Also, over 400 Ml/d is imported from other regions including up to 340 Ml/d from Elan Valley Reservoirs, by Severn Trent Water to supply Birmingham. Figure A.1 illustrates the principal features of the regional water resource system to meet public supply demands.

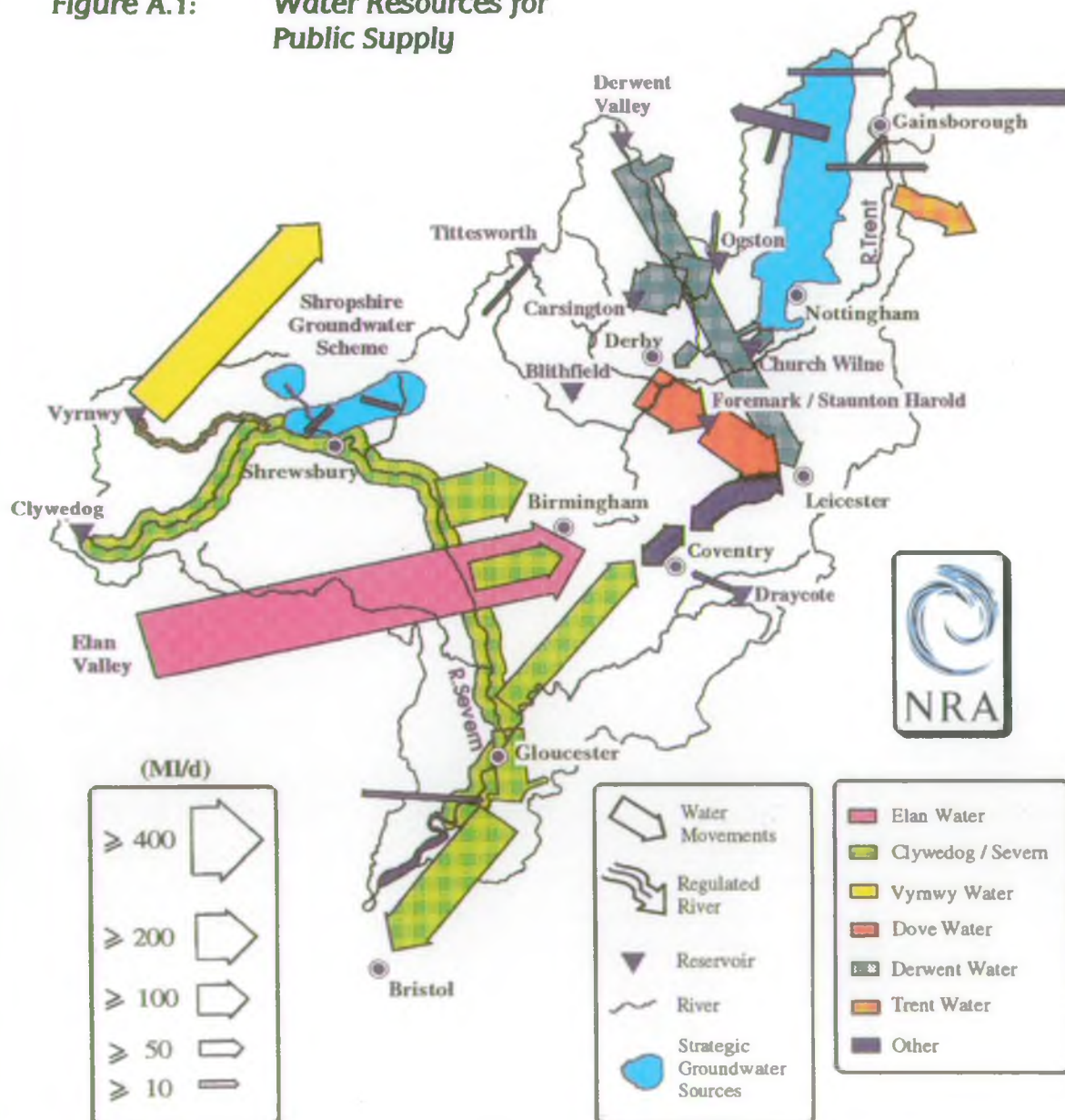
##### Demand Forecasts

The NRA, as part of its National Water Resources Strategy, has prepared a range of demand scenarios for all the water companies in England and Wales so that comparisons between companies and between regions can be made on a consistent basis. These continue to be refined as part of the development of



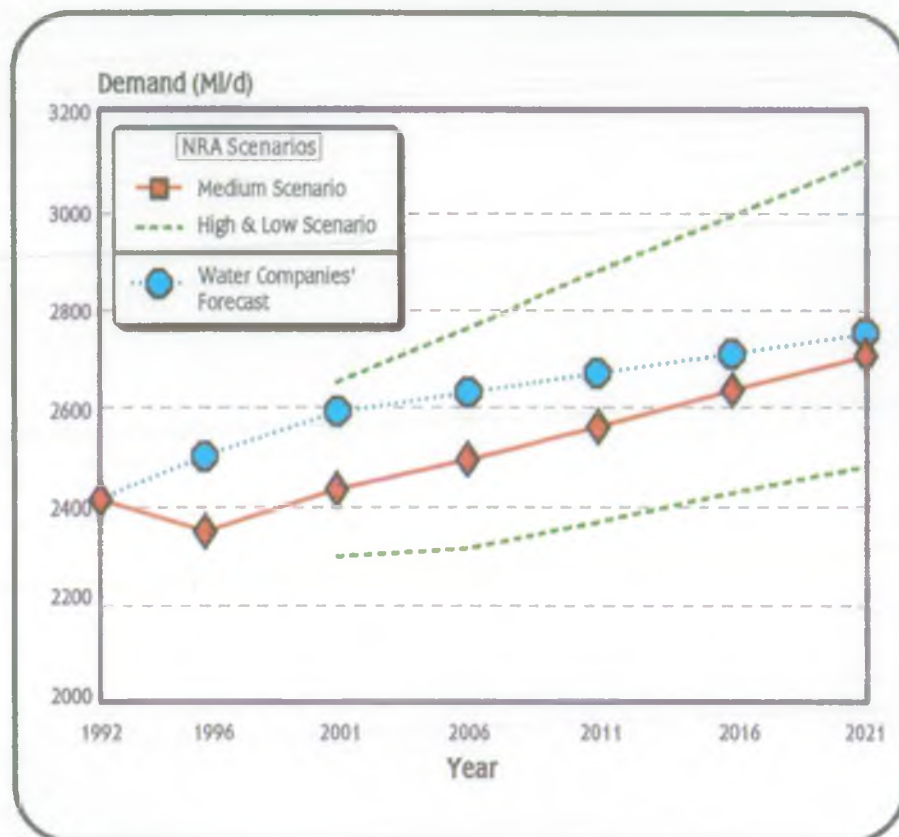
the National Strategy. A summary of the assumptions made in these scenarios is included in Appendix 2. Scenarios for total demand for the two regional water companies over the period to 2021 are included as Figure A.2. These range from a modest 1% increase by 2021 for the low estimate to 28% for the high estimate. The NRA medium scenario indicates a regional increase in demands of 12% by 2021 from 2,410 to 2,700 Ml/d. The planning forecasts of water demand for 2021 used by the regional water companies, agree to within 5% of the NRA's medium scenario. The potential impact of demand management measures is illustrated by the low forecast scenario, which incorporates the assumption that leakage would be reduced to 6 litres/property/hour with metering introduced in 30% of domestic properties.

**Figure A.1: Water Resources for Public Supply**



For planning purposes the region has been divided into four regional strategic water supply areas. The NRA demand scenarios for each of these four areas is shown in Figure A.3, the large range reflecting the uncertainty in the various components of demand for which different assumptions can be made.

**Figure A.2:**  
**NRA Demand Scenarios**  
**for Total Regional Public**  
**Water Supply Demands**  
(Figures based on Severn  
Trent and South Staffs. supply  
areas only)



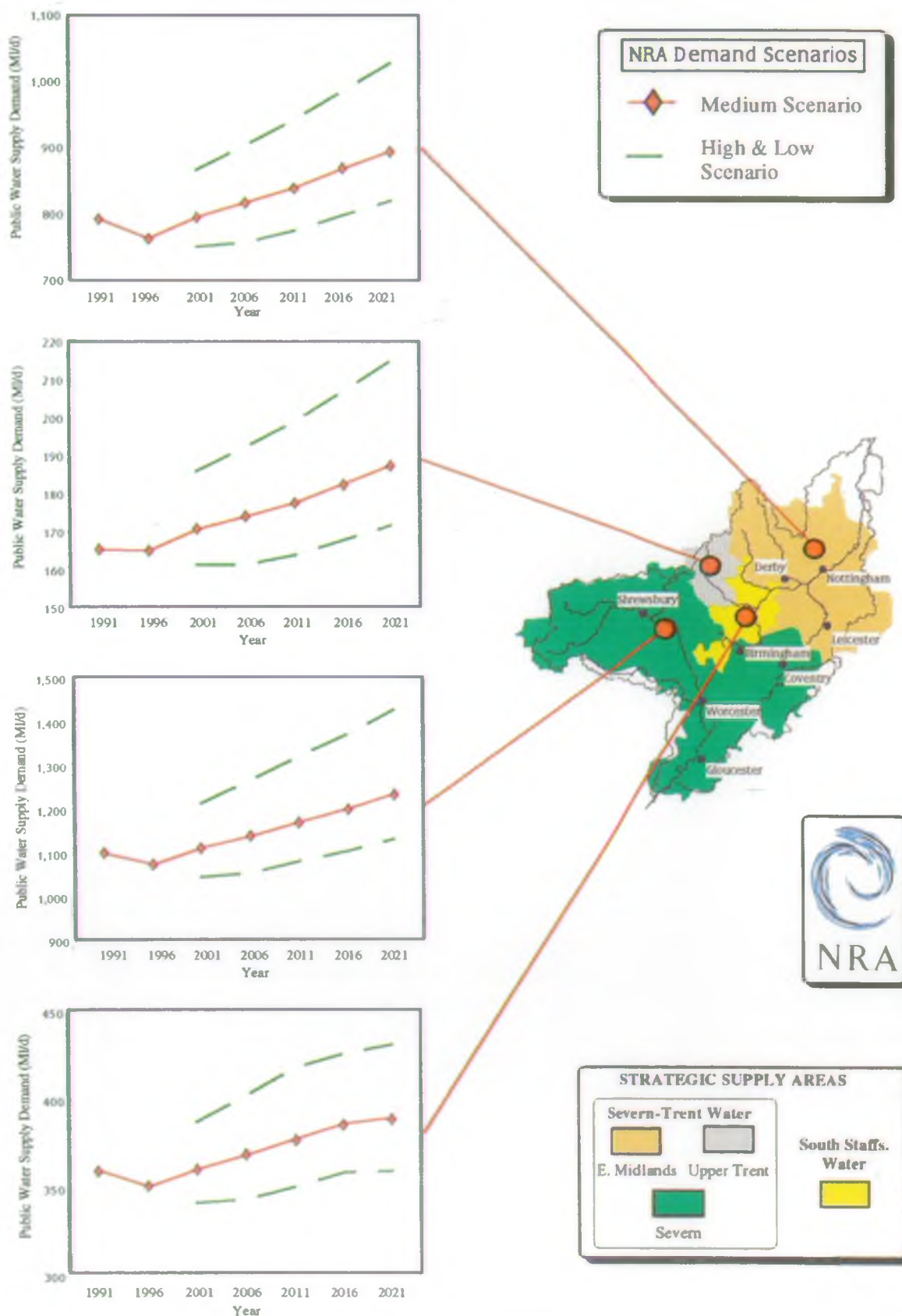
Projections of regional population growth are shown in Figure A.4, with a forecast increase of about 5% by 2021. There are marked differences across the region with an anticipated fall in population over the South Staffordshire area, Wolverhampton, Birmingham and Coventry.

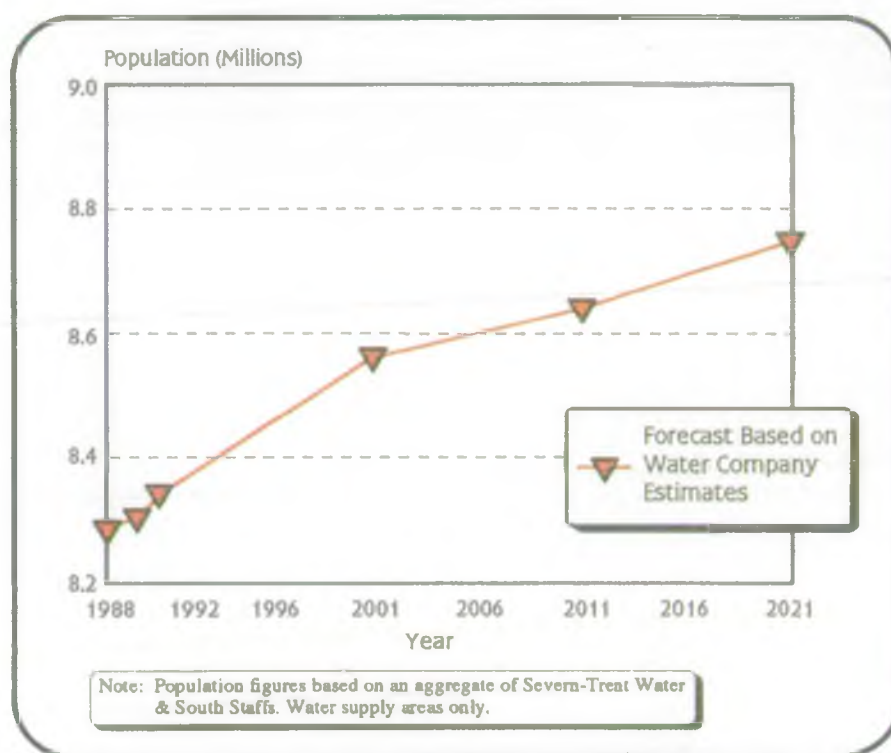
A significant proportion of water supply demand is to meet losses through leakage and therefore estimates of these losses are a key component of the demand forecasts. There is some debate at present on how to assess leakage with differences in approach by the local companies. Data from a recent Office of Water Services (OFWAT) report, applying standardised assumptions for domestic consumption per person, are included to illustrate the variation in distribution losses between the local water companies. In this region active leakage control has been practised for a number of years resulting in sizeable savings with regional losses over 5% below the national average (see Figure A.5). However, a level of diminishing return has been reached in many areas and further significant reductions are only likely following major capital investment on water supply systems, in particular the replacement of ageing water mains. It is also recognised that a proportion of distribution losses will contribute to supporting the baseflows of some rivers.

It is the policy of the NRA to ensure that water companies are doing all they can to reduce leakage down to an economic level before a new resource development is authorised. This appraisal should take into account the environmental costs as well as the purely financial cost of any new scheme. Substantial expenditure on the regional water distribution system over the period to 2021 would be required to reduce leakage down to the targets assumed in the NRA low forecasts. However, there would be other considerable benefits arising in terms of improved drinking water quality and overall standard of service to the consumer.



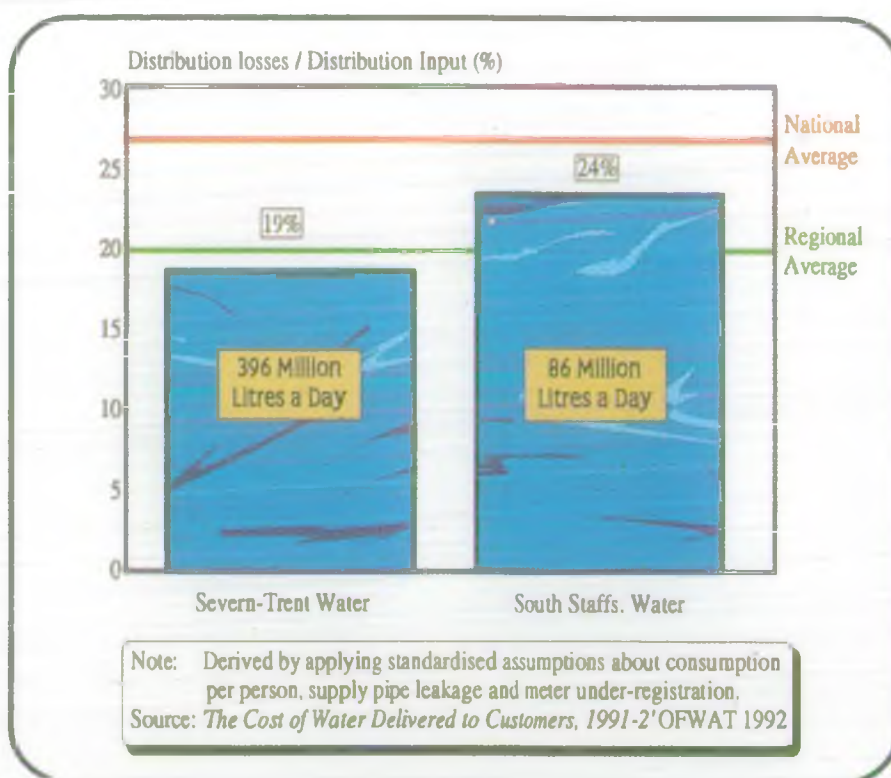
**Figure A.3: Public Water Supply Demand Scenarios for Strategic Supply Centres**





**Figure A.4:**  
Population Forecasts for  
the Severn-Trent Region

**Figure A.5:**  
Regional Leakage  
Figures.





## Available Water Resources

The total drought reliable yield currently available with the existing resources, sourceworks and infrastructure, is around 2,620 Ml/d. This consists of 1,220 Ml/d from surface sources, 980 Ml/d groundwater and 420 Ml/d imported from neighbouring regions. Excluding proposed new resource developments there will be changes in the quantity of resources available over the planning period from:

- Planned closure or reduction in yield of unsatisfactory local sources: for example, groundwater sources where nitrates are rising to above the maximum acceptable limits for drinking water.
- Where reductions in groundwater licences in overabstracted aquifers have already been agreed.
- Where the NRA has set out target objectives to reduce groundwater abstractions in overabstracted aquifers over the period to 2021 as part of the forthcoming periodic review of the water companies asset management plans by OFWAT. The target reductions are detailed in Appendix 1. These have not yet been agreed either by the companies or OFWAT but will form the basis of discussion to agree a programme of phased reductions over the planning period to 2021.
- Increases in available source yield within existing licensed quantities by improvements to sourceworks, or new or improved treatment facilities. In the East Midlands this includes the extensions to treatment works in order to fully utilise the yield of Carsington Reservoir.

