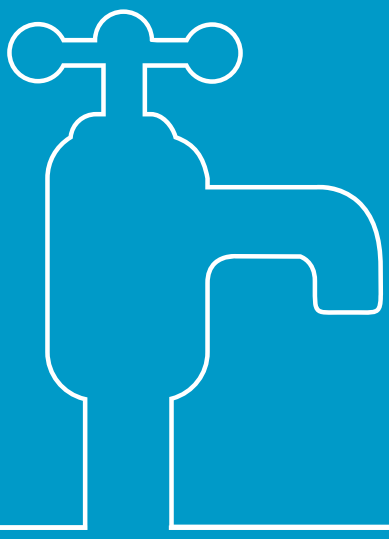
Campaign to Protect
Rural England
SOUTH EAST

A CPRE South East report

A Water Resource Strategy for the South East of England



A Water Resource Strategy for the South East of England

Report by
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Foreword and summary by
Christine Drury, Chair, CPRE South East.

Contents

Foreword and Summary

- **The latest drought may be officially over, but despite the rain since April and recent floods the South East's water-supply crisis has not passed.**
- **In the past 18 years, some parts of the region have been under hose pipe bans eight times, even though these measures are designed for 1-in-10-year conditions.**
- **Heavy rain and floods alternating with periods of drought emphasise the increasingly unpredictable nature of our weather patterns, and the need to move on from our historic dependence on steady and predictable conditions.**
- **The reality is that floods do not compensate for drought conditions, not least for reasons of water quality. "Water, water everywhere and not a drop to drink" has taken on a new meaning in 2007.**
- **Further structural pressures on our water resources – from housing growth, climate change and environmental legislation – mean we could face deficits of a billion litres a day by 2025.**
- **The Government and the water companies haven't fully woken up to the new realities of water supply – their strategies rely too much on building reservoirs that may never fill.**
- **Only when there is a change in approach will there be a reasonable chance of balancing supply and demand through the difficult and uncertain decades ahead.**
- **In this report, CPRE South East recommends the adoption of new policies which conserve and recycle the South East's increasingly scarce and erratic water supplies.**

The South East is finally beginning to wake up to the seriousness of the water supply crisis, thanks to recent hose pipe bans and emergency powers. But after a good wet winter and devastating floods, we are in danger of being lulled back to sleep instead of thinking and behaving differently about water.

For far too long water resource management for the South East has been based solely on security of supply, alongside a belief that there was always enough left "for the environment". In an equable climate, with relatively modest levels of development and water consumption, that was probably not an unreasonable assumption. The problem is that the assumption no longer fits the world we live in.

We have continuously increased abstractions from rivers and boreholes to meet the demands of many more households using much more water. This has resulted in water tables and rivers being structurally depleted and wetlands degraded. The wildlife dependent on them has been forced into narrower corridors, with some populations reduced to crisis levels. The climate is not as equable as it was: winter droughts and stormier, flashy rainfall and less predictable conditions may be here to stay as we face the effects of climate change, even if we are told this will "settle down' to warmer, wetter winters and hotter, drier summers. The sharply fluctuating conditions of recent months make it unwise to predict and wiser to find ways to be less dependent on the weather.

We increase the stress on our water systems by building more homes than those

systems can cope with. We surround them with more hard-run-off surfaces – roofs, driveways and roads. Government housing targets add to the water stress. All of these actions are supported and institutionalised in the regulatory frameworks for water supply, building regulations and behaviours that we all, as normal, right-thinking individuals, have called good practice or "doing the right thing".

Now, however, we are beginning to realise this isn't "doing the right thing" at all. The level of stress on water supply in the South East and on its environment means we have to think differently about water and behave differently too, using new financial frameworks and incentives to effect the necessary changes. If we do this, water can be an almost infinitely available, renewable resource.

The issue is urgent, and hose pipe bans and floods are a wake-up call. Government has been severely challenged for having ignored water supply totally in its Sustainable Communities Plan. Detailed examination of the South East Plan makes it clear that development is already limited by water supply, which is too often still bundled in as another item of "infrastructure".

Institutional change is beginning: the Environment Agency (EA) can now exercise stronger controls on abstractions to meet EU regulations on the environmental status of rivers, groundwater and special protection areas for wildlife. But the regulatory framework, operated by Ofwat, that governs the investment and pricing decisions and priorities for the water industry is still based too much on old assumptions of the primacy of security of supply over conservation and recycling.

As we see with so much of the sustainability agenda, consumers are more ready to change than institutions, but need the facilities and pricing signals to do so. Metering, tariff incentives and water-saving equipment lead to lower water consumption, and encourage the development of water conservation mindsets. This is tested, established fact, but the work needs to be more actively and urgently applied in the South East.

It is in this context that CPRE SE's water expert Graham Warren has reviewed the current water supply work of the Environment Agency and water companies, and drawn on the findings of the House of Lords' Science and Technology Committee's report of 2006. Following Graham's first, county-scale report – for CPRE Kent, published in June 2006 – this study looks at the South East region of England. It considers the key factors influencing water supply and demand, and makes some sobering forecasts of future supply/demand balance.