The changes in available yield resulting from these changes are shown in Table A.1.

Table A.1: Variations in Existing Source Yield (Ml/d)						
Strategic supply area	Reliable yield 1993	Closure of local sources	Agreed groundwater licence reductions	NRA identified reductions in groundwater abstractions	Increases within existing licences	Total in 2021
Severn	1251	-18	-8	-36	+46	1235
East Midlands	815	-9	-27	-43	+140	876
Upper Trent	197	-1	0	-3	+8	201
South Staffs.	357	-2	0	-23	0	332
<b>REGION</b>	<b>2620</b>	<b>-30</b>	<b>-35</b>	<b>-105</b>	<b>+194</b>	<b>2644</b>

## Projected Resource Shortfall

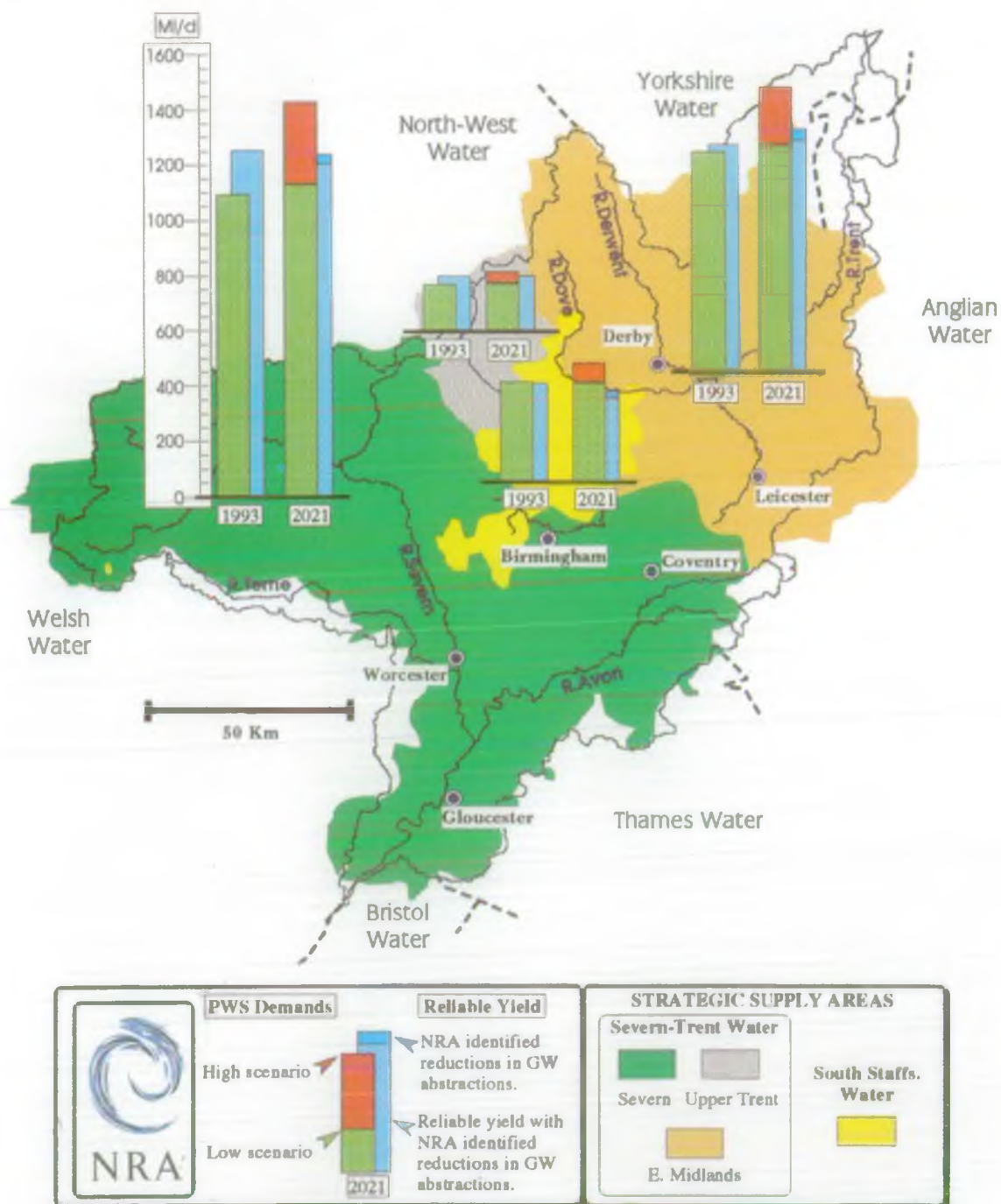
A comparison between available yield (excluding new resource developments) and the range of NRA forecast scenarios for average demands for each of the strategic supply areas is illustrated in Figure A.6. There are differences between supply areas in the degree to which available resources need to exceed average demands. For example, the small margin between average demands and reliable yields for the South Staffordshire area reflects the lower level of resource reliability compared to other parts of the region but is partly mitigated by the company's largely integrated water distribution system. In contrast, the Severn area requires a healthy surplus of



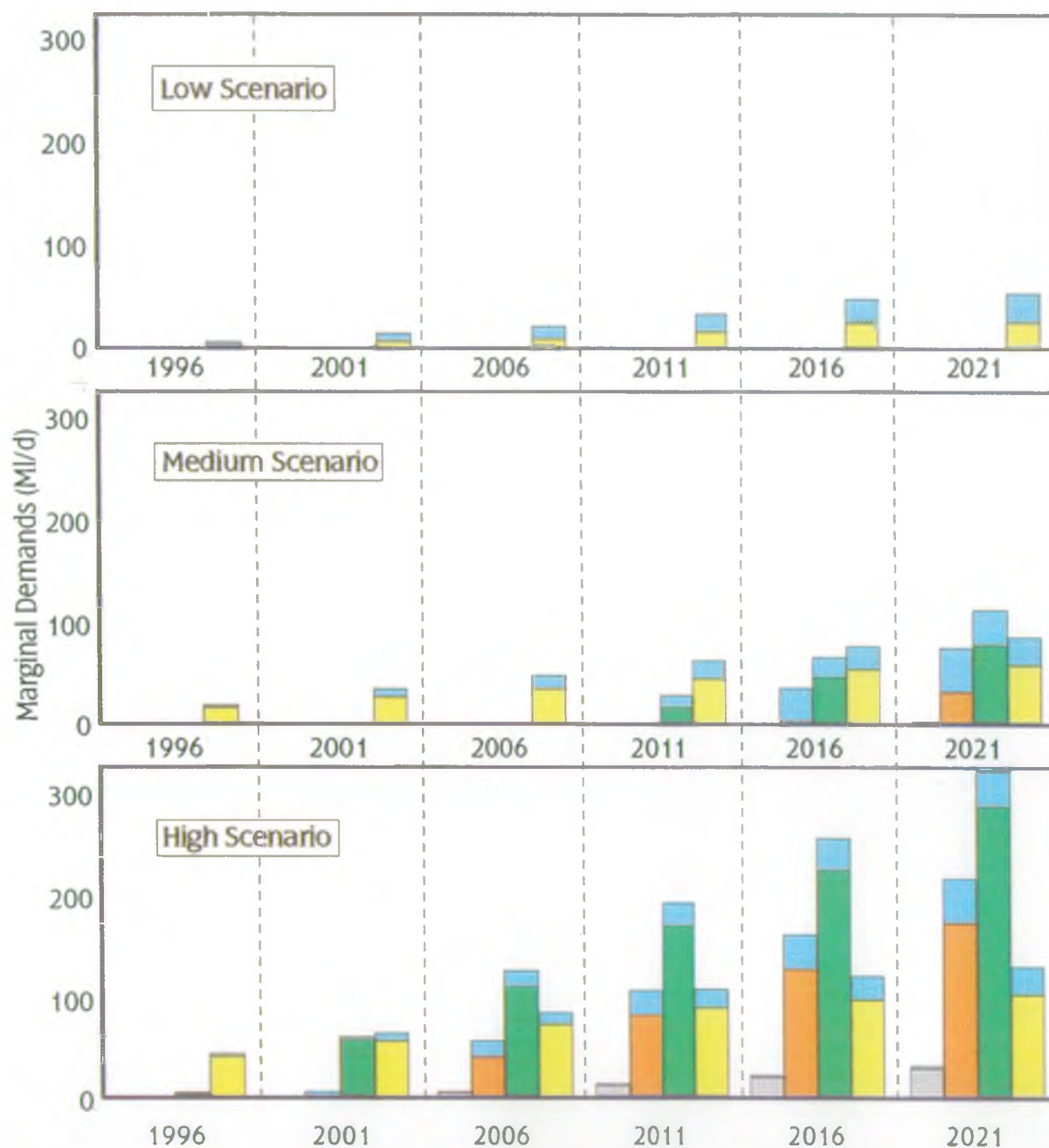
resources to meet demands to a number of isolated supply zones.

The balance between available resources (assuming the implementation of the NRA long term identified reductions for overabstracted groundwater units) and average demands, has been calculated and gives a marginal demand profile for each of the strategic supply areas. In practice a water company will wish to have the level of resources set above average demands to allow a sensible operating margin to cope with higher than average demand years and to allow sources and treatment works to be out of action for maintenance or emergencies. Even with plans to further integrate water

**Figure A.6: Water Supply Resource Yield and Demand.**



**Figure A.7: Marginal Demands for Each Strategic Supply Area Based on NRA Demand Scenarios**



#### Strategic Supply Areas

- Upper Trent
- East Midlands
- Severn
- South Staffs.

Marginal demands resulting from NRA identified reductions in groundwater abstraction

distribution systems, there will continue to be a number of isolated supply zones where the safety margin has to be set higher to guarantee supplies to the consumer. Therefore a contingency allowance has been built into the marginal demands calculation varying between supply districts averaging out at around 7.5% across the region. The anticipated yields, excluding new developments, have been set against the range of NRA demand scenarios and are illustrated in Figure A.7.

The profiles show that for the South Staffordshire supply area there is a resource deficit for all the forecast scenarios for the entire planning period ranging from 50 MI/d for the low scenario and to 130 MI/d for the high scenario by 2021. Development of resources will be required to improve the reliability of the resource system and to compensate for reductions in groundwater abstractions which are subsequently agreed with the NRA.

For the East Midlands area there are marginal demands by 2001 for the high scenario and by 2016 for the medium scenario indicating the possible full utilisation of Carsington Reservoir by the end of the planning period. The timing of this will depend on the actual trend in consumption, the degree of success in reducing leakage, and the agreed targets for reduction of groundwater abstractions.

The high forecast scenario for the Severn supply area projects a small resource shortfall in 1996 rising to 100 MI/d by 2021. The medium scenario indicates a deficit of around 30 MI/d by 2011, rising to over 100 MI/d by 2021. In practice there will be a need for some resource development over the next five years because there are a number of local requirements to improve the existing resource reliability or where new low nitrate sources of water will be required for blending with existing supplies.

For the Upper Trent supply area the only significant marginal demands arise under the high forecast scenario from 2006 rising to 30 MI/d by 2021. Although this area is likely to be largely self sufficient for resources over the planning period some resource development will be required to provide low nitrate supplies for blending.

These projections illustrate how sensitive the timing of new resource developments is to the assumptions made in the demand scenarios. For example, if the assumptions for demand management under the low forecast scenario prove accurate, only limited resource development would be required to meet average demands even with the target reductions in groundwater abstractions included.

The projections also show the extent to which long term identified reductions in groundwater in overabstracted areas directly influence the marginal demands under each demand scenario. In making these projections we have assumed a staged introduction of these long term reductions.

Only broad indications of the relative degree of resource shortfall and likely timing of developments can be drawn from this analysis. However, it does emphasise the importance of reviewing demand forecasts regularly and the adoption of a consistent methodology for assessing resource needs between the NRA and the water companies.

### **Resource Development Options**

The responsibility for identifying need and making proposals for new resource schemes to meet public water supply demand rests with the water companies. The NRA is in regular dialogue with each of the companies using or seeking resources in the Severn-Trent region. Schemes at various stages of consideration are included in Tables A.2 for groundwater and A.3 for surface water.

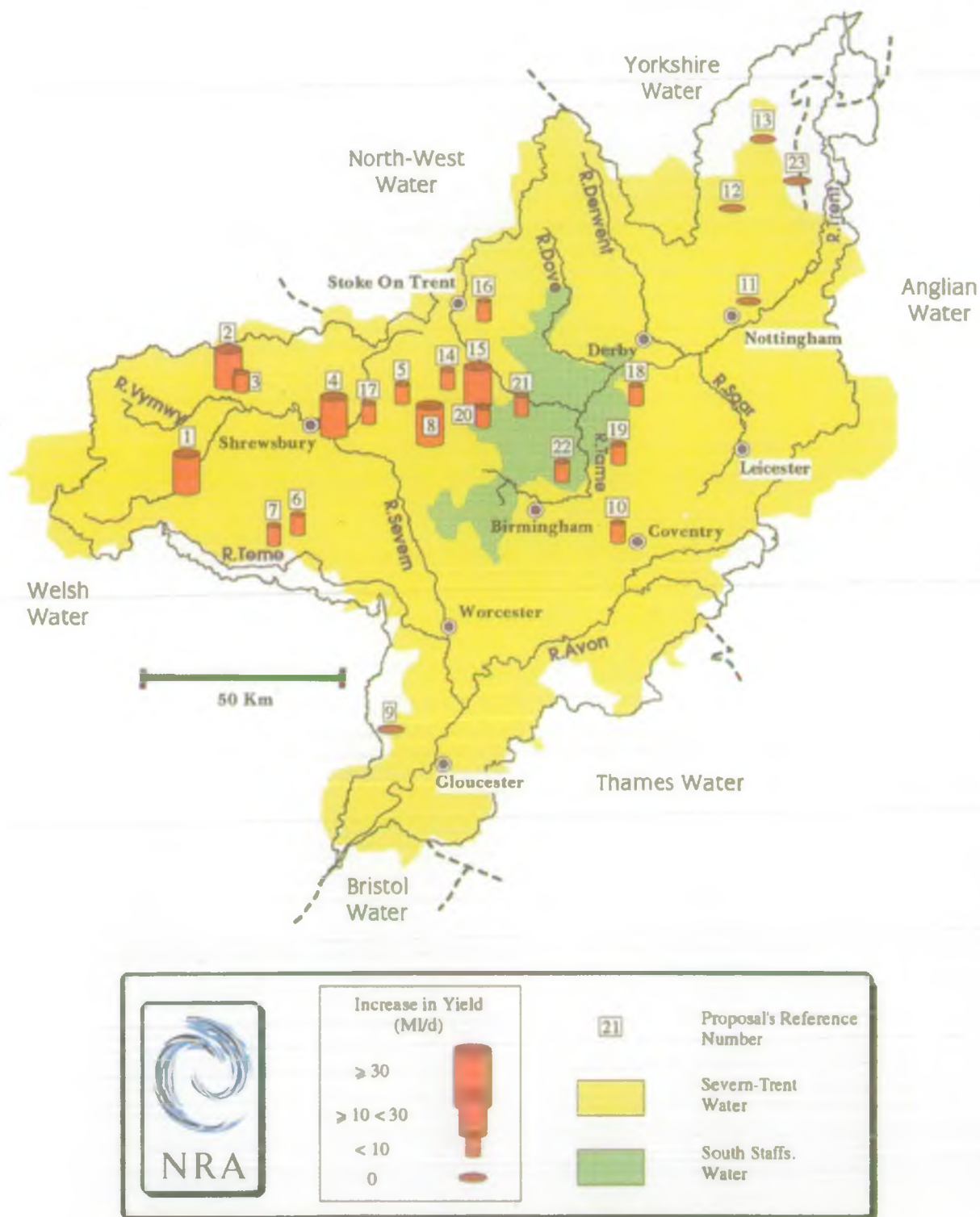
**Table A.2: Water Resource Development Proposals - GROUNDWATER RESOURCES**

Severn Trent Water					
Reference	Supply Area	Source	Ave. Annual Quantity (Ml/d)	Status	Comments
1	Newtown / W pool	Abermule	10	A	
2	Oswestry / Montg'y	Morton	10	A	Subject to the protection of a neighbouring SSSI.
3	Oswestry / Montg'y	Site in Knockin Unit	5	B	
4	Telford	Hencott Bomere Heath Uckington Attingham	20	A B A A	Development at new and existing sites to provide an additional 20 Ml/d in total to Telford.
5	Telford	Stockton Moors (or alternatives)	5	A	No objection in principle but may be subject to compensation discharges.
6	Craven Arms	Munslow	3	--	No status as proposal falls in a licence exempt area.
7	Bishops Castle	Clungunford	0.2	A	No objection in principle but may include a compensation flow clause.
8	Wolverhampton / Telford	Hilton Beckbury Longbitch Farm Oaken Royal Oak	18	B B A A B	A total of 18 Ml/d is sought balanced by reductions in the Cosford groundwater unit.
9	Malvern / Gloucs.	Ketford	(2.8)	A	Linked to a licence reduction at Bromsberrow.
10	Coventry	Pickford Green (or alternative)	4.5	A	
11	Nottingham	Burton Joyce Lambley	(d)	--	Increase in source yield agreed as part of overall reduction in Blidworth unit licence quantities.
12	Sherwood	Budby Forest	(10)	--	To be included with the existing Budby licence. No licence increase.
13	Worksop	Hayton	(10)	--	Forms a joint licence with Barnby Moor. No decision has yet been made as to whether licence is to be made permanent.
14	Stafford	Hollies	4	A	Licence increase initially for time limited period. Compensation discharge required.
15	Stafford	Acton Trussell Peggs Farm	10	B	
16	Stoke	Cresswell	2	B	
17	E. Shropshire	Site in Sambrook Unit	5	B	
South Staffordshire Water					
18	--	Chilcote Extension	4	A	No objection in principle but will probably require compensation discharges.
19	--	Warton Boreholes	8	B	
20	--	Slade Heath	2	B	
21	--	Morse Gorse / Sifting Mill	4	A	No objection in principle but will probably require compensation discharges.
22	--	East Sutton	5	A	Time limited licence for seven years
Anglian Water Services					
23	--	Elkesley	--	--	No extra water available. New replacement boreholes will be added to licence provided that overall abstraction is reduced.

(See Table A.3 for key)



**Figure A.8: Proposals to Meet Public Water Supply Demand - Groundwater Options (See Table A.2)**





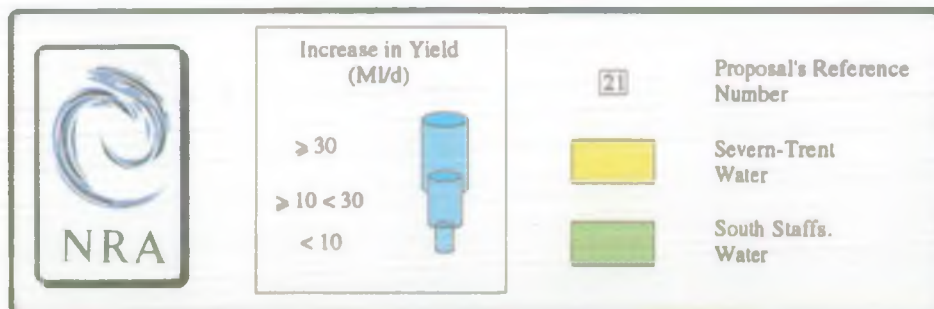
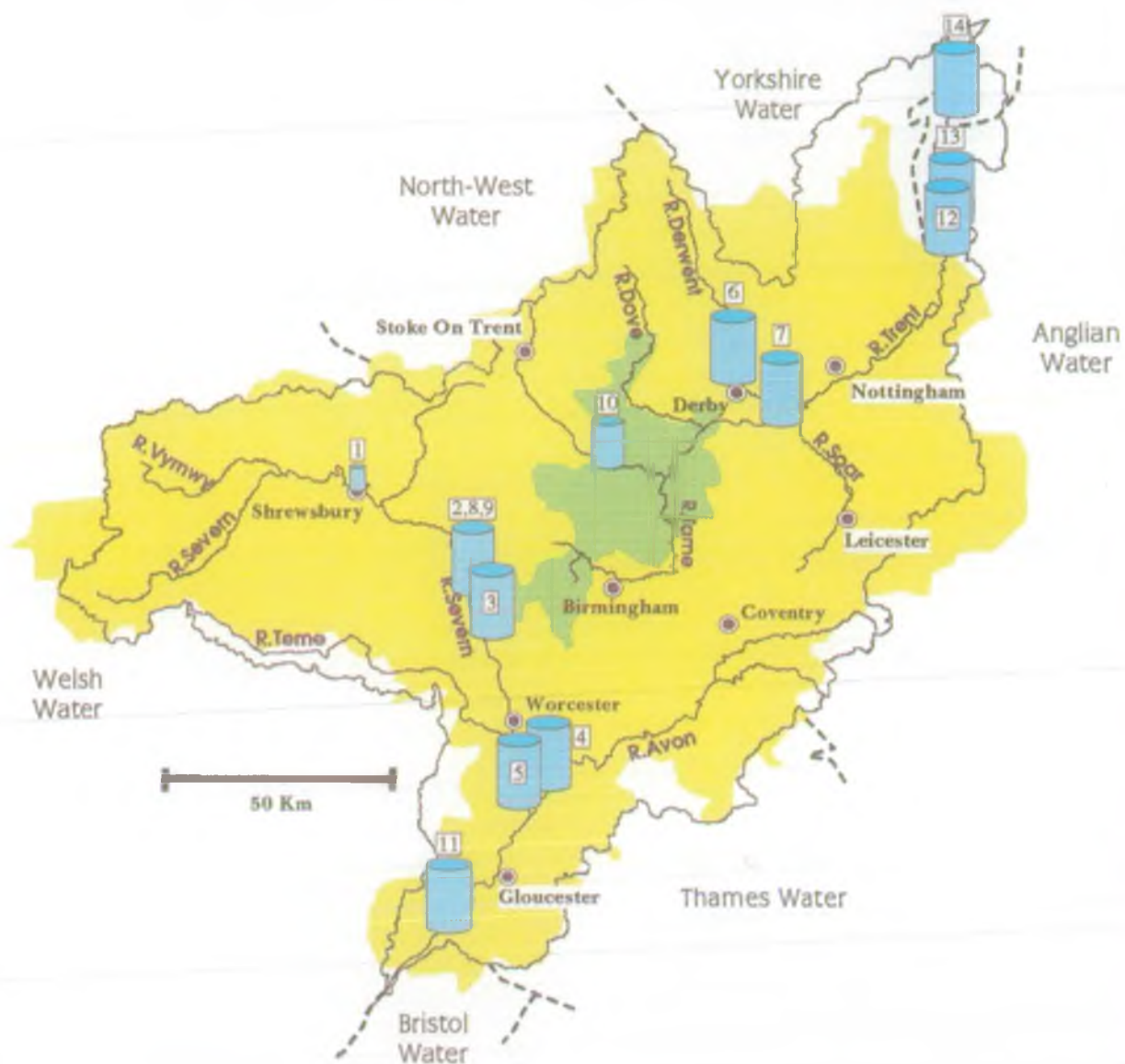
**Table A.3: Water Resource Development Proposals - SURFACE WATER RESOURCES**

Severn Trent Water						
Reference	Supply Area	River	Location	Daily Licensed Quantity (Ml/d)	Status	Comments
1	Oswestry / Montgomery	Severn	Shelton	1.3	-	Transfer of existing licensed quantity from Clywedog
2	Wolverhampton	Severn	Hampton Loade	10	A	To replace output from groundwater sources supplying Wolverhampton area. In conjunction with 8 below (1)
3	E.Worcs. / Worcs. / Kidderminster	Severn	Trimpley	40	A	Extension of treatment works to supply East Worcester area and Worcester (1) via new strategic aqueduct (2)
4	Worcs. / S.Worcs. / Coventry	Severn	Strensham	23	A	Extension of treatment works to supply East Worcester area and Worcester (1) via the new strategic aqueduct & meet growth in demands in South Warwickshire / Coventry (2)
5	Gloucestershire	Severn	Mythe	56	A	40 Ml/d required to supply new treatment works. To meet growth in demands in Gloucestershire. Total quantity not finally agreed by NRA.
6	Derby	Derwent	Little Eaton	35	A	Supported by Carsington Reservoir to supply new treatment works.
7	East Midlands	Trent	Church Wine	c 100	B	Possible future option to meet demands after Carsington Res. is fully utilised. Could be considered as part of conjunctive use scheme. (3)
South Staffordshire Water						
8	South Staffs.	Severn	Hampton Loade	10	A	In Conjunction with 2 above. Future quantities required may be greater to replace output lost from sources in overabstracted aquifers (1)
9	South Staffs.	Severn	Hampton Loade	20	A	Increase in winter abstraction only to allow conjunctive use with groundwater sources.
10	South Staffs.	Trent	Rugeley	35	A	Summer abstraction (15 Ml/d average) to transfer water to Blithfield Res. to increase reliable yield. Subject to environmental impact assessment. (3)
Bristol Water						
11	Bristol	Glas & Sharpness canal	Purton	56	A	To support extension to Purton treatment works. Possibility of further increase post 2005 dependent on demand growth. (1)
Anglian Water						
12	Lincoln	Trent	Dunham	40	A	Conjunctive use with groundwater sources favoured. (3)
13	Lincs. / S.Humberside	Trent	Torksey	40	B	Transfer by NRA Anglian region via Fossdyke Canal to Witham / Ancholme system for abstraction at Cadney. (3)
Yorkshire Water						
14	Doncaster	Trent	Tidal Reaches	c 30	B	One of a number of possible options to meet resource shortfall in Doncaster area (3)
<b>Notes:</b> (1) Licence increase supported by development of Shropshire Groundwater Scheme phased over the period to 2021 to match growth in demands. (2) Increase to partly replace Barbourne (Worcester) treatment works (3) Would be subject to a prescribed flow on the river Trent						

**Key:**

Status A	-	Resource allocation agreed in principle.
Status B	-	Resource allocation not yet agreed.
[10]	-	No overall increase in yield / licence.
(d)	-	Increase in daily abstraction.

**Figure A.9: Proposals to Meet Public Water Supply Demand - Surface Water Options (See Table A.3)**





New resource developments fall into three main categories:

- local groundwater developments;
- increased river Severn abstractions;
- new abstractions from the river Trent.

Each of these categories is discussed in the following paragraphs. In addition, the water companies will make improvements to the distribution network to increase the reliability of the system without increasing the resource need. Also, where sources fail to meet required quality standards, improvements in water treatment or schemes for blending to achieve an acceptable quality will enable companies to maintain existing source yields.

**a) Local Groundwater Developments**

All new potential sources will be subject to rigorous pumping tests with the impact on the local water environment carefully monitored. A number of the proposals listed will be required either to replace or blend with existing sources with quality problems such as high nitrates. It is unlikely that all the proposals listed will be successful and the increase in regional resources from these developments has been estimated to be in the range 60 to 100 Ml/d. Where feasible, conjunctive use of groundwater sources with surface sources will be encouraged so that optimal use of water resources can be achieved. More details on conjunctive use are included in Section 11 on P. C3.

**b) River Severn Abstractions**

Increased abstraction from the river Severn is the preferred option for meeting resource deficits in the Severn and South Staffs supply areas which cannot be met by local resources. Further phased development of the Shropshire Groundwater Scheme will support increased net abstractions from the river Severn. The operation and future development of the scheme is managed by the NRA. The scheme is fully licensed with two phases already developed worth approximately 80 Ml/d net with a further six stages remaining which would support up to an estimated further 155 Ml/d net abstraction from the river Severn.

There is considerable re-use of resources along the Severn with effluents returned upstream of Gloucester available for abstraction downstream. This means that a larger increase in gross abstractions can be supported than the 155 Ml/d net resource from further development of Shropshire Groundwater depending on where associated effluent returns are made.

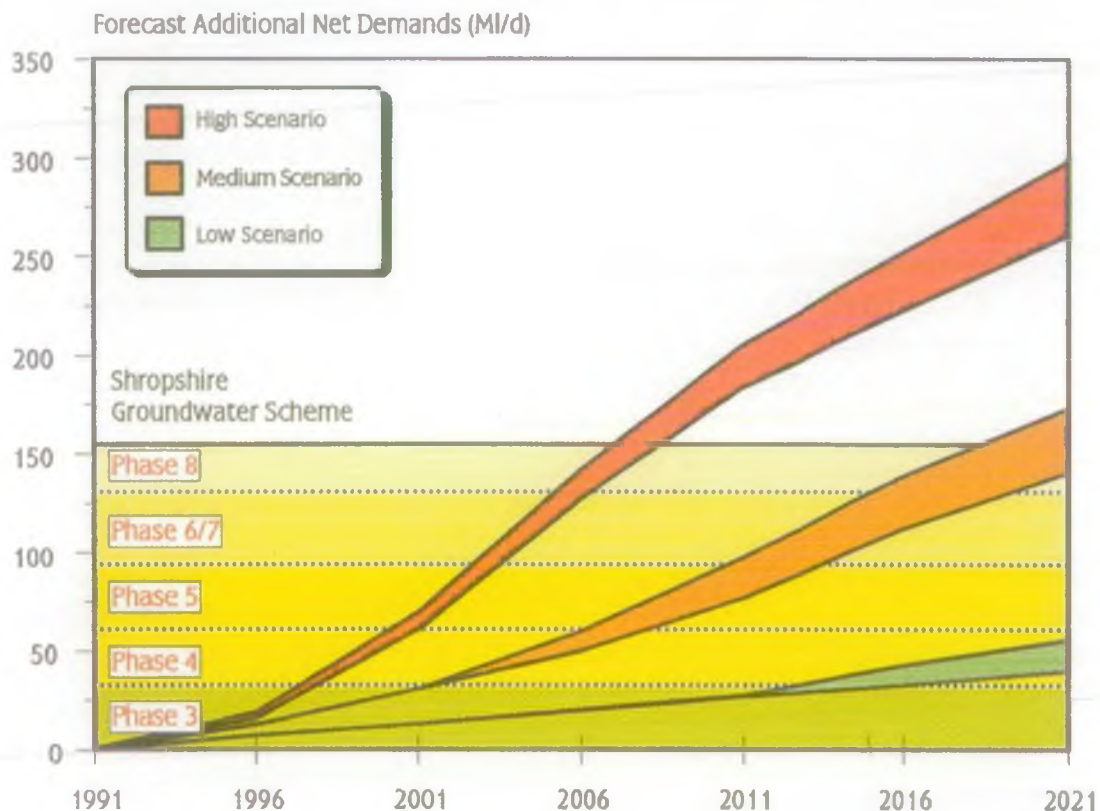
There will also be the following demands on the river Severn to be met in addition to the regional water supply needs.

- i) Bristol Water are currently proceeding with extensions to Purton treatment works to increase its capacity by 55 Ml/d which will be supported by abstractions from the Severn via the Gloucester and Sharpness Canal. When the new works capacity is fully committed, a further extension at Purton would be considered as a possible option.



ii) An allowance needs to be made for other additional net abstractions from the Severn catchment. This has been estimated at a maximum of 50 MI/d over the period to 2021, principally from spray irrigation.

**Figure A.10: Demand Scenarios in the Severn Supply Area and the Phased Introduction of the Shropshire Groundwater Scheme**



Projections of the likely phasing of the scheme for the range of NRA forecasts are shown in Figure A.10. They are based on the marginal demands shown in Figure A.7 plus those demands identified above. The upper limit of each scenario shows the demand forecast with the NRA identified reductions in groundwater abstractions. In practice, there will be some gradual recovery in baseflows to the Severn as a result of cutbacks in groundwater abstraction which will ameliorate the need for new resources to support abstractions from the Severn. Account has been taken of the probable local groundwater developments over the planning period. However, the actual pattern may differ and is a further uncertainty factor.

The main conclusions are:

- The Shropshire Groundwater Scheme could meet the regional needs and those of Bristol Water throughout the planning period for the low forecast scenario.
- Under the medium scenario, Shropshire groundwater would be fully developed by the end of the planning period, with the possibility that a new resource would be required after 2018.
- The high scenario projects the need for a new resource around the year 2008. By 2021 the requirement would increase by over 100 MI/d.

The control rules for the river Severn will be reviewed by 1996 which will have a bearing on the level of resources required to meet an agreed standard of service.

All the uncertainties inherent in the demand forecasts and assumptions of source yield emphasise the benefits of a phased scheme which can be developed to keep pace with the pattern of demands.