The report is one of the first to take into account the reality of current, climate-change-affected dry-year frequency in the South East – more like one in two years than the 1-in-10 model the water companies work to. The report's estimates for future resource imbalance also consider the impact of the European Water Framework Directive, which aims to give back to the environment a fairer share of our continent's water. The legacy of over abstraction and habitat depletion is only very slowly beginning to mend, and is at constant threat from new proposals for development.

This report has, however, been written and published in a spirit of optimism rather than despair, because solutions to our water supply problems are known. Investment criteria can be changed and consumers are ready to alter their behaviour, given the facilities and encouragement to do so. On top of this, we have examples from some other parts of the world where water is managed differently, with much more emphasis on conservation and recycling. (This is notably true of Australia, and we should perhaps be cheered by the fact that the UK's largest water company is now under Australian ownership.)

The report sets out the water situation as the facts appear to a hydrologist. From it CPRE South East draws five key conclusions and produces five key recommendations essential for the direction and delivery of a more sustainable approach to water supply in the South East.

CPRE South East's conclusions:

1. The South East is already facing a severe deficit in supply today – annual demand is close to average year supply and supply is well below peak demand in dry conditions. By 2025, with the effects of climate change, better care for our environment under the Water Framework Directive and massive housing growth, the public water deficit could be as much as a billion litres per day based on the 1-in-10 dry year design criterion on which supply is assessed.
2. The Government has failed to recognise the reality of water limits under current operating conditions, either as a constraint on house building or in the urgency for changes in regulatory frameworks.
3. The financial framework for the water companies is wrong for the conditions that now exist in the South East. Investment in conservation and recycling needs to have much higher financial priority. And conservation is still not being adequately promoted by water companies, through leakage reduction or in enabling actions to customers. The concept of an "economic level of leakage" is an outdated criterion for managing a scarce resource, and is incompatible with appeals to consumers to do more. Good communication alone is an inadequate incentive to consumers keen to conserve but needing the facilities to do so.
4. The primary focus of public discussion is still on reservoirs, even though these are becoming less viable as river flows are less reliable, and winter storage assumptions are challenged by recent meteorological evidence.
5. Water re-use and indirect recycling of waste water through water courses is largely ignored when it should be a major structural element in water supply strategies. It offers us the chance to live more compatibly with our environment and does not involve any sacrifice.

CPRE South East's recommendations:

1. First priority should be given to restoring the water environment. The work of the EA needs to be supported to reach consensus on scientifically sound but not over precautionary ways to achieve an equitable balance between the needs of the environment and the needs of public supply.
2. Spatial Strategies and other Government housing plans for the Sustainable Communities Plan, "Eco Towns" etc must take greater account of environmental limits on water supply in current circumstances, and not just assume the water companies can be bound by their mandate to provide.
3. The operating framework and criteria for water supply needs to alter in response to the changes we are already seeing from climate change. The mandate, and if necessary, the organisation, of Ofwat should be changed to initiate a much stronger approach to conservation. "Economic level of leakage" criteria should be strengthened.
4. We should think and behave differently about water supply. This is not just a communication and mindset issue: it is structural, financial and regulatory. Change needs to be joined up so that the incentives for water companies are consistent with those for consumers. Water efficiency needs to be a standard expectation in all new building – to save money as well as the resource – and retro-fitting of existing homes should be tested as part of Section 106 planning agreements.
5. Water supply strategies have to change. It needs to be recognised that reservoirs are no longer the first choice technical solution. This is not mainly about local rejection; they are increasingly unsound as a technical solution given the level of water stress from over-abstraction and their increasing unreliability under climate change conditions. Water recycling needs to be a leading part of all water companies' business plans, and the brief from Ofwat needs to reflect this. Discharge of fresh, clean wastewater to the sea from sewage treatment plants needs to stop.

Christine Drury, Chair, CPRE South East.

1. Introduction

1.1 The shared experience of the recent drought, with some restrictions on garden watering and other "non-essential" uses running into a third winter, has highlighted the urgent need for a long-overdue strategy for the sustainable management of the region's water resources, notwithstanding the extreme flood events of June/July which only serve to illustrate the increasing instability of our climate.

Our renewable resources in a year of average rainfall are now barely sufficient to sustain supplies to meet basic domestic, industrial and agricultural needs; and it requires only relatively minor drought episodes to create a significant supply deficit with a virtual year-round shortfall in the balance of river and groundwater resources. In recognition of this, much of the South East has been classified by the Environment Agency (EA), as having an unsustainable regime for water abstraction under both summer and winter conditions. Furthermore, we now face the prospect of a progressive increase in the stress on resources arising from:

- the need for water companies to comply with new and more demanding environmental controls on their abstraction from rivers and groundwater sources;
- the ongoing impact of climate change (forecast to bring wetter winters and drier summers); and
- the housing growth proposed for the South East.

CPRE South East believes that, unless action is taken to address the deficit as a matter of the highest priority, the water companies will be unable to keep pace with the resulting steep increase in demand under drought conditions.