Preliminary investigations have already taken place to assess the possible resource options for the river Severn once Shropshire Groundwater is fully committed. At present there are no plans for a new reservoir in the Severn Catchment or further use of groundwater to augment river Severn flows. Details of possible schemes that have had some consideration include:

i) **Redeployment of Lake Vyrnwy**

Initial studies as part of the national water resources strategy have shown that there would be a benefit in the reallocation of a modest proportion of the storage of Lake Vyrnwy, which is used by North West Water to supply Liverpool, to regulate the river Severn and support increased abstractions. However, because Vyrnwy is a relatively cheap, high quality, reliable source of water the costs of meeting any resulting shortfall in supplies to North West Water will be a key issue.

ii) **Enlargement of Craig Goch Reservoir**

The feasibility of enlarging Craig Goch Reservoir in the Wye catchment was investigated in detail in the 1970s and a preliminary study to update this appraisal has recently been carried out. An enlarged Craig Goch would only be viable if there were guaranteed needs for new resources in other regions as part of the National Water Resources Strategy.

c) **River Trent**

The river Trent is now being considered as a potential option to meet demands in the East Midlands once Carsington Reservoir has been fully committed. Figure A.11 is included to show the utilisation of the spare yield of Carsington Reservoir for the range of NRA forecasts with and without the target reductions in groundwater abstractions in Nottinghamshire included. The projections are based on the marginal demands shown in Figure A.7, with the upper limit of each line showing the impact of the NRA identified reductions in groundwater abstractions.

The main conclusions are:

- Under the low forecast scenario Carsington Reservoir would meet the supply needs of the East Midlands throughout the planning period.
- A new resource would be required by 2016 following the medium scenario and up to five year earlier if all the target groundwater reductions were achieved. By 2021 the resource need would amount to between 30 and 70 Ml/d.
- Following the high scenario a new scheme would be required by around 2001, with the requirement increasing to over 170 Ml/d by 2021.

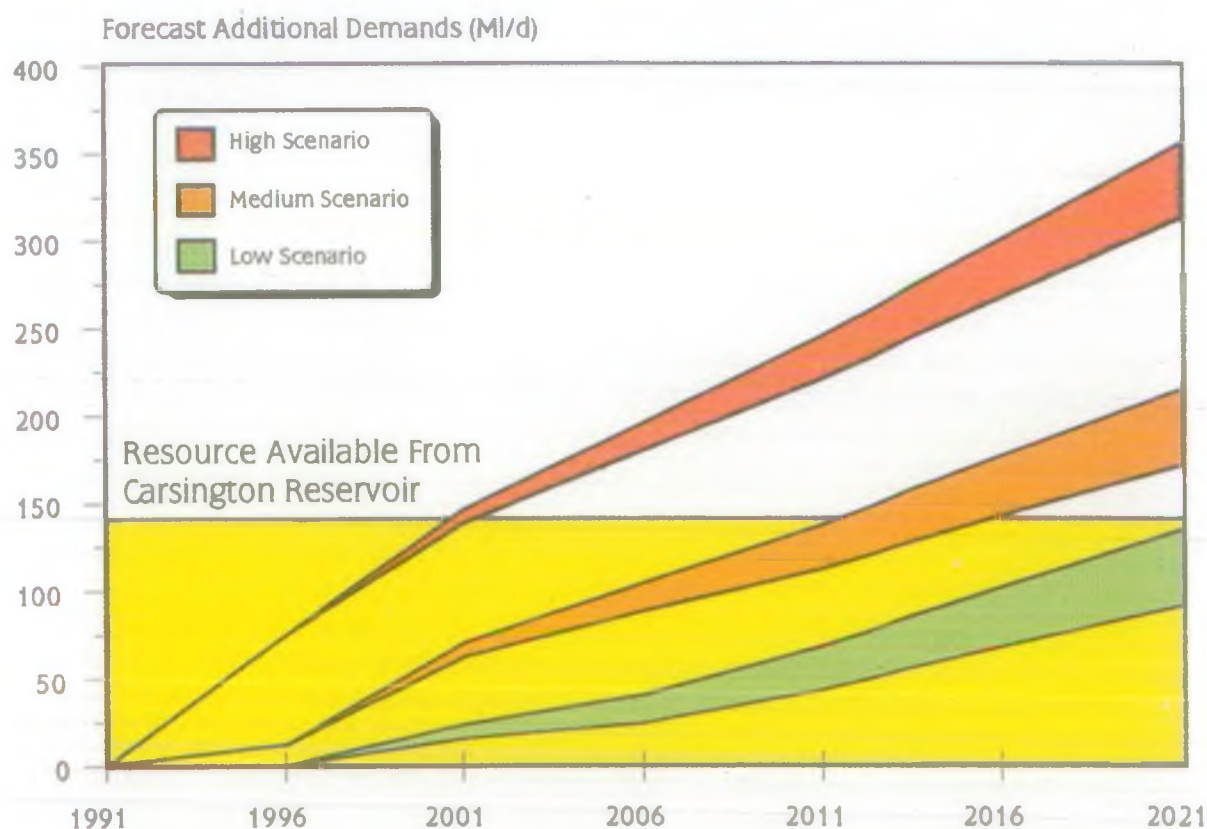
Initial studies by Severn Trent Water indicate that a river Trent abstraction managed conjunctively



with other resources in the East Midlands could increase the total system yield by up to 100 Ml/d. However, this is very dependant on the level of prescribed flow set in future for the river Trent and more work is required to fully investigate this option.

Other proposals over the planning period to use the Trent for public water supplies are summarised below. Any new abstraction would be subject to a prescribed flow. Studies are currently underway to investigate how river Trent abstractions should be controlled to protect the existing uses. Any direct abstraction from the Trent for drinking water supplies could have implications for treatment of effluent discharged upstream in order to meet higher water quality standards under EC directives.

**Figure A.11: Demand Scenarios in the East Midlands Supply Area and the Resources Made Available by Carsington Reservoir.**



Proposals being considered are:

- i) Increasing the yield of Blithfield Reservoir by 15 Ml/d by pumping from the Trent during the summer period. It is not certain whether this scheme will be viable, one critical factor being the impact on water quality in Blithfield Reservoir.
- ii) A direct abstraction from the river Trent near Dunham of up to 40 Ml/d to meet demands in Lincoln. Conjunctive use of the Trent with existing groundwater sources in Nottinghamshire would probably be needed to maintain supplies when abstractions from the river Trent are restricted.
- iii) A potential increase in the existing transfer of Trent water via the Fosdyke Canal to the Witham Ancholme system is being considered as part of the Regional Water Resources



Strategy by NRA Anglian region. This would meet the long term needs by Anglian Water to meet demands in Lincolnshire and South Humberside and would be a possible strategic option to support abstractions for public supply elsewhere in the region plus demands by other water users, principally for irrigation.

iv) An abstraction from the lower reaches of the Trent as a possible, but not preferred, future option to supply the Doncaster area.

Investigations are also taking place into possible ways to augment the river Trent when it would otherwise fall below any prescribed flow that may be set, including water transfers from the river Severn and the potential use of Birmingham groundwater.

## 7.2 Spray Irrigation

Most of the water abstracted from rivers and groundwater for use by agriculture is for spray irrigation. Unlike many other uses virtually all water used for spray irrigation is lost, either by evaporation or crop transpiration. It is a recognised legitimate use of water resources providing benefits to farmers by increasing crop yields, improving the quality of produce and aiding the planning of harvest dates, all of which growers demand to aid market competitiveness. Also with diversification of agriculture and the development of leisure facilities an increasing number of applications are being received for irrigation of golf courses. All applications for new licences are critically examined by the NRA to ensure that the use is reasonable and that the quantities applied for are not excessive taking into account the proposed use and acreage to be irrigated.

Although less than 2% of annual licensed water resources, abstractions for spray irrigation can have a major impact on the water environment because:

- Demands are largely restricted to the summer period and will always be greatest during critical drought years when available surface water resources are scarce. For example, during June and July of the recent dry summers of 1989 and 1990 abstractions for spray irrigation are estimated to have been more than 200 Ml/d over the region, equivalent to the quantity of water required to supply Warwickshire twice over.
- Demands are not uniformly distributed regionally but are concentrated in the areas of sandy or lighter soils such as Nottinghamshire, North Shropshire, parts of the West Midlands, and the Vale of Evesham. The combined impact of a number of irrigators in a single catchment can be significant and the available resource can be temporarily diminished to the detriment of other water users and the aquatic environment.

In many catchments there are insufficient resources to meet the demands for spray irrigation in a dry year. For example, in parts of Nottinghamshire where there has been overabstraction from groundwater for public water supply for many years there is virtually no baseflow left in local watercourses and it is now policy not to grant further groundwater licences.

In line with the general licensing policy for surface water most new spray irrigation licences include conditions which allow the NRA to restrict or prohibit abstraction when the river flow measured at a control point falls below a prescribed value (see Section 5 on P.7). As the quantity of water licensed in a given catchment has increased it has been necessary to progressively raise restriction thresholds in order to protect the rights of existing abstractors. This has meant that in some

catchments thresholds are now so high that any new licences would be of limited benefit to farmers and it is now policy not to grant licences beyond a third restriction level. These restrictions are illustrated in Figure 3, on P.8.



*Spray irrigation  
raingun operating  
along a travel lane*

It is difficult to forecast future demands for spray irrigation with, in particular, uncertainties as a result of EC farming policy and the possibility of climate change. Trends in the demands for new licences are generally reactive to the dryness of recent summers. There has however been a steady increase in the number of licences issued year by year and the NRA is currently involved in a number of initiatives aimed at obtaining a better picture of existing and forecast demands in order to plan future water resources. A national project has recently reported that under the expected agricultural policy, the most likely forecast is that there will be a growth in demand of 1.6% per annum from 1996 to 2001 and 0.6% per annum from 2001 to 2021. However, actual usage may be constrained by restrictions on water availability, for whatever reason. We are also working with farmers who are installing data loggers on a number of irrigation meters in order to obtain more detail of actual water use.

There are several ways in which optimum use can be made of the existing resources available for irrigation and initiatives that the agricultural community can pursue in order to ease problems in areas where resources are limited. These are explored further in Appendix 3.

### **7.3 Agriculture/Domestic**

The demand in actual resources terms for general agricultural and domestic use is small. Abstractions are mostly less than 20m<sup>3</sup>/day, and do not therefore need a licence. There are however a considerable number of abstractions, which need to be safeguarded whether licensed or exempt and their existence can place constraints on resource developments. For example, they often rely on shallow wells or springs as sources of supply and are very sensitive to variations in the local water table and therefore vulnerable to groundwater development. Many farms rely on stream and river flows for livestock watering and general agricultural use. This again can limit potential use by others.



In real terms therefore the use of water for agriculture and domestic purposes can impose a demand upon resources that is greater than first appears from licensed abstraction figures.

Regional demand for resources for fish farming is small and is not expected to change. However, the high rates of throughflow required can impose limits on other developments. Appendix 4 discusses further the issues raised by large, non-consumptive demands.

#### **7.4 Electricity Generation**

The need for water for cooling at power generating stations is a major demand on resources. Most of the demand for cooling water is in the Trent catchment, where it accounts for 46% of total licensed abstractions. The consumptive use by power stations is however much less than their licensed abstractions as most of the water is returned to the river. Consumptive use depends on the cooling process used by the power station. Direct cooling uses large volumes of water, but virtually all is returned to the river. Evaporative cooling requires smaller volumes of water but consumption is high due to evaporative losses from cooling towers. Most modern stations tend to employ evaporative cooling.

Although actual abstraction is less, the licensed quantities at a number of power stations on the lower reaches of the Trent exceed the flows in the river in dry weather. These are sites which generally operate by direct cooling methods and therefore actual consumption of resources is low. But, in having to protect the licensed quantity, these licences totally dominate the allocation of available resources in the Trent catchment.

The recent privatisation of the industry has led to ongoing operational changes at power stations. These reduce water need and bring about changes in the pattern of generation within the network which means the current licences at each site may not be the most appropriate.



*The cooling towers at Ironbridge Power Station on the river Severn*



Power station licences therefore need to be reviewed and the NRA has already commenced discussion with the industry. In reviewing the licences the NRA will be seeking reductions in quantities in line with current and anticipated needs. Should it prove to remain necessary following re-negotiation of the licences the NRA will also be seeking to agree an approach to future licensing of upstream developments where these might theoretically impinge. These issues are explored more thoroughly in Appendix 4.

### 7.5 Hydropower

There are opportunities for development of new hydropower schemes within the region both at existing impoundment reservoirs and low head installations at new or existing river weir sites. As a pollution free operation hydropower is generally recognised as environmentally friendly and a renewable source of energy and as such the NRA will aim to be responsive and adopt a constructive approach when considering any new proposals.

There are a number of non-water resources issues of concern to the NRA associated with any new hydropower developments. It is important, therefore, that schemes are properly designed and managed if they are not to be damaging to the river environment. Appendix 4 gives further comment on the region's approach to the licensing of hydropower sites.

### 7.6 Industry

Since the early 1960s there has been a progressive and significant decline in industrial activity resulting in a marked reduction in licences for direct industrial abstraction and in actual abstraction. Heavy industry especially has shown a distinct downturn primarily in the major industrial cities such as Birmingham, Wolverhampton and Nottingham. The only abstractions which have kept relatively constant are those associated with the food and drink industries. This downward trend is in marked contrast to other sectors, such as public water supply and spray irrigation for example, where demand is steadily increasing.

Due to the current low rate of new industrial development and pessimistic economic projections that this will not significantly increase in the next few years it is considered that the demand for new industrial licences, whether surface or groundwater, will be minimal. It is anticipated that more licences will be relinquished than issued in the next five years in the industrial sector. A significant reduction in licences is anticipated in the coal industry as mines are closed. Further reductions are also anticipated in some sectors of the heavy industries associated with processes such as metal finishing.

As far as new industrial licence applications are concerned these will be considered on their merits and will be treated in the same way as any other application. It is envisaged that most of the applications will relate to groundwater rather than surface water because of its associated reliability and quality.



*"The NRA encourages existing industry to develop groundwater sources in some areas of Birmingham, Wolverhampton and Nottingham so as to arrest the rise in groundwater levels within the sandstone aquifer."*



"The NRA will also seek to reduce existing large industrial licences which are not used or only to a small extent; the retaining of these licences can sometimes inhibit the granting of new licences in the same vicinity."

## 8. National Water Resource Demands

The region is already a major net exporter of resources to other regions. This is summarised in table A.4.

Table A.4: Water Resources Exported from the Severn-Trent Region.		
Recipient NRA Region	Transfer	Quantity (Ml/d)
North West	Lake Vyrnwy to Merseyside	200 - 220
Northumbrian / Yorkshire	Derwent Valley Reservoirs to Sheffield.	40 - 60
	Ogston Reservoir & other E.Midlands sources to Chesterfield.	75 - 80
	Notts. Groundwater to Doncaster	60 - 65
Anglian	Notts. Groundwater to Lincoln. River Trent to Lincoln, Grimsby & South Humberside (intermittent)	30 - 40 180 Max.
South West & Wessex	River Severn to Bristol via the Gloucester & Sharpness Canal	190

### 8.1 National Proposals

As well as considering demands within the region, the NRA is looking at future water resources at the national level. At this strategic level, the South and South East of England are of particular concern as they:

- have the highest anticipated increase in demand;
- receive the lowest rainfall;
- already have highly developed resources;
- have the most low flow problems associated with overabstraction.

A National Water Resources Strategy document was published for discussion in March 1992. The preferred NRA strategy for the future development of water resources to meet the needs of public water supply, industry and agriculture is expected to be produced early in 1994. This National Strategy will look at a number of scenarios related primarily to different demand forecasts over the next 30 years.

A number of strategic resources options are being explored in collaboration with the water companies. These relate to sources of additional water and to schemes for distribution. With its

**Table A.5: Major Resource and Transfer Options within the National Water Resources Strategy**

Major Resource Options		
Ref. to Figure A.12	Schemes directly affecting Severn-Trent region	Schemes indirectly affecting Severn-Trent region
1	Redeployment of Vyrnwy Reservoir	Kielder Reservoir
2	Enlargement of Craig Goch Reservoir	New Reservoir in Anglian Region
3	River Trent	New Reservoir in Oxfordshire for Thames Water
4	Temporary Use of Carsington Reservoir	
Major Transfer Options		
Ref. to Figure A.12	Schemes directly affecting Severn-Trent region	Schemes indirectly affecting Severn-Trent region
5	River Severn to River Trent	Kielder to Anglian Region
6	River Severn to River Thames	
7	River Severn to Wessex Region	North West to South and East via British Waterways (BW) Canal System
8	Craig Goch to River Severn	
9	River Trent to Anglian Region	

**Figure A.12:**  
**Schematic Showing National Resource & Transfer Options.**



central position, this region will play a key role in these studies. A list of the major resources and transfers under consideration are given in Table A.5 and shown diagrammatically in Figure A.12.

Not all the options involve this region directly but may have an indirect effect because of their strategic nature. They are discussed in more detail below.

### **National Strategic Resource Developments**

#### **i) Vyrnwy Redeployment / Craig Goch Enlargement**

Vyrnwy reservoir is principally operated as a direct supply reservoir to North West Water. It has been proposed, however, that the yield of Vyrnwy could be partially redeployed for regulation of the Severn. The redeployment of Lake Vyrnwy would have implications for water supplies within the North West of England and these are also being investigated. An enlarged Craig Goch reservoir could also be used to provide increased regulation of either the river Wye or, via catchment transfer arrangements, the river Severn. This could in turn support transfers to the river Trent or Thames catchments.

#### **ii) River Trent / Temporary use of Carsington**

The use of the river Trent for potable supply has only been made possible by the significant improvement in water quality since the mid 1970s. The river quality at Torksey is now such that it may be suitable, after treatment, for potable water supply. Although the river Trent has not in the past been used for potable water supply it has been extensively used for other purposes, notably for effluent dilution, for power station cooling water, as a good coarse fishery and for navigation. The needs of existing users have to be taken into account before new licences for abstractions can be granted. This will entail defining prescribed flows for different reaches of the river Trent. The resource value of the Trent could be enhanced by regulation, with the use of a Severn to Trent transfer link.

There is also the possibility of the temporary use of Carsington to support any downstream abstraction. The duration and magnitude of this support would depend on the increase in the existing demands on Carsington.

#### **iii) Other Resource Options**

Outside of the Severn and Trent basin there are three other major resource options being investigated as part of the National Strategy. Two new reservoirs, one in Anglian region and one in Oxfordshire, and the existing Kielder Reservoir. Up to 525 Ml/d of unallocated yield is estimated as available for export from the river Tees, supported when necessary by the transfer of augmentation releases from Kielder. In Anglian region two potential sites for a pumped storage reservoir, at Great Bradley or Shrubhill, in Norfolk, are being investigated. A proposal by Thames Water Services for a 150,000 Ml pumped storage reservoir near Abingdon would be the second largest reservoir in the country after Kielder, should it be developed.

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## National Strategic Water Transfer Schemes

### i) Severn to Trent Transfer

The feasibility and possible route for a raw water transfer between the river Severn and the river Trent has been investigated. This has concentrated on the engineering feasibility of the link, the environmental implications and how often the flows in the Trent would have to be supported. The source of the additional augmentation required to support such a transfer was not investigated as part of this study. The benefit of such a link is that it could provide an alternative route to transfer water from the north and west to the south and east if combined with a Trent to Anglian transfer as in (v) below. The preferred route for a Severn to Trent transfer would run from near Ironbridge to the river Penk or to the river Trent downstream of the river Sow confluence.

### ii) Severn to Thames Transfer

Studies into possible routes for a raw water transfer between the river Severn and the river Thames suggest a preferred location for the intake on the river Severn is at Deerhurst, below Tewkesbury. If not supported by a new source development such as Craig Goch, transfers would have to be limited to periods of higher flows. Detailed studies of flow and quality for the estuary indicated that minimum flows in the range of 2,500 - 4,000 MI/d at Deerhurst would need to be protected. This would severely limit an unsupported abstraction in the summer months. Studies are in hand to more firmly establish the most appropriate minimum flow to the estuary.

### iii) Craig Goch to River Severn Transfer

An enlargement of Craig Goch offers the potential to transfer water to the river Severn to support downstream demands including the possible transfers to the Trent and Thames basins. This would require a tunnel which could either outfall to the river Dulas or directly to the the river Severn at Llanidloes.

### iv) River Severn to Wessex Region

The Severn to Wessex region transfer has already been discussed in Section 7.1 on P.A1 as the additional abstraction for Bristol Water via the Gloucester and Sharpness Canal. It is anticipated that this licenced increase would be supported by the continued development of the Shropshire Groundwater Scheme.

### v) Trent to Anglian Transfer

The NRA Anglian Strategic Options Study investigated the feasibility of increasing the existing Torksey abstraction by up to 600 MI/d and transferring the water southwards by a series of river transfers and pipelines. As with the Severn estuary an estimate of the residual flow requirement to the Trent / Humber estuary has had to be made to enable the operation and yield of an increased abstraction at Torksey to be assessed. Preliminary estimates suggest that this residual flow requirement would be in the range of between 1750 to 2500 MI/d. Initial modelling studies have begun to study the residual flow requirement of the estuary. Further detailed studies will be required in the future. The proposed residual flow requirement on the Trent will limit the time during which any new abstraction would operate unless the river flow could be supported.

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vi) Other Transfer Schemes

British Waterways (BW) are investigating the potential use of canals to transfer water from the north west to the south and east of the country. Also, the possibility of moving water from Kielder to the Anglian region, via river transfers and pipelines, is being studied.

**The Next Stage**

The investigations detailed above are primarily feasibility studies to provide information for the National Strategy. A range of possible options will be studied before a preferred option is put forward, which will include improved demand management. Further, more detailed studies would be required before any new inter-basin transfer scheme was approved, including environmental appraisals.

As part of the above studies the issues of residual flows to estuaries has become increasingly important. Initial estimates for residual flows to the river Severn and the river Trent have been made. However, considerably more work is required before these figures can be finalised.

The final national strategic development framework report is due to be published during April 1994. Following this date there will be a period of full public consultation. All interested parties will be provided with an opportunity to comment on the proposed strategy.





## Section B: Threats to Our Resources

Water resources are limited. It is therefore important to ensure maximum protection to them to secure their future availability. Threats from overexploitation of resources are addressed elsewhere in this strategy. Other threats exist both as physical impacts on the resources and in reducing their quality to a point which restricts, or possibly curtails, their use.

The legislative framework which controls water quality is outlined in Appendix 5.

### 9. Threats to the Resource

#### 9.1 Groundwater Contamination

The main issues facing groundwater quality in the Severn-Trent region are:

- rising nitrate levels from agricultural activities (see Figure B.1);
- chlorinated solvent pollution from industry;
- hydrocarbon contamination from oil storage and usage.

Other sources of pollution are numerous and contamination can arise from the disposal of liquid or solid wastes to land, the redevelopment of contaminated land, direct discharges to groundwater and many other practices relating to the use of land. Some of those practices are under the direct control of the NRA but mostly the NRA has to ensure that the pollution does not occur by liaison with other regulatory bodies or the relevant industries. It is important that the *"Policy and Practice for the Protection of Groundwater"*, as detailed in Appendix 5, is fully implemented by all relevant authorities.

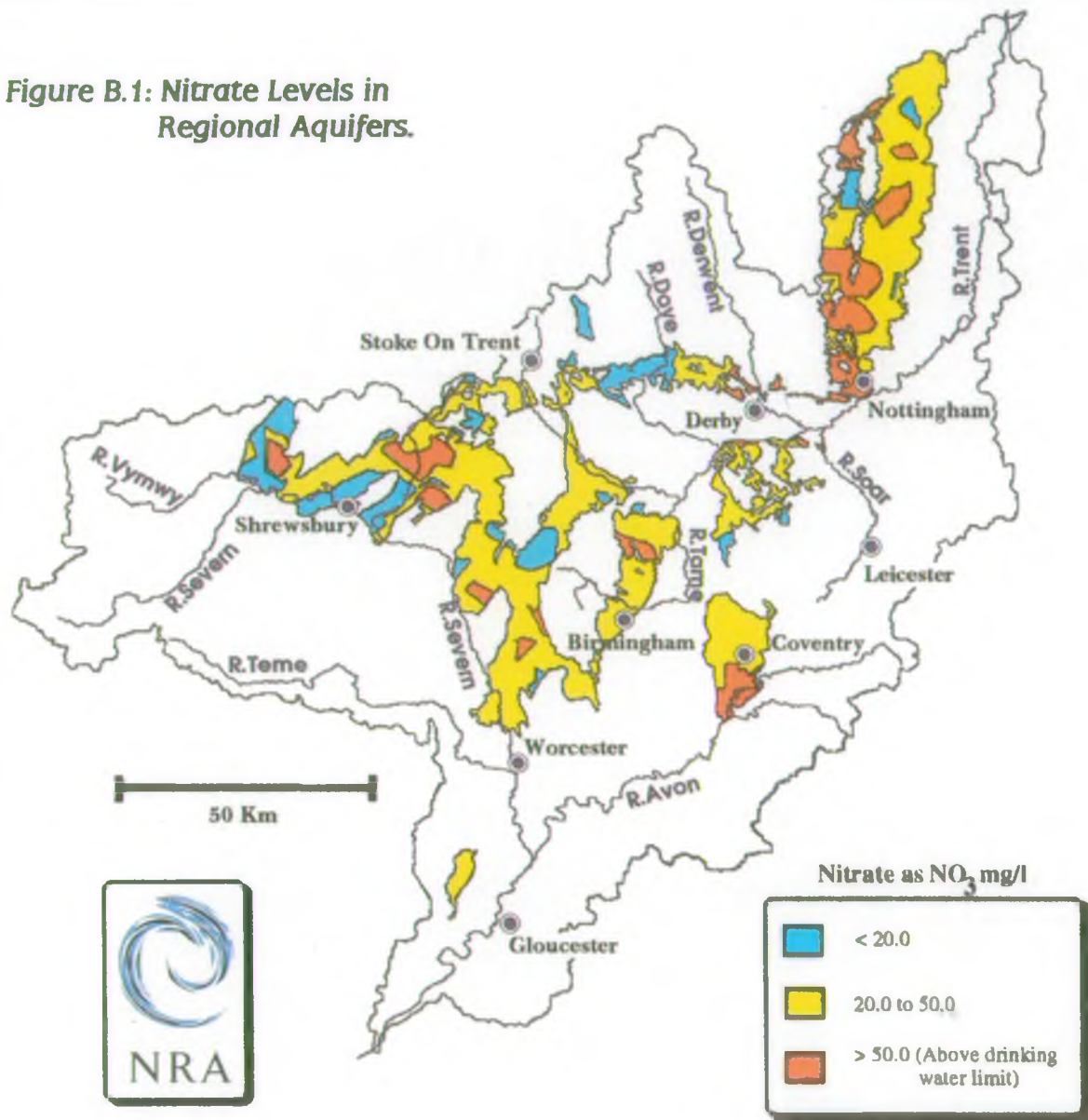


*"The NRA encourages all regulatory bodies, public organisations and others to have full regard to the 'Policy and Protection of Groundwater' as part of their decision making processes."*

#### 9.2 Mineral Extraction and the Disturbance of Aquifers

A number of activities can physically disturb aquifers and groundwater flow. In some cases there is a consequential effect on springs, stream flows and wetlands. The NRA's powers under the Water

**Figure B.1: Nitrate Levels in Regional Aquifers.**



Resources Act 1991 extend only to the control of licensable abstractions and a number of other specific activities which may disturb aquifers and affect groundwater flow. However the NRA's own powers are limited in controlling some aspects of the following:

- quarrying and gravel extraction above and below the water table whether worked wet, or dry by dewatering;
- mining;
- landfill using low permeability materials likely to impede groundwater flow and especially recharge;
- construction of highways and railways;
- any activity which inter-connects naturally separate aquifers.



The NRA recognises the economic importance of these activities. The major raw materials of the minerals industry often come from major aquifers, especially for the construction industry, and there are therefore potential conflicts of interest. In addition many of the major aquifers in Nottinghamshire, Staffordshire and Warwickshire lie on Coal Measures which have and are being extensively exploited. The dewatering of mines can impact upon groundwater resources but, just as importantly, the closure of mines and decline in long standing dewatering activities can also have a number of consequences:

- reduced flows in watercourses which previously received water from dewatering. Sometimes this can affect the ability to abstract downstream and has quality implications where the dilution of effluents discharging to the system is lost;
- uncontrolled polluted mine overflows where water levels in old workings begin to rise as dewatering activity decreases.

*"The NRA seeks to be actively involved in liaison with:*



NRA

- Mineral Planning Authorities.
- Public and Private Promoters of Transport Schemes.
- Waste Regulatory Authorities & Industry.
- Drilling Organisations Mining & Mineral Exploration Companies."

### 9.3 Urbanisation

Clearly increased urbanisation is part of our future. It is NRA policy to try to ensure that any urban development has a minimum impact on the aquatic environment and, in an effort to prevent problems that can be caused by urbanisation, the NRA takes an active part in the local consultation process with planning authorities. To support this we have developed a set of model policies for use in development plans entitled *"Guidance Notes for Local Planning Authorities on the Methods of Protecting the Water Environment Through Development Plans."*



NRA

*"The NRA encourages planning authorities to have regard to the NRA Guidance Notes and to incorporate appropriate policies into structure and local plans."*

Without adequate consultation, urbanisation can raise serious problems. For example, the soil's unsaturated zone provides a buffer which serves to delay and attenuate flood peaks as well as sustaining baseflows during dry periods. If the unsaturated zone is 'capped' by urbanisation then the catchment may be prone to lower flows in the summer months. Groundwater recharge may also be reduced as flows quickly drain to rivers. In some areas this can be of particular concern.

More and more there is a likely need to turn to urbanised rivers to meet future demands for water supply demand. This can be considered as river water quality standards continue to improve. However, in so doing, the need to protect the improved quality becomes critical to ensure security



of supplies. This has implications in terms of:

- discharge consents and effluent treatment standards, with the possible need to comply with the EC Urban Wastewater Directives;
- measures necessary to control pollution caused by runoff in urbanised areas;
- the need for higher standards of pollution prevention.

It is important that any problems are identified early in the planning process. Measures can then be introduced or development relocated to areas of lesser and more acceptable impact.

#### **9.4 Afforestation**

Although the NRA supports the principle of community and commercial afforestation, consultation is required to avoid any detrimental effect on the aquatic environment. Figure B.2, shows some of the currently proposed forestry initiatives in the Severn-Trent region.

There are two main instances where these impacts become important:

- preparation of land, planning and final development of forests;
- management practices associated with forests.

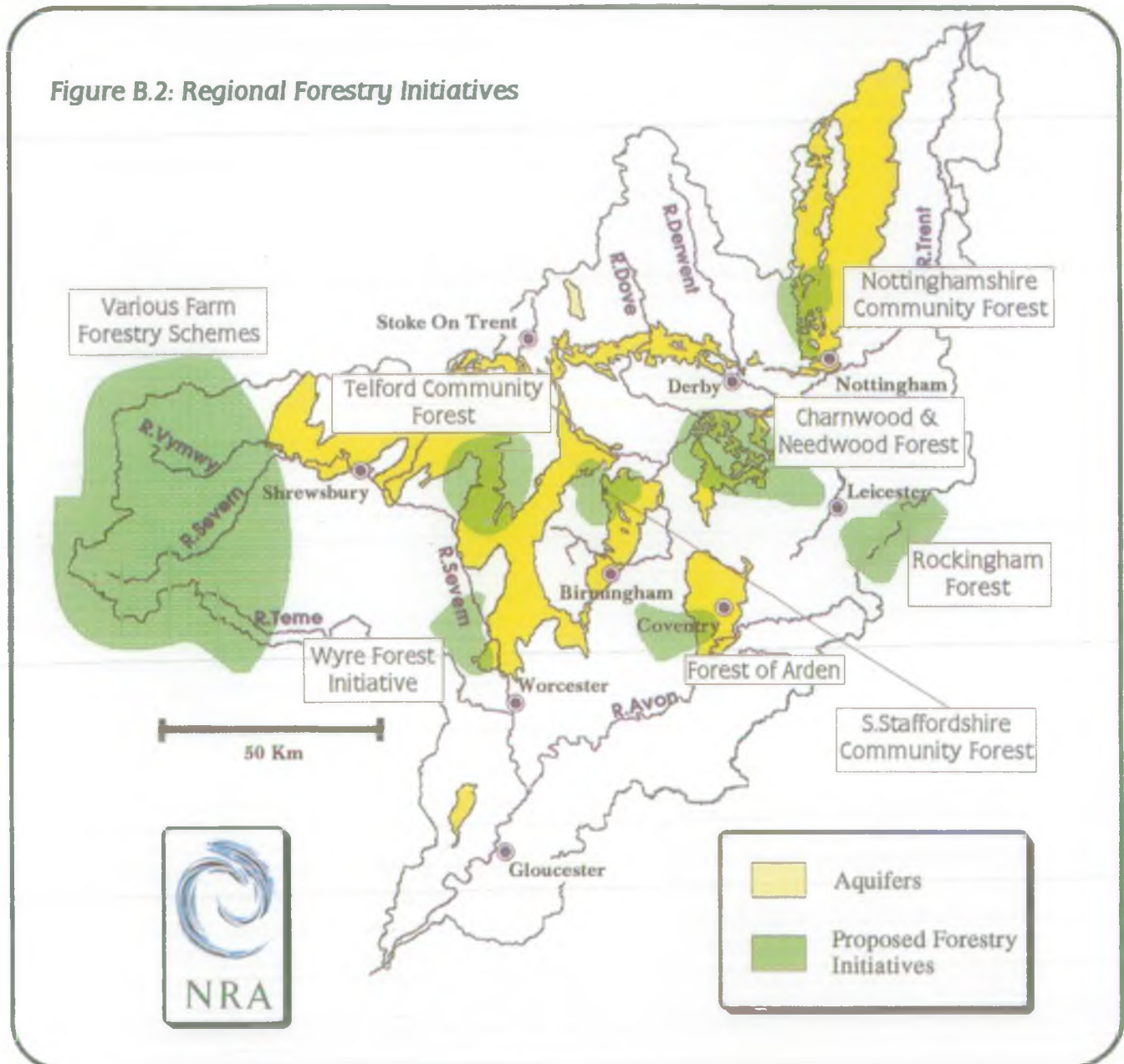
**Afforestation in an  
Upland Catchment**



Both can have a major impact on a catchments response to rainfall and the quality of runoff.