1.2 Policy NRM1 of the draft South East Plan (Ref 1) states: "Water supply, groundwater and river quality will be maintained and enhanced through avoiding adverse effects of development on the water environment. A twin-track approach of demand management and water-resource development will be pursued, together with development of sewerage and waste-water treatment infrastructure."

The policy also looks to local authorities when preparing Local Development Documents and determining planning applications to:

- ensure compatibility with River Basin Management Plans and EA Regional Water Resource Strategies;
- ensure that local development does not lead to "unacceptable" deterioration in water quality and is in step with the provision of appropriate infrastructure;
- achieve high levels of water efficiency and reflect best practice, including "very good" and "excellent" standards, as defined in the Building Research Establishment Environmental Assessment Method (BREEAM).

1.3 A more explicit policy statement is given in NRM2, which recognises "a demonstrable need for new water-resource schemes and increased demand management over the period of the Plan, to cater for water supply needs of current and future development and the protection of the environment." The list of candidate schemes includes reservoir construction, bulk transfers and effluent re-use.

1.4 We fully support the general thrust of the policy statements. But while they focus, for good reason, on the implications for the future effective management of resources,

they overlook the fact that the South East region is *already* in deficit (hence the hose pipe bans and emergency restrictions) under drought conditions that are now of such frequency that they can no longer be regarded as rare or extreme events, and indeed are forecast to occur with increasing frequency, duration and severity as the influence of climate change takes hold throughout the South East. There are also areas of special concern that we have attempted to address in the formulation of what we trust is a practical and realistic strategy for the sustainable management of the region's water resources.

1.5 Some of the more fundamental issues have already been raised in the report of the House of Lords (HOL) Select Committee on Water Management (Ref 2). They question, for example, the wisdom of planning and promoting growth in the region with the greatest stress on water resources, and without prior consideration of the likely scale of the requisite infrastructure. It was also noted that the drought experience had exposed weaknesses in the water companies' resource management plans and there was still a reluctance on their part fully to engage in the active promotion of basic demand management and water efficiency measures (as reflected in the slow uptake of domestic supply meters). The Committee also questioned the adoption by the water companies of relatively narrow economic criteria in assessing the success of leakage-reduction programmes and there was considered to be a continuing emphasis on supply-side solutions as exemplified by the heavy investment in reservoir schemes, with comparatively scant attention paid to demand management initiatives. Much of this, in the view of the HOL, arises from the fact that, as they saw it, responsibility for water management remained "dispersed and unclear" and that at present, neither the water industry nor the regulators have an agreed methodology for including sustainability within the decision-making process.

1.6 The water companies nonetheless seem confident that they have the solutions and will be able to meet the new challenges. CPRE SE does not agree. We have drawn lessons from the history of water use and management in the South East, in a forecast of the likely trend in the balance of supply and demand over the next 20 years. From the companies' general intentions for addressing future demand growth, we conclude that few of the options so far included in their business plans are likely to deliver the necessary shift to more broadly based sustainable strategies. For this reason we have put forward an alternative long-term strategy, one which we believe offers viable engineering solutions and provides a cost-effective and environmentally sustainable way forward for the region. It requires, however, a radical shift in approach to the use of dwindling resources. And time is not on our side if we are to avoid more decades of crisis management.

1.7 CPRE SE's strategy puts a special emphasis on the conservation, re-use and reallocation of our existing water resources, with correspondingly less reliance on the further development of groundwater and reservoir-based sources of supply. The EA is working on a new water resource strategy for England and Wales, and we commend our proposals for consideration in the assessment of options for the South East.