Studies indicate that yield can be reduced by up to 17% if planting strategies and species selection are not carefully considered. This is especially important in catchments where water yields are critical.

**Figure B.2: Regional Forestry Initiatives**



"The NRA encourages full consultation on forestry location to ensure current and future water resources are not jeopardised."

In general the impact of afforestation depends on the type of trees being planted and the vegetation being replaced. For example, if broadleaf planting replaces grassland then the overall effect can be beneficial in water resources terms but not necessarily if broadleaf planting replaces cereal crops. Similarly, replacement of fertilised agricultural land by forest can reduce nitrate leaching. This is especially important when planting occurs over open aquifer near public water supply boreholes. Generally, broadleaf planting is preferable to coniferous and should have less impact on water quality and quantity.





## Section C: Opportunities

### 10. Influencing demand

#### 10.1 Demand Management for Public Water Supply

The provision of all water resources involves a cost, both financial and environmental. Therefore, against a background of population growth leading to increasing demand for water, it is important that these demands are managed to keep them as low as is reasonably practicable.

Management initiatives include both leakage control and metering. These have a cost in themselves and the NRA recognises the need to keep a balanced view of demand management costs versus water resource development costs. The latter should, however, always include the true environmental costs.

##### i) Leakage

By minimising leakage, existing and future levels of demand can be reduced. Keeping demand down in this way has an important part to play in reducing the need to develop new water resource schemes and new sources and hence in moving towards sustainable use of resources and environmental protection. Leakage is also costly in supply terms since costs incurred in treating and supplying water are wasted.



*"The NRA expects that leakage should be reduced to economic levels and in considering applications for increases in public water supply abstraction will expect water companies to be taking steps to reduce leakage, especially in areas where levels are high."*

##### ii) Metering

National metering trials are ongoing, but so far indicate that domestic consumption can be reduced by 10%. Peaks in demand due to garden watering for example, can be reduced by as much as 30%. Experience in other countries suggest that, over a period, metering brings about significant changes in consumers' water use habits, to the extent that water saving appliances are widely used. This has an important role in keeping demands as low as possible.



*"The NRA encourages the installation of meters in all new properties and a policy of selective metering for areas where water resources are particularly under stress."*

## **10.2 Minimising Use**

### **i) Domestic**

Consumers can play a part in reducing demand by reducing their own use of water. This can be done by changing the way in which water is used.



*"The NRA supports moves towards use of water efficient domestic appliances to reduce per capita consumption."*

### **ii) Agriculture**

Section 7.2 on P.A18 describes the difficulties facing farmers who require water resources for spray irrigation. With spray irrigation demands usually occurring when resources are least available, it is critical that farmers use what resources do exist sensibly and efficiently. By investing in both efficient irrigation equipment and new irrigation practices all members of the agricultural community should be able to benefit from the limited resources available.



*"The NRA encourages the development of methods of spray irrigation which make more effective use of water resources."*

## **10.3 Recycling**

The re-use of water can play an important role in optimising the use of our limited resources. When ever possible 'used' water should be returned to the river as close as possible to the point of abstraction. If quality can be maintained then this previously 'used' water can be abstracted further down stream.



*"The NRA will have regard to where water will return to the system when considering abstraction proposals."*

## 10.4 The National Abstraction Charging Scheme

A new national scheme of abstraction charges was introduced on 1 April 1993 and provides a consistent basis for charges across England and Wales. It is designed taking some account of the impact of a particular abstraction on the water environment.

In the new scheme the charge is calculated using an equation which is the product of a number of factors reflecting the impact of the water use. It provides limited incentives for good water resources management by encouraging a potential abstractor not to apply for a greater licensed quantity than necessary, incentives for abstraction when resources are more plentiful and charging less for lower net consumption of water. How the scheme might be developed to provide for even more incentive charging is currently being considered at the national level.

## 11. Conjunctive Use

The optimisation of yields of any water resource system can be achieved by conjunctive use of surface and groundwater sources within water catchments. Whilst in terms of cost to the water user it is often more economic to operate groundwater and surface water systems as distinct separate supply sources this, in many cases, does not result in the best usage of scarce water resources.

### **Conjunctive Use**

*Clywedog Reservoir and the Shropshire groundwater scheme are used conjunctively to augment flows in the river Severn.*



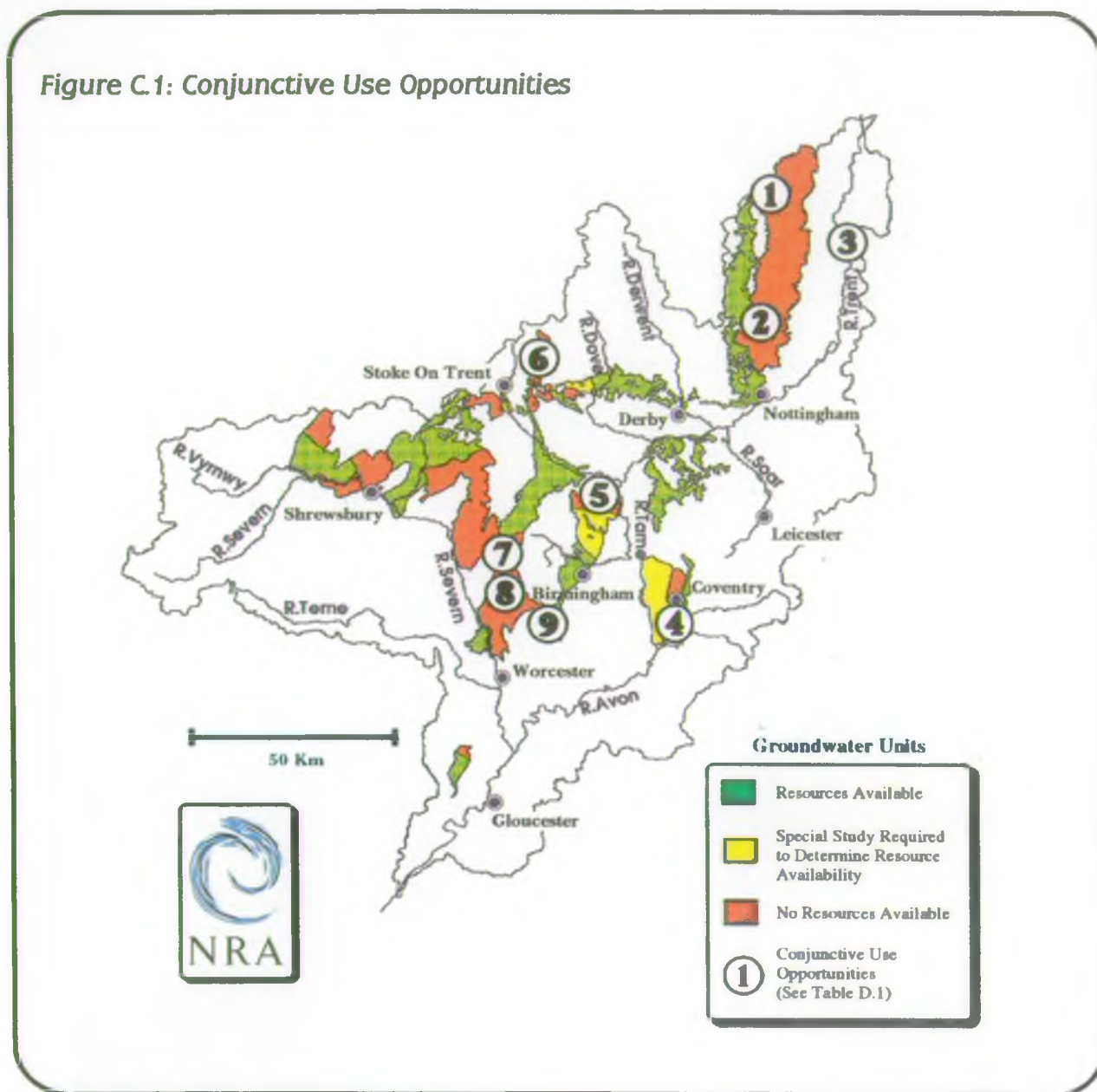
**Clywedog Reservoir**



**Shropshire groundwater  
outflowing to a river in the  
Severn catchment.**



Figure C.1: Conjunctive Use Opportunities



For example, many aquifers are pumped on a continuous basis whilst for some periods of the year there is excess surface water resources either in reservoirs and/or rivers. Where aquifers are heavily overpumped, conjunctive use offers an opportunity to make use of the surplus winter resources.

Aquifers can be partially rested in the winters, which will result in improved aquifer sustainability both in terms of safe yield of sources and protection of the groundwater based environment. It can also provide opportunities to increase short term peak utilisation of some groundwater sources during the summer period providing that there is an overall reduction in annual abstraction, with operational advantages.



*"The NRA encourages the better usage of groundwater and surface water with emphasis being placed on greater use of surface water during the winter months when there is generally ample water to meet both supply and environmental requirements."*

The presence of multiple aquifers and surface reservoirs in this region make this policy particularly

**Table C.1: Conjunctive Use Opportunities**

Reference	Area	Ground Water Units	Surface Water Sources
1	Doncaster	Doncaster	River Trent, Surface Water From Yorkshire Region
2	Central & South Nottinghamshire	Ranskill, Clumber, Clipstone, Blidworth	River Derwent (Carsington Reservoir)
3	Central Nottinghamshire	Ranskill, Clumber, Clipstone, Blidworth	River Trent
4	Coventry	Coventry (Perno-Carboniferous)	River Severn, River Leam (Draycote Reservoir)
5	Lichfield & Rugeley	Lichfield, Shenstone, Rugeley	River Severn, Blithfield Reservoir and River Trent
6	Stoke-on-Trent	Leek, Forsbrook, Tean	Tittesworth Reservoir
7	Wombourne, Stourbridge & Kidderminster	Cosford, Wombourne, Stourbridge, Kidderminster	River Severn
8	Cosford & Kidderminster	Cosford, Wombourne, Stourbridge, Kidderminster	River Severn
9	Bromsgrove	Bromsgrove	River Severn

suitable and some conjunctive use of groundwater and surface water already occurs. Examples include:

- The Leek area of Staffordshire where groundwater from the Sherwood Sandstones is used conjunctively with Tittesworth Reservoir by Severn Trent Water.
- Increased river Severn abstraction during recent winters by Bristol Water to rest overstretched Mendip groundwater sources.
- The use of enhanced surface water storage in the Derwent/Carsington/Ogston triangle with reduced pumping of groundwater in Nottinghamshire by Severn Trent Water.

There is great potential for other schemes to be implemented, some of which may require additional infrastructure. In many cases conjunctive use can offer the means to achieve the reductions in use of groundwater identified by the NRA as detailed in Section A. Some of the schemes are listed in Table C.1 and shown in Figure C.1.

Conjunctive use is not restricted to water supply companies. The principles hold good for all users

of water. Some use of the principle has been made by industry and the power generators. Opportunities now exist in some areas for agricultural users to adopt similar practices. These are outlined in more detail in Appendix 3.

As well as already operating the Shropshire Groundwater Scheme conjunctively with Clywedog reservoir to support river Severn flows, the NRA is also investigating pumping groundwater from under the city of Birmingham during periods when flows in the river Trent are relatively low. This could support increases in demand on the water resources of the river downstream of Nottingham and have the added benefit of improving water quality in both the river Tame and the river Trent.

## 12. Environmental Appraisals

A common feature of the issues which have come to light during the consultations leading up to this strategy has been the extent to which environmental issues have been perceived as forming an integral part of the assessment of types of water use.

The precise level of environmental appraisal required for any development proposal depends on local circumstances. This approach is used in assessing the environmental implications of local developments. Major schemes are likely to be subject to full assessment procedures.



NRA

*"The NRA will ensure that the full environmental implications of water development proposals are identified."*

## 13. Integrated Catchment Management Plans (CMP)

The Catchment Management planning process aims to produce an agreed strategy for realising the environmental potential of a catchment within prevailing economic and political constraints. They offer an important opportunity to ensure resources are managed to the best overall advantage. The Water Resource Strategy is one of the fundamental building blocks of any CMP. The CMP process involves the NRA and all groups with an interest in the water environment of a catchment. The plan brings together all the NRA's roles in managing a catchment together with all the water based uses of that catchment.

Severn-Trent region produced its first CMP for the Worcestershire Stour catchment in 1992. These plans are produced in two stages: initially a plan is produced for consultation; following consultation a final action plan is produced, setting out the agreed means for bringing about improvements within the catchment.



NRA

*"A CMP will be produced for all catchments within the region. Water Resources issues will be reviewed in the context of full catchment needs by this process."*





## Section D: The Way Forward

Existing water demands in the region are, for the most part, now met with only a few occasions when public use of water is restricted and these are to a limited extent.

The aim of this strategy is that this situation should continue and where possible improve while ensuring environmental and other interests are preserved.

The NRA has a central role in achieving this, but there are other players. If the strategy is to be fully implemented it needs the commitment and cooperation of others. This includes us all as water consumers, but principally the water supply industry, industry generally, the agricultural community and other public organisations and authorities.

It is the intention that the strategy will be modified and updated as necessary, reacting to changing circumstances and needs.

In summary the key proposals and policies are:

Key proposal or Policy	Relevant section
<b>The Regional Water Resources Strategy</b>	2.
<i>"This strategy will ensure we meet the NRA's statutory duties and objectives with regard to Water Resources"</i>	
<b>Regional Licensing Policy</b>	5.
<i>"When determining any licence application we will:</i>	
<ul style="list-style-type: none"> <li><i>ensure the abstraction will not be in excess of the renewable resources;</i></li> <li><i>consider the effects on other abstractors and will not allow abstractions which derogate existing rights and other protected rights to abstract unless suitable arrangements are agreed;</i></li> </ul>	

Relevant section	Key proposal or Policy
	<ul style="list-style-type: none"> <li>consider the impact on river flows, especially ensuring flows are not reduced to unacceptably low levels;</li> <li>consider the potential effect on wetlands and pools, and not allow abstractions which would be damaging or otherwise unacceptably affect them."</li> </ul> <p>"In those units which are already overlicensed the NRA will take opportunities to redress the imbalance."</p>
<b>7.6</b>	<p><b>Industrial abstraction licences</b></p> <p>"The NRA encourages existing industry to develop groundwater sources in some areas of Birmingham, Wolverhampton and Nottingham so as to arrest the rise in groundwater levels within the sandstone aquifer"</p> <p>"The NRA will also seek to reduce existing large industrial licences which are not used or only to a small extent; the retaining of these licences can sometimes inhibit the granting of new licences in the same vicinity."</p>
<b>9.1</b>	<p><b>Groundwater Contamination</b></p> <p>"The NRA encourages all regulatory bodies, public organisations and others to have full regard to the 'Policy and Practice for the Protection of Groundwater' as part of their decision making processes."</p>
<b>9.2</b>	<p><b>Mineral Extraction and the Disturbance of Aquifers</b></p> <p>"The NRA seeks to be actively involved in liaison with:</p> <ul style="list-style-type: none"> <li>Mineral Planning Authorities.</li> <li>Public and Private Promoters of Transport Schemes.</li> <li>Waste Regulatory Authorities &amp; Industry.</li> <li>Drilling Organisations &amp; Mineral Exploration Companies."</li> </ul>
<b>9.3</b>	<p><b>Urbanisation</b></p> <p>"The NRA encourages planning authorities to have regard to the NRA Guidance Note and to incorporate appropriate policies into the structure and local plans."</p>
<b>9.4</b>	<p><b>Afforestation</b></p> <p>"The NRA encourages full consultation on forestry location to ensure current and future water resources are not jeopardised."</p>

Key proposal or Policy	Relevant section
<p><b>Demand Management for Public Water Supply</b></p> <p>"The NRA expects that leakage should be reduced to economic levels and in considering applications for increases in public water supply abstraction will expect water companies to be taking steps to reduce leakage, especially in areas where levels are high."</p> <p>"The NRA encourages the installation of water meters in all new properties and a policy of selective metering for areas where water resources are particularly under stress."</p>	10.1
<p><b>Minimising the Use of Water</b></p> <p>"The NRA supports moves toward the use of water efficient domestic appliances to reduce per capita consumption."</p> <p>"The NRA encourages the development of methods of spray irrigation which make more effective use of water resources."</p>	10.2
<p><b>Recycling of water</b></p> <p>"The NRA will have regard to the point that water will return to the system when considering abstraction proposals."</p>	10.3
<p><b>Conjunctive Use</b></p> <p>"The NRA encourages the better usage of groundwater and surface water with emphasis being placed on greater use of surface water during the winter months when there is generally ample water to meet both supply and environmental requirements."</p>	11.
<p><b>Environmental Appraisals</b></p> <p>"The NRA will ensure that the full environmental implications of water development proposals are identified."</p>	12.
<p><b>Integrated Catchment Management Plans (CMP)</b></p> <p>"A CMP will be produced for all catchments within the region. Water resources issues will be reviewed in the context of full catchment needs by this process."</p>	13.
<p><b>Wetlands</b></p> <p>"The NRA is committed to protecting existing wetlands and also identifying and investigating problems already caused by over abstraction."</p>	App 1.4



Relevant section	Key proposal or Policy
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*"Development and licensing of sources will not be allowed to proceed until the NRA is satisfied that environmental damage will not occur."*

### **App. 3**

#### **Spray Irrigation**

*"The NRA will actively consider any proposals for schemes, within licensing constraints, which:*

- make for better use of water;*
- provide fairer allocation of resources;*
- include winter storage;*
- provide environmental benefit."*

### **App. 4**

#### **Non-Consumptive Uses**

*"In considering new proposals for large non-consumptive uses, the NRA will seek to reserve a quantity of water for other uses."*

*"In reviewing licences the NRA will be seeking reductions in quantities in line with current and anticipated needs."*

*"The NRA will encourage the development of hydropower schemes where the promoter can demonstrate that the environmental impact of the proposal is acceptable and does not unduly inhibit existing and proposed legitimate uses of water resources."*

*"The NRA will where necessary seek to include conditions in impounding or abstraction licences and seek operating agreements to ensure a satisfactory method of operation."*

### **Local Resource Strategies**

As a follow up to this regional strategy, a series of local resource strategies will be produced. These will contain a greater level of detail than it is possible to include at regional scale. Ground and surface water characteristics and their use will be covered. The issues as they affect each area will be raised and the way forward identified. The local resource plans will be a fundamental element of the Catchment Management Plans as they are developed.



**NRA**

# **Appendices**

**Regional Water Resources Strategy**

**NRA Severn-Trent Region**

Appendix 1:	Groundwater Management	I
Appendix 2:	Public Water Supply Demand Scenario Assumptions	X
Appendix 3:	Spray Irrigation	XI
Appendix 4:	Non-Consumptive Uses	XIII
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## Appendix One: Groundwater Management

### 1. Classification of Groundwater Management Units for Licensing Purposes

All major aquifers in the Severn-Trent region are divided into groundwater management units. For each unit a licensing policy has been in operation since 1979 with the aim of introducing better aquifer management and with the objective of preventing over abstraction. Groundwater models are now being established to assist the management process and aid licensing decisions; the largest being for the Nottinghamshire/South Yorkshire area where a model is essential to understand the relationship between abstraction in the confined aquifer and the recharge area to the west.

A feature of many units is that not all the quantities licensed are currently being abstracted. This is of particular concern in areas where existing levels of abstraction have already caused environmental problems but is also an issue in areas where the potential level of abstraction exceeds that considered sustainable.

The classification, therefore, considers the long term rate of recharge of each unit relative to both the quantities licensed to be abstracted and the quantities actually being abstracted.

This appendix contains the definitions of each unit classification and a map (Figure Ap.1) which lists all 76 units, their relative position within the region and policy classification.

#### **Classification A: Units with no resources available**

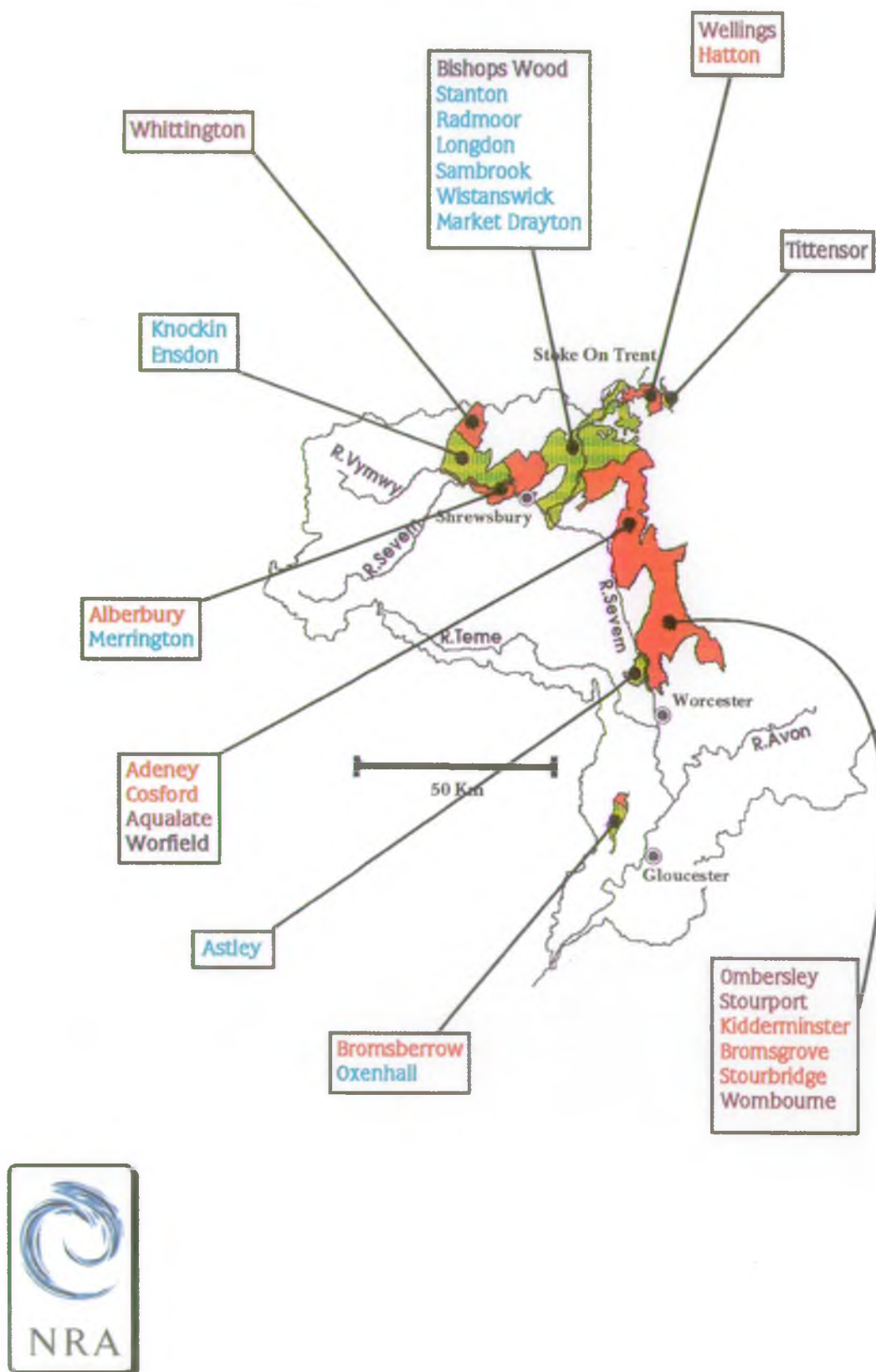
These units are where the licences exceed the long term rate of recharge into the aquifer. There are currently 26 in this category. Units with the greatest density being in Nottinghamshire / South Yorkshire, parts of Staffordshire (especially around Lichfield and to the south of the Potteries) and in the Stourbridge / Kidderminster / Bromsgrove area of the West Midlands. In many cases actual abstractions also exceed the rate of recharge whilst in others abstraction is still below. This classification is subdivided based on the levels of actual abstraction relative to the recharge.

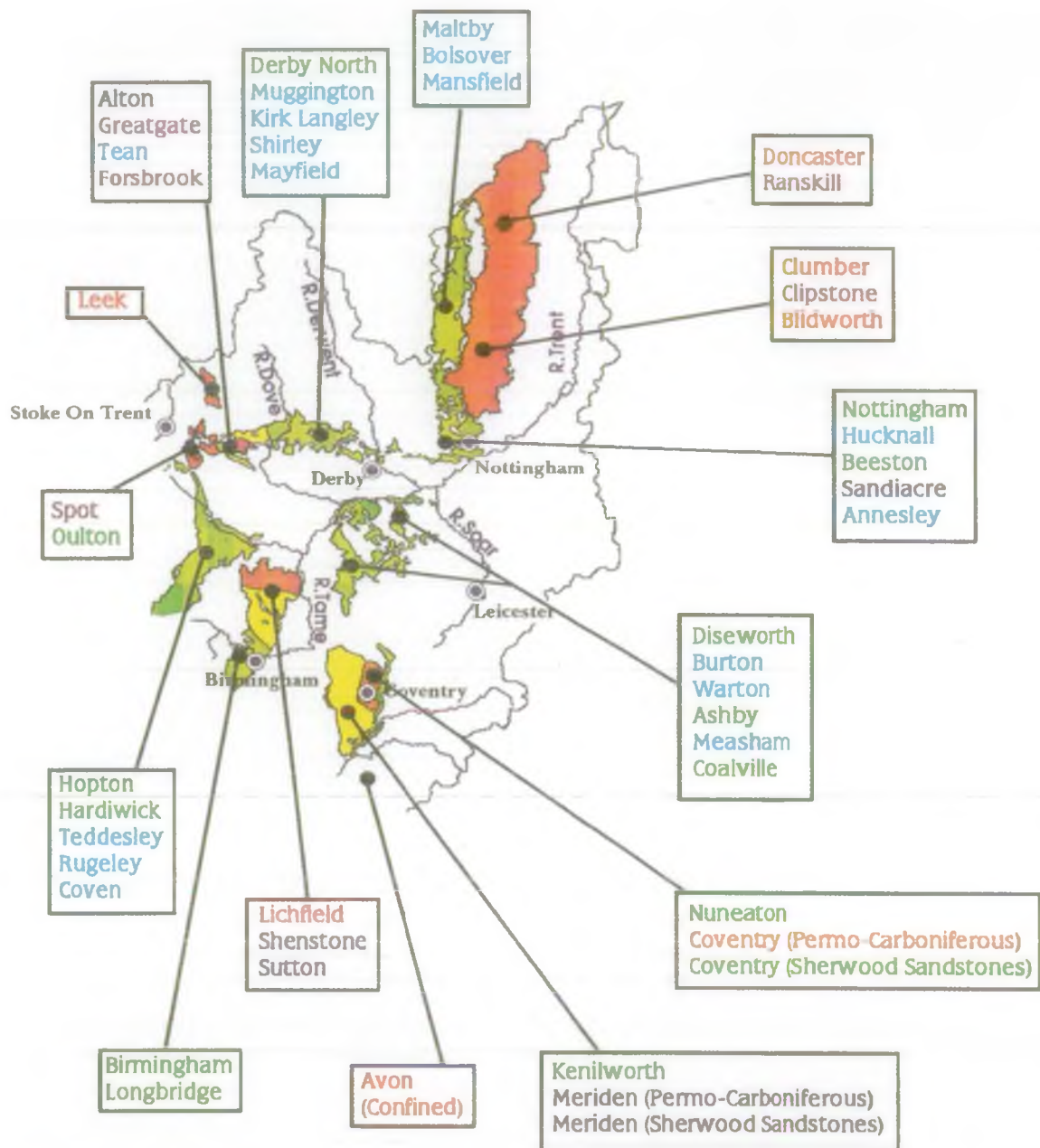
##### **A.1: Units which are overlicensed and overabstracted**

There are 14 units falling into this category and it is the clear policy of the NRA to take every opportunity to achieve a substantial reduction in both licensed and actual abstraction. The objective is to prevent further declines in aquifer levels and with time to see a return of baseflow to watercourses currently either dry or suffering from unacceptably low flows. To achieve a return






Figure Ap.1: Groundwater Units and their Resource Availability





### Groundwater Policy Units

<p> No Resources Available</p> <p><b>Units which are overlicensed and overabstracted</b></p> <p>Units which are overlicensed and underabstracted</p>	<p> Resources Available</p> <p>Units where proposals need to protect baseflow and environmentally sensitive areas</p> <p>Units where there are no potential baseflow or Environmental problems</p>	<p> Special Study Required to Determine Resource Availability</p> <p>Units requiring a special study to determine resource availability</p>
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of baseflow to an acceptable level, the reduction in abstraction must be to a rate below the rate of recharge.

No more new or varied licences that would result in an increase in annual abstraction will be issued; existing licences can only be varied (for example to incorporate new replacement boreholes) provided there is a substantial reduction in annual abstraction, the degree of reduction being governed by the intensity of overabstraction.

Negotiations have been and are taking place with the water companies in order to secure further licence reductions in order to safeguard the aquifer in the long term. Agreements to reduce future abstractions in six management units have already been reached.

Even though already overabstracted, in some units not all of the licensed abstractions are fully utilised and further environmental problems will result if this unused capacity were to be exploited. The NRA will therefore actively discourage licence holders from increasing current rates of abstraction whenever possible.

In many of the units groundwater abstraction can be reduced during periods of high river flows if used conjunctively with nearby surface water sources. Any proposals for conjunctive use schemes resulting in significant reduction in annual groundwater abstraction will be favourably considered. This could include increasing the peak capacity of some borehole sources over a limited period of time - when there are yield constraints associated with surface water sources - provided that the overall package reduced long term groundwater abstraction.

#### **A.2: Units which are overlicensed and underabstracted**

There are 12 overlicensed units in which many licences are not fully utilised. This can be due to a lack of demand and/or quantity/quality constraints. The NRA is concerned that, with time, actual abstraction will increase towards the licensed total resulting in widespread environmental damage. In many units a progressive increase in abstraction since the issue of Licences of Right has already caused some problems. For all units the policy will be the same as for those units where abstraction exceeds the recharge, i.e. no more licences will be issued that would result in an increase in abstraction. In some limited cases consideration may be given to variations to existing licences provided that there is no increase in abstraction. Such variations might include replacement boreholes. In these cases each application will have to be critically assessed with factors such as source location in relation to watercourses and environmentally sensitive areas being taken into account.

Again the conjunctive use of groundwater with surface water resources will be actively encouraged following the same principles outlined for units in A.1 above.

<b>Classification B:</b>	<b>Units with resources available</b>
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Here licensed abstractions are sufficiently less than the long term rate of recharge into the aquifer to allow some further development of resources. There are currently 41 such units and these are mostly distant from the main centres of population and often at the headwaters of watercourses.



The units falling into this classification can be subdivided into:

**B.1: Units where proposals need to protect baseflow and environmentally sensitive areas.**

Due to groundwater development having already been well established in the lower reaches of many catchments, new applications, especially for public water supply, tend now to be concentrated at the headwaters of watercourses where baseflow protection is of paramount importance. In some extreme cases, due to the sensitivity of the area in terms of the effect on flows, the NRA will strongly discourage licence applications. In all but very small applications the NRA will be requesting an environmental report to be submitted by the applicant. Any licences issued will invariably have special conditions attached which may entail the release of compensation flows into watercourses, especially during dry weather. There are 28 units falling into this category.

**B.2: Units where there are no potential major baseflow or environmental problems**

In these units groundwater licences can be favourably considered. Licences can generally be issued without special conditions having to be attached. However, whilst baseflow protection is normally not necessary, it may occasionally be required depending on the location of the proposed abstraction within a specific unit. The 13 units falling into this category are for the most part confined to the lower reaches of catchments.

<b>Classification C: Units which require a special study to assess resource availability</b>
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A small number of units (9) are difficult to categorise without further investigation. The reasons are varied and dependent on factors such as complex hydrogeology within the unit. In such cases each application has to be considered on its merits with no presumption regarding the issue of licences.

<b>Other groundwater resources</b>
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The same basic principles apply to the minor aquifer areas as detailed above. In these areas, however, demand for groundwater development is low and generally there are no objections to licence applications. Some parts of the region, principally in the Upper Severn and Teme catchments, are exempt by special order from the licensing of groundwater sources (except from river gravels). The NRA is considering the continued appropriateness of this exemption in the light of increasing demand for water in these areas.

## 2. Groundwater units where the NRA have identified the need for reductions in abstractions

In some areas where there is a legacy of overabstraction this has had severe effects on river flows and wetlands and created resource problems. The balance must now be redressed. This is a difficult process with often long term objectives, as the only real solution is the development of alternative resources to replace those now being overexploited. These developments can have significant lead in times.

For long term planning purposes, the NRA has identified a number of groundwater units where the objective is to reduce abstraction or, in some cases, to reduce licensed quantities where their potential uptake in the future would cause the unit to be overabstracted. These are detailed in Table Ap.1.

Table Ap1: NRA Identified Areas for Reductions in Groundwater Licences		
Groundwater Unit	Water Company Affected	Comments
Doncaster	Yorkshire	6 MI/d already agreed as part of planned licence reductions, but long term targets are the subject of a joint study with Yorkshire Water
Clumber	Severn Trent / Anglian	
Clipstone	Severn Trent	
Blidworth	Severn Trent	21 MI/d already agreed as part of planned licence reductions
Spot	Severn Trent	
Lichfield	South Staffs.	
Cosford	Severn Trent	
Womborne	Severn Trent / S.Staffs.	
Stourbridge	Severn Trent / S.Staffs.	
Kidderminster	Severn Trent / S.Staffs.	
Bromsgrove	Severn Trent	2 MI/d already agreed as part of planned licence reductions
Bromsberrow	Severn Trent	
		<b>29 MI/d already Agreed</b>

## 3. Short term measures

The long term objectives to reduce abstraction will take some time to achieve. Even having achieved it, recovery of groundwater levels will not occur overnight and there will, in many cases, be a further period before any significant environmental recovery.