2. Setting the Scene

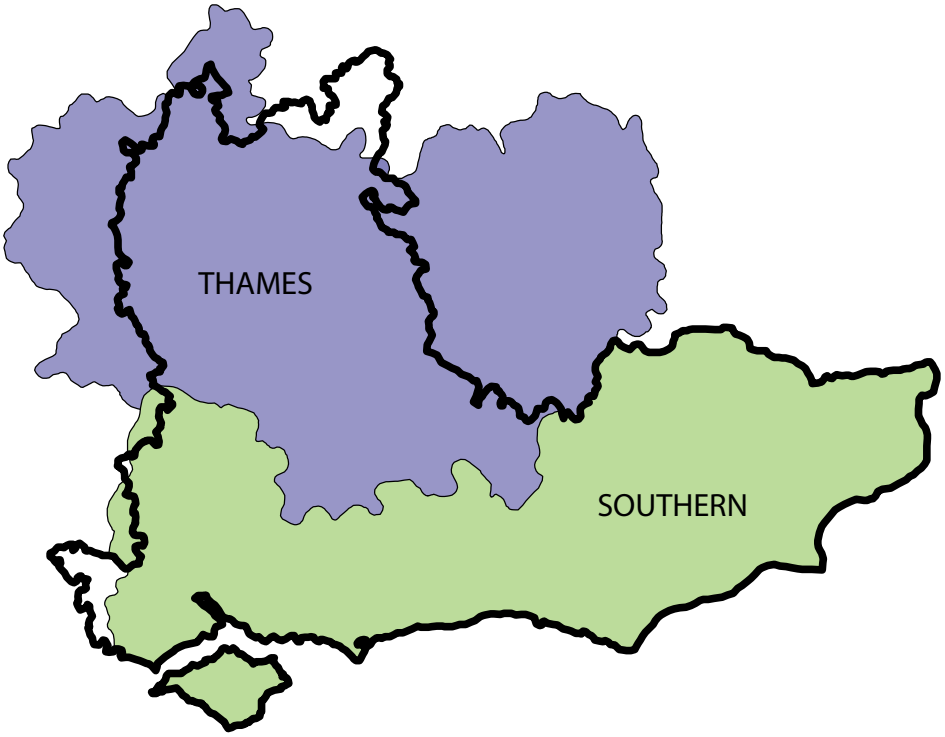
2.1. Boundaries

The South East region comprises the counties of Kent, East and West Sussex, Hampshire, Berkshire, Oxfordshire, Buckinghamshire and Surrey – a total area of approx 19,600 Km² supporting a population of around eight million (Fig 2.1). The region is not defined by any distinct geographic or hydrological boundaries and its borders cut across hills, valleys and major watersheds. This of course complicates the calculations required in the assessment of water resources, but a crude approximation has been attempted using data available for the Thames and Southern regions of the Environment Agency (Fig 2.2). Although having boundaries which are for the most part roughly co-incident with those of the South East region, there are large areas in the east and west which fall outside and need to be accounted for separately in the final balance. Even with these corrections, the analysis has to be treated with caution, and a more precise assessment will have to await completion of the EA model studies now in progress (Ref 3). Any attempt to match this level of resolution would clearly be beyond the scope of this preliminary review, but it is hoped that it will at least serve to identify the key factors influencing the supply/demand balance now and in the foreseeable future.

The following discussion therefore concentrates on the EA Thames and Southern regions as surrogates for the South East, with adjustments made, where appropriate, in the final stages of the resource assessment.

Fig 2.1 South East Region

Fig 2.2 South East and EA Regions



2.2 The water balance

The region's rivers and aquifers are vital elements of the natural environment, with its rich diversity and recreational value. Their evolution as sources of supply has been controlled by the geological and erosional processes that have produced the distinct topographic landscape and drainage features that we see today (Figs 2.3 and 2.4). The continued survival of these resources and landscape character depends, for the most part, on how prudently we manage and regulate water abstraction and consumption, for whatever purpose, particularly in times of drought when demand is high. Just how much importance the community attaches to this principle has determined the policies and strategies that have evolved over the years in our efforts to reconcile the competing demands for water supply and environmental sustainability. Management of a water resource is essentially a matter of good house-keeping – balancing the budget at levels which satisfy all reasonable requirements. In its simplest terms, it can be represented by an equation, or balance sheet, of gains and losses – and this in turn involves the measurement and evaluation of the main components.

Gains	Losses	Environmental balance
Rainfall and inflow	Evaporation and Transpiration Abstraction	River runoff Spring flow Change in storage

Fig 2.5 shows the relationship between these components as elements of the Water Cycle. The processes involved in the planning and management of the region's water resources are based on boundaries which, in many instances, correspond to the watersheds separating the major river catchments. Elsewhere they are defined as sub-divisions of important aquifers such as the Chalk, the Oolites and the Lower Greensand.

Fig 2.3 Geology

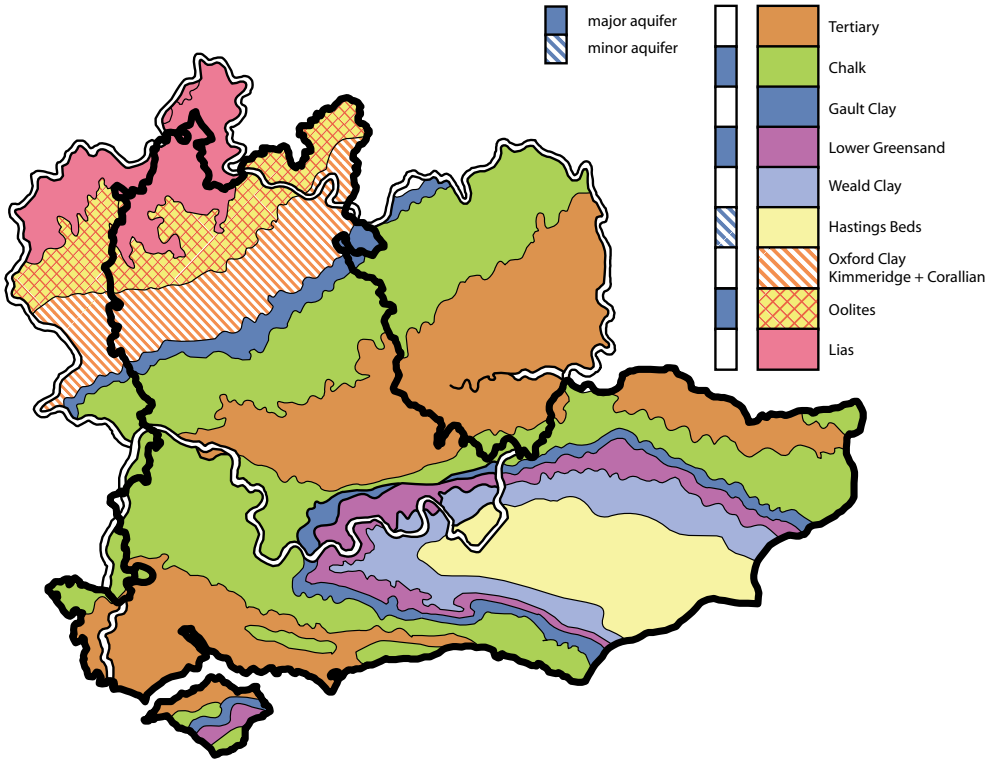


Fig 2.4 Topography and Drainage

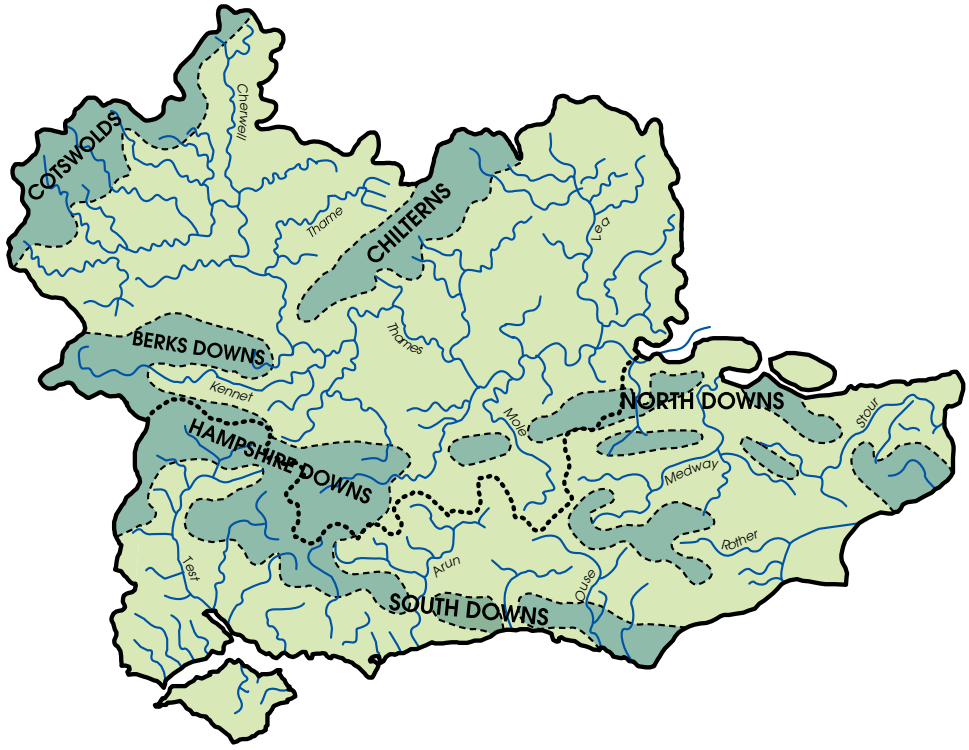
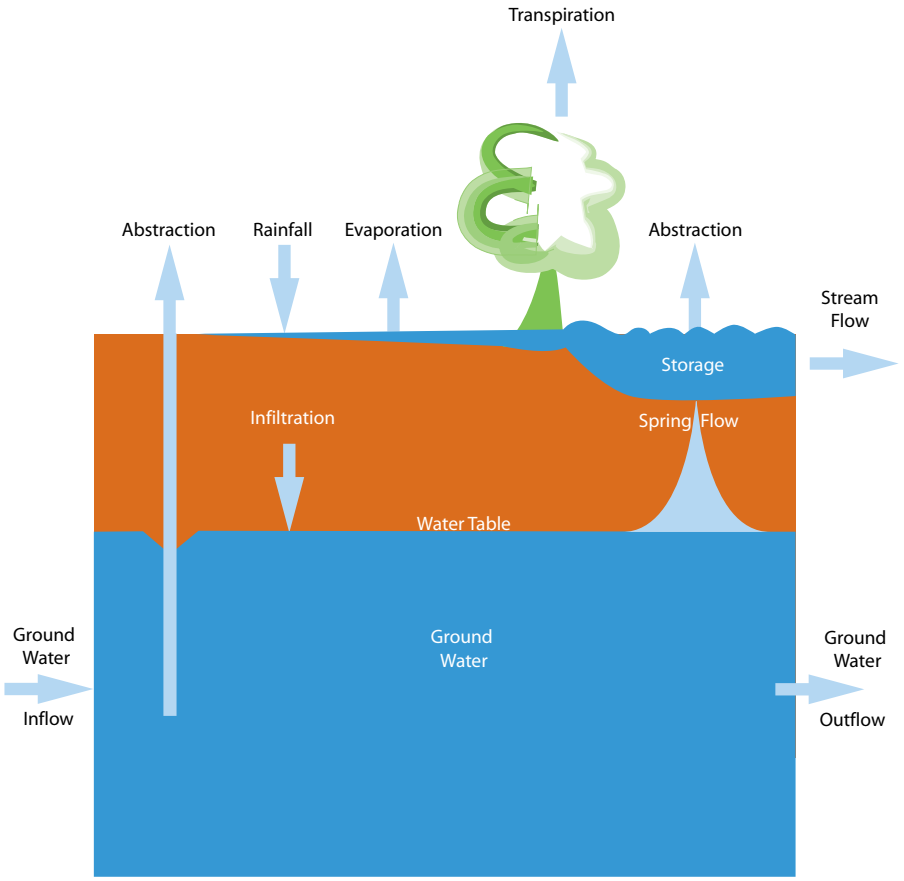


Fig 2.5 The Water Cycle



2.3 Rainfall

Figure 2.6 shows the variations in average annual rainfall across the Thames and Southern regions, calculated on the basis of the Meteorological Office long-term standard average for the period 1961-90. The average for the Thames is estimated at 690mm, but there are wide local variations reflecting topographic influences and the prevailing south-westerly weather patterns. Totals of between 800 and 900mm are, for example, recorded for the Chilterns, but by contrast, there are large areas of the Thames and Lea Valleys with totals of less than 600mm. Southern region records a consistently higher annual total at approximately 740mm but with a similar range, varying from 800mm to 1,000mm on higher ground in the west of the region to between 550mm and 650mm in parts of north and east Kent – the latter ranks as one of the driest regions in the British Isles. There is relatively little seasonal variation across the two regions; the winter (Oct-Mar) and summer (Apr-Sept) recording 53% and 47% respectively of the annual total. The vulnerability of both regions has been highlighted by recent drought experience, characterised by significant shortfalls in both winter and summer rainfall. Prolonged dry periods spanning two or more winters are particularly damaging. As experience of the 1989-92 and the recent drought shows, such episodes are typically marked by severely depleted river flows and a general decline in water table levels. It is becoming apparent that even under average rainfall conditions, the increased levels of abstraction for public supply have brought a progressive deterioration in the regime of many important spring-fed streams and wetland habitats.

2.4 Evaporation and Transpiration

These are the processes whereby water is lost as vapour to the atmosphere from open water surfaces and from vegetation. A small but important proportion is also lost during the summer months from areas of bare soil and wherever the water table is at a relatively shallow depth. The average annual potential loss rate (i.e. assuming constant availability of water) for the two regions amounts to between 500 and 550mm – nearly three quarters of the total annual rainfall. Actual losses for any given location will, of course, vary with water availability, but for most years the average would fall between 400mm and 450mm – about 60% of the annual rainfall (Fig 2.7). What remains is the "effective" rainfall, which represents the renewable resource for sustaining river flows, groundwater levels and the increasingly heavy demands from abstraction for public supply. For Thames, this has been estimated at an annual average of 235mm.

2.5 River flow

Every river system displays a pattern of seasonal flow variations which reflects the geological, topographic and land-use characteristics of its catchment area. For rivers such as the Thames and Medway, the regime is also strongly influenced by abstraction and regulation operations associated with water transfers and navigation.

Spring-fed streams, such as those draining the outcrops of the Chalk and Oolites, show a high degree of natural regulation reflected in the relatively small winter/summer flow ratio. By contrast, rivers such as the Medway which drain relatively impermeable catchments have very little natural storage and the high winter/summer rates reflect their very "flashy" characteristic.

The landscape and river systems of the two EA regions are products of a fairly equable climate, one which has also strongly influenced land use and agricultural practices. If climate change brings more extreme conditions, we will need to rethink the way in which we use the land and manage our rivers, including formulating more integrated strategies which tackle both floods and droughts. Ideally this would involve restoring some of the essential natural characteristics of the catchment which, prior to human intervention, would have regulated the response of the river to any abnormal fluctuations in yearly or seasonal rainfall. Rivers with a history of frequent "flash" flooding can be improved by changing the way in which land in the headwaters is managed, establishing mixed woodland and reinstating hedgerows and buffer strips. The result would be a more even distribution of flows throughout the year, with reduced flood peaks and higher summer levels in reaches that might otherwise cease to flow or even dry out altogether. We would also frequently see a corresponding reduction in soil erosion and channel siltation and a more robust environment in terms of landscape and biodiversity. This situation also highlights the importance of ground cover and permeable, absorbent surfaces over hard "runoff" surfaces.

2.6 Groundwater

Fig 2.3 includes an inset identifying the major aquifers in the local geological succession. The Chalk is the dominant aquifer, providing 60% of public supplies in Southern with a further 20% drawn from the Lower Greensand and Hastings Beds. Groundwater also predominates in Thames with the majority of supplies drawn from the Chalk, Oolites and Lower Greensand. In terms of the proportion of the resource committed for all supply purposes, the Chalk of south-east England must rank as one of the most intensively developed aquifers in the British Isles. The region is also one of the driest, and the aquifer has to support rates of abstraction approaching and, now, frequently exceeding the average rate of natural replenishment. The difficulties facing water companies in recent years have often been attributed to this heavy dependence on groundwater. This is a resource which relies on consistently high rates of winter rainfall

Fig 2.6 Average Annual Rainfall 1961-90

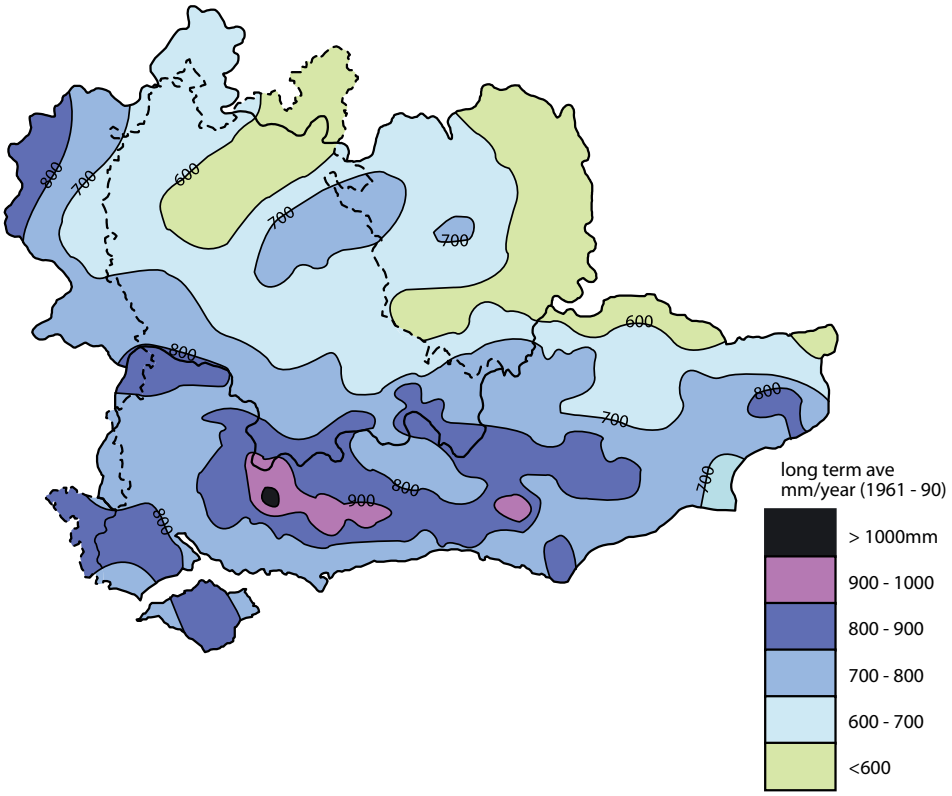
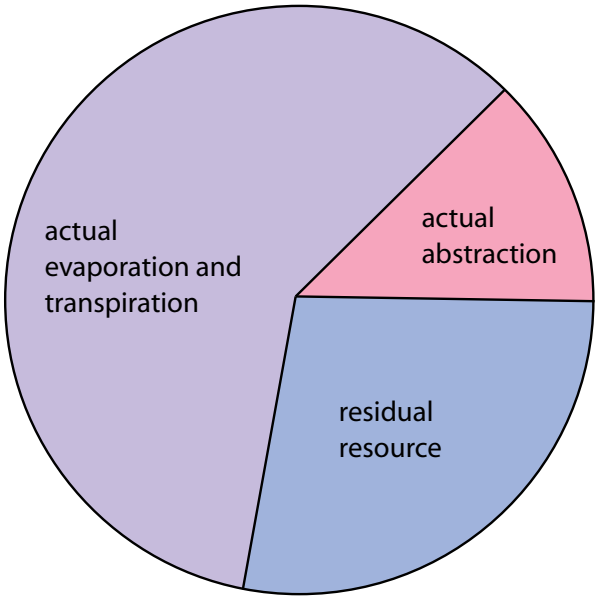


Fig 2.7 Rainfall and Resource Balance



Actual evaporation and transpiration = approx. 60% of annual rainfall.
Actual abstraction = approx. 30% of effective rainfall.
Residual resource includes river flow and ground-water recharge.

for its annual replenishment. Much of the drainage of the area is also largely supported by groundwater discharge in the form of springs or seepages, and any significant depletion in the level of aquifer storage will produce a corresponding decrease in the baseflows of streams draining the outcrops of the major aquifers. This means consequent loss of flow to any associated wetlands.

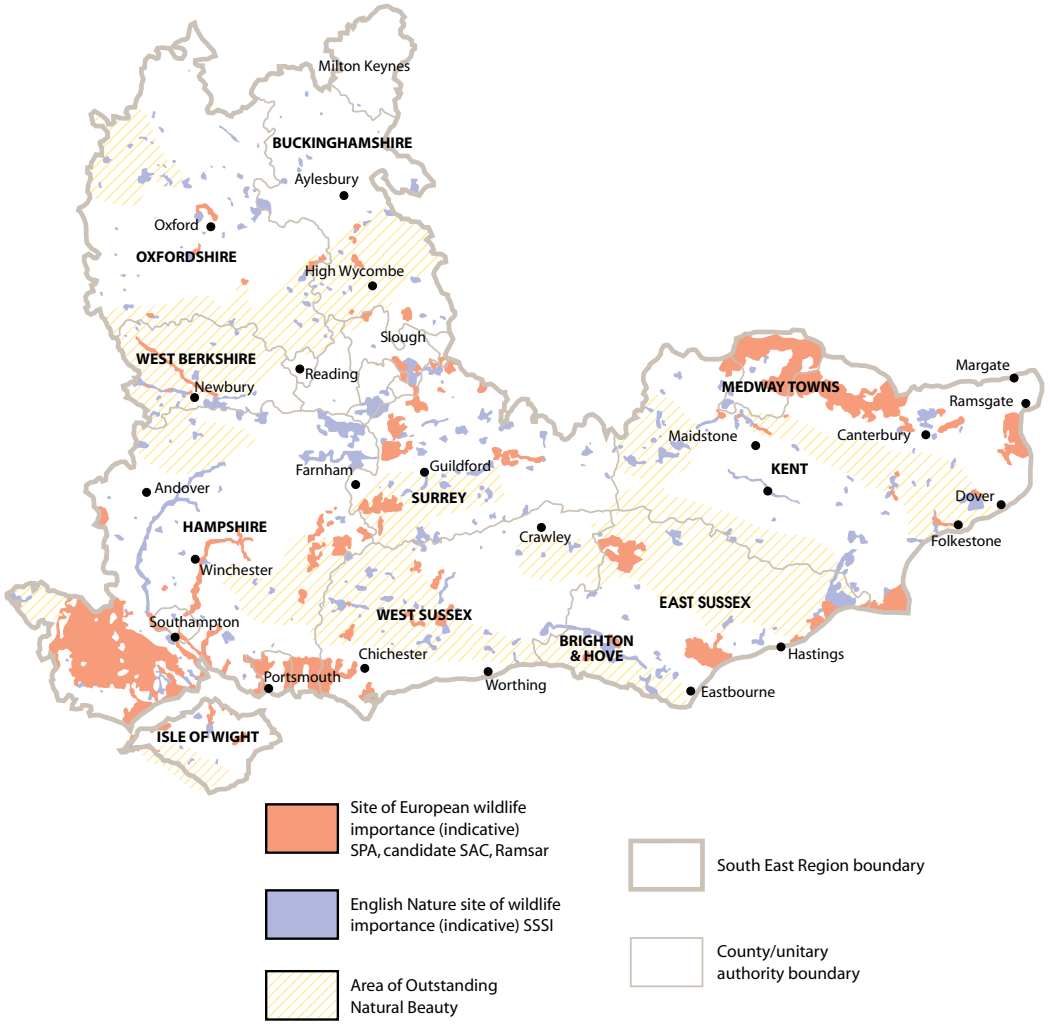
2.7 Water and the environment

Not so many years ago, there was a presumption embodied in most water resource management strategies that priority should always be given to the security and continuity of public supplies, albeit with the minimum environmental impact. As a result, many supply schemes of this era have left the region with a legacy of depleted river flows and degraded wildlife sites. The more recent, and rather belated, recognition of the fundamental importance of environmental sustainability has shifted the ground toward a more equitable balance with the community's supply needs. This has been driven by both European and national legislation. For the South East the change also reflects our experience of the recent long droughts which have served to highlight the precarious state of our river and wetland habitats. Other reports have documented how and why this has happened. The purpose here is to propose a more sustainable, broad based approach to supply.

The EC Habitats Directive (HD) (Ref 4) and its accompanying UK 1994 Regulations make provision for protecting the biodiversity of our more important wildlife sites which, under "Natura 2000", embraces Special Protection Areas (for wild birds) and Special Areas of Conservation (for other fauna and flora). The EA, as competent authority, has a duty under this directive to review all abstraction licences likely to impact adversely on any designated sites, and to identify and implement appropriate measures for restoring sustainable abstraction (RSA). This process converges with the European Water Framework Directive (Ref 5) now incorporated into national legislation and aimed at the achievement of "good ecological status" in terms of both the quantity and quality of our rivers and aquifers. The appropriate remedial measures will be identified as part of the EA CAMS programme (Ref 6) and this in turn forms a component of the national River Basin Management Plans (Ref 7). In many instances RSA will involve the reduction, relocation, or even total cancellation of an authorised abstraction; and the licence holder will then be obliged to develop an alternative and more sustainable source of supply. Any major RSA commitment imposed on a water company will normally be addressed via the National Environment Programme (NEP) under which Ofwat can set revised charges to reflect the expenditure incurred by the company in securing alternative public water supply sources. Fig 2.8 shows the locations of some of the more important river and wetland sites which have been designated under the HD and NEP programmes.

CPRE SE believes that the priority Ofwat gives to pricing based on new supply investment is fundamentally flawed. The first priority for pricing should be for measures to improve conservation, reduce leakage by water companies and encourage and enable water efficiency by consumers.

Fig 2.8 Important Wildlife and Landscape Conservation Sites



Environment Agency *State of the Environment 2003*

3. Water Abstraction – Where are we Now?

3.1 A 40-year legacy

Control over abstraction falls to the EA