# ADDENDUM

Table Ap.1 on page VI in Appendix One has been revised. The table shown below supersedes the table contained in the document.

<b>Table Ap1: NRA Identified Areas for Reductions in Groundwater Licences</b>		
<b>Groundwater Unit</b>	<b>Water Company Affected</b>	<b>Comments</b>
Doncaster	Yorkshire	11 MI/d already agreed as part of planned licence reductions, but long term targets are the subject of a joint study with Yorkshire Water
Clumber	Severn Trent / Anglian	
Clipstone	Severn Trent	
Blidworth	Severn Trent	21 MI/d already agreed as part of planned licence reductions
Spot	Severn Trent	
Lichfield	South Staffs.	
Cosford	Severn Trent	
Wombourne	Severn Trent / S.Staffs.	
Stourbridge	Severn Trent / S.Staffs.	
Kidderminster	Severn Trent / S.Staffs.	
Bromsgrove	Severn Trent	2 MI/d already agreed as part of planned licence reductions
Bromsberrow	Severn Trent	
		<b>34 MI/d already Agreed</b>

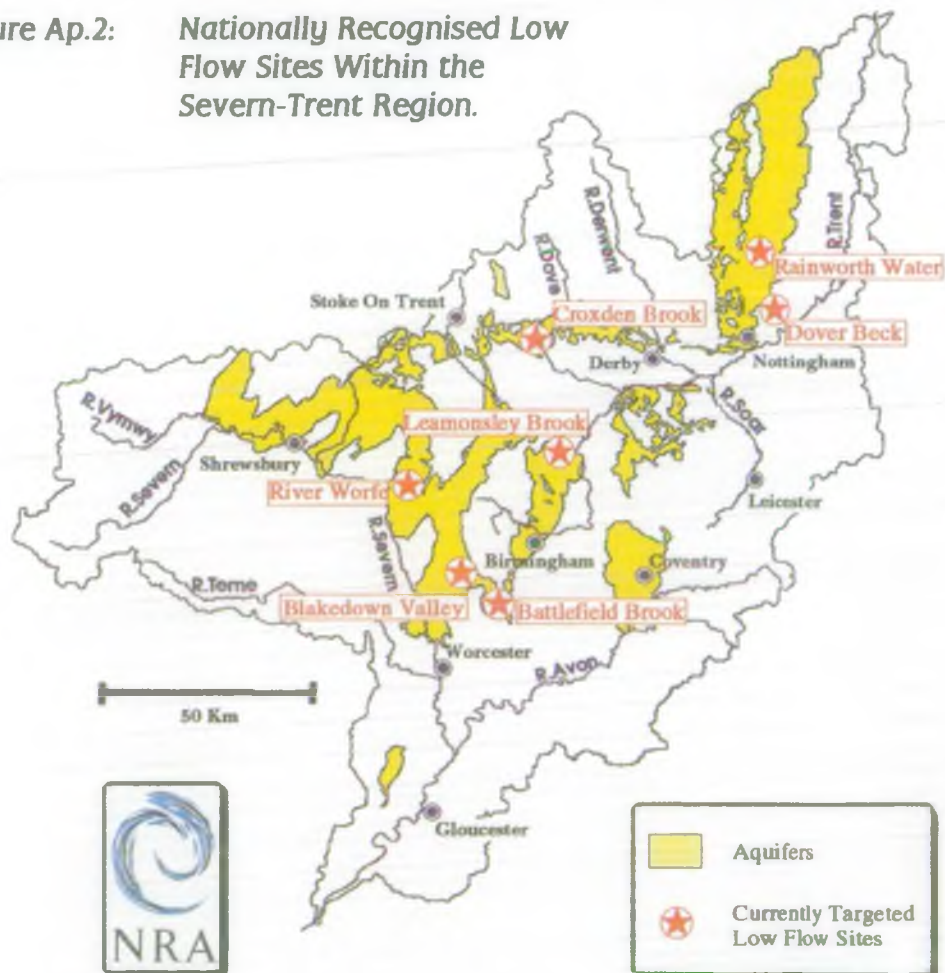


In the meantime, as part of a national initiative, we have identified a number of the most critically affected rivers.

Studies have been undertaken or are underway to evaluate the problems and where feasible propose solutions. In this region the following rivers were considered to have been adversely affected by the loss of baseflows and were the subject of concerns from both the local community and conservation groups. Figure Ap.2 shows the location of these rivers within the Severn-Trent region.

- Leamonsley Brook, Lichfield.
- Battlefield Brook, Bromsgrove.
- River Worfe, Shropshire.
- Dover Beck, Nottinghamshire.
- Rainworth Water, Nottinghamshire.
- Croxden Brook, Uttoxeter.
- Blakedown Valley, Kidderminster.

**Figure Ap.2: Nationally Recognised Low Flow Sites Within the Severn-Trent Region.**



**The Stowe Pool at Lichfield.**

*The NRA recently restored the water level in these historic pools.*



For the Leamonsley Brook and the Battlefield Brook the NRA has successfully developed boreholes for the purpose of discharging water to augment the reduced flows caused by overabstraction of groundwater. This type of solution can however only benefit a limited part of a catchment and is not a solution to the problem. This can only be to reduce overall groundwater abstraction to a more environmentally acceptable level. More detailed studies on the remainder of the rivers listed above are currently being undertaken. This includes preliminary work on the Blakedown Brook near Kidderminster to restore levels of pools in the area, and a further study will be initiated at Croxden Brook in Staffordshire, again an example of the adverse effects of groundwater abstraction.

The main options available to the NRA to improve low flow conditions include:

- Schemes to pump from groundwater to support flows in local watercourses when necessary.
- Consideration of bed lining to reduce leakage from the watercourse. This could be applicable to localised areas probably in conjunction with augmentation from groundwater.
- Reshaping to restrict the width of the low flow channel, possibly combined with the construction of weirs to raise water levels. This can help to improve the visual amenity of an affected watercourse.

#### **4. Wetlands**

There are many wetland ecosystems within the region dependant on groundwater levels in one way or another. The majority rely on high water tables within underlying aquifers and are therefore sensitive to over licensing of groundwater.



NRA

*"The NRA is committed to protecting existing wetlands and also identifying and investigating problems already caused by over abstraction."*

If, during the initial stages of appraising an application for the development of new groundwater sources there is concern that abstraction may adversely affect a wetland, then the applicant may be required to submit an environmental report.



NRA

*"Development and licensing of sources will not be allowed to proceed until the NRA is satisfied that environmental damage will not occur."*

To enable the NRA and conservation bodies to improve wetland management, further research is needed. More needs to be known about the specific water requirements of particular wetland ecosystems. A number of research projects addressing this issue are currently underway and studies will begin in 1993 concentrating on the most sensitive areas.





## Appendix Two: Public Water Supply Demand Scenario Assumptions

No	Assumptions	Assumptions for Each Scenario			
		High	Medium	Low	Effected Area
1	Growth of PCC by compound annual rate of 1%. Per capita figures are constrained to a max of 189 l/h/d. Existing PCC from OFWAT 1992 returns.	✓			PCC growth
2	Growth of PCC by compound annual percentage rates derived from Binnie & Herrington*. Existing PCC from OFWAT 1992 returns.		✓	✓	
3	Growth in metered and unmetered non-household consumption by compound annual rate of 0.75%.	✓			Commercial growth
4	Growth in metered and unmetered non-household consumption by compound annual rate of 0.5%.		✓		
5	No growth in metered and unmetered non-household consumption above 1991 levels.			✓	
6	No increase in the proportion of domestic metered properties subject to metering above 1991 levels. Existing metered properties PCC not reduced by 10% in recognition of the uncertainty associated with such a reduction. Assumed leakage reductions of 1.5 l/prop/hr to account for decreased SPL in existing metered properties.	✓			Metering
7	15% of domestic properties will have meters by 2021 (starting in 1996, with equal phasing each year) leading to a 10% reduction in PCC and a reduction in total treated water losses of 1.5 l/prop/hr to account for reduced SPL in metered properties.		✓		
8	30% of domestic properties will have meters by 2006 (starting in 1996, with equal phasing each year) leading to a 10% reduction in PCC and a reduction in total treated water losses of 1.5 l/prop/hr to account for reduced SPL in metered properties.			✓	
9	Leakage levels per property held at 1991 levels to simulate effect of no improvements being made to reduce leakage levels.	✓			Leakage
10	Leakage reduction achieved affecting a reduction in total treated water losses of 7 litres/prop/hr (20 hour day). Rate of reduction is 0.5 l/prop/hr/yr.		✓		
11	Leakage targets achieved affecting a reduction in total treated water losses of 6 litres/prop/hr (20 hour day). Rate of reduction is 1 l/prop/hr/yr.			✓	

Notes: PCC - Per Capita Consumption

SPL - Supply Pipe Leakage

\* Binnie & Herrington, 1992, 'Effects of Climate Change on Water Res. & Demands'



## Appendix Three: Spray Irrigation

The availability of water for spray irrigation is inevitably limited at critical times as peak demand will coincide with the lowest river flows.

It is, however, the NRA view that any investment in both local and strategic resources for agricultural use should be funded from within the industry, just as the water companies secure their resources by capital investment in reservoirs and other industry in boreholes. Although more limited in scale and scope and inclined to a local level, this principle holds. A contribution to the cost of developments may be appropriate, however, where schemes incorporate significant environmental gains alongside resource enhancement. The NRA role is as a facilitator and we will explore fully any new initiatives that may be proposed within the constraints of current legislation governing licensing.

It is hoped research will continue into more efficient forms of irrigation, and new farming methods (including land drainage practice) which help conserve available soil moisture and the development of drought resistant crop strains will help make better use of available water resources.

In the mean time there are a number of initiatives available to the farming community, both to make existing resources go further and to make more resources available.

### **Management Initiatives**

These are aimed at making better use of the resources already licensed. Some can be promoted by individual farmers, others by groups:

- Scheduling systems designed to optimise the application and phasing of irrigation to match the specific needs of the crop are already available and widely used. This can be assisted by the use of data loggers. These provide very detailed reports of water use on which farmers can base future management decisions and improve the efficiency of water useage on the farm. The NRA can help by advising on installation and processing data.
- Typically, actual water use averages only 40%-60% of licensed quantities in many years. This reflects a contingency element, but also the variance in the needs of many individual farmers due to crop rotation practice. Arrangements for pooling and sharing water already licensed may, therefore, enable a better and fairer allocation.

- Where individual farmers have licences for both surface and groundwater sources there is often scope to operate them conjunctively. This can increase the effective yield of water available to the farmers, as detailed in Section 11 on P.C3, especially where low river flows are a constraint, and can also frequently offer opportunities that are environmentally beneficial.
- This conjunctive use principle applies also to multiple farm situations. Where low flow restrictions on licences can present difficult operational limitations on some farmers others may be in a position to overcome these restrictions by making compensatory discharges from groundwater resources elsewhere in the local system. This would for the most part be the subject of commercial arrangement between the parties, but the NRA would have to be satisfied that the wider needs of the environment are fully met and the schemes can operate within the licensing framework.

### Development Initiatives

These are aimed at increasing the resources. Conjunctive use schemes as described can optimise resources, but the storage of winter water is the only true means of enhancing and securing resources at critical times.

Over most of the region winter water is still available. Where individual farmers view construction of reservoirs as uneconomic, it is possible to reduce unit costs by co-operative ventures by economies of scale. Distribution difficulties can be a problem for strategically placed local reservoirs. However, as above, the NRA will consider schemes which allow the continuation of an otherwise low flow restricted abstraction at one location if offset by compensatory discharges elsewhere. For example, from reservoir storage.

*"The NRA will actively consider any proposals for schemes, within licensing constraints, which:*

- make for better use of water;*
- provide fairer allocation of resources;*
- include winter storage;*
- provide environmental benefit."*







## Appendix Four: Non-Consumptive Uses

A number of uses of water do not consume resources but are large and legitimate users such as hydropower, fish farming and power station cooling. Each of these uses can need the reservation of large quantities of water and so can impose a constraint on water available to others upstream. The main issues involved largely relate to the 'no-derogation' principle. This is because licensing legislation does not allow new abstractions to use water that has been reserved in a licence downstream. Non-consumptive type uses are often located in lower reaches of catchments where the potential to limit upstream abstraction is greater and where there is limited scope for the re-use of water when returned.

To avoid sterilising the future use of upstream resources when considering new licences of this type we will seek to negotiate a quantity for other future potential uses. It is unlikely that such a reservation would have a significant impact on the viability of schemes, especially hydropower, which will be dependent in the main on the availability of the higher winter flows. In many cases licences will also be time limited to allow periodic review of licence conditions.



*"In considering new proposals for large non-consumptive uses, the NRA will seek to reserve a quantity of water for other uses."*

In some cases, licences that are already held may not be appropriate for current use, as circumstances have changed, for example in the power industry. But, their existence prevents the issue of licences to others. These licences need reviewing if resources are to be fairly allocated.



*"In reviewing licences the NRA will be seeking reductions in quantities in line with current and anticipated needs."*

The nature of instream hydropower installations often means there are other issues specific to this particular use. They can cause extreme and often unacceptable fluctuations in flows downstream with impacts on water quality and fisheries. This is particularly so where minimum flows downstream are important for dilution of effluents and protection of fisheries.

In some cases it may be necessary for an environmental appraisal to be carried out by the promoter of the scheme including proper consultation with relevant outside bodies and organisations.



NRA

*"The NRA will encourage the development of hydropower schemes where the promoter can demonstrate that the environmental impact of the proposal is acceptable and does not unduly inhibit existing and proposed legitimate uses of water resources."*

It may be that the impact of schemes for hydropower, fish farms, etc, can be overcome by the way in which they are operated. How it is operated can be incorporated into agreements associated with licences.



NRA

*"The NRA will where necessary seek to include conditions in impounding or abstraction licences and seek operating agreements to ensure a satisfactory method of operation."*



## Appendix Five: Water Quality Framework

### Water Quality Framework

#### (a) Surface Water Resources

The quality of surface waters in England and Wales is controlled by setting discharge consents to meet informal River Quality Objectives (RQOs). These were first defined in the late 1970s and comprise of five classes:

- 1a and 1b (Good),
- 2 (Fair),
- 3 (Poor),
- 4 (Bad).

The scheme is based primarily on chemical parameters with "Good" and "Fair" quality expected to be suitable for drinking water supplies after some treatment.

Under the Water Resources Act 1991 the Government is allowed to set statutory water quality objectives (SWQOs) for all controlled waters. These SWQOs will be linked to specific river uses. These use classes will be given the appropriate standards for key chemical parameters required for that use as well as incorporating the relevant EC directives. The list of proposed Use Classes include:

- abstraction for drinking water supply,
- agricultural abstractions,
- industrial abstractions.

It is anticipated that SWQOs for rivers will be introduced gradually from late 1993. The NRA has embarked upon a programme of work with a number of 'pilot' catchments. Within the Severn-Trent region the two pilot catchments are the Worcestershire Stour and the Blythe/Cole/Bourne catchments.

SWQOs will represent quality targets for river management and pollution control purposes and provide the background against which new discharges will be considered but will not guarantee that the river water will necessarily be suitable for a particular end use.



The quality of water that can be abstracted for drinking water supply is covered by an EC Directive (75/440/EEC). The Classification Regulations for this directive have been made by the Government and the standards are currently being implemented. The EC Directive identifies three classes of abstracted water quality and the relevant minimum treatment required before it is passed to drinking water supply.

Under the EC Urban Wastewater Directive (91/271/EEC) the catchment of a river or other surface source from which water is abstracted for drinking water can be defined as a Sensitive Area. Definition depends on the concentrations of total phosphorus and/or total nitrogen. That is, if the nitrate levels are too high, as defined under the EC Surface Water Directive (75/440/EEC), or the water is considered to be, or likely to be eutrophic. Where catchments have been defined as Sensitive Areas this imposes a need for more stringent controls on discharges to them.

### **(b) Groundwater Resources**

Discharges to groundwater are controlled by a consenting process under the Water Resources Act 1991. The Act also allows for the setting of SWQOs for groundwater, and the production of regulations for the prevention of pollution and the taking of remedial action where it is occurring.

In a wider context the EC has adopted an action programme for the future protection of groundwaters, recognising the particular threat from diffuse pollution and the need to ensure sustainability.

To promote groundwater protection interests and ensure that other regulatory bodies understand the approach that the NRA takes, the NRA has published a *"Policy and Practice for the Protection of Groundwater."* This incorporates EC philosophy and consolidates existing regional policies. A key objective has been to devise a framework which covers all types of threat to groundwater, whether large or small, from point or diffuse sources.

The policy is based on the concept of groundwater vulnerability whereby the risks of pollution are variable depending upon the geological conditions and the overlying soils. A series of vulnerability maps will be drawn up over the next five years to support the policy. A regional appendix specific to the issues in Severn-Trent region has also been published. Individual public supply abstractions will have three concentric zones progressively defined around them with increasing restrictions on development with proximity to the borehole. The policy incorporates statements explaining the likely NRA attitude to specific activities within the three zones and the groundwater vulnerability areas.



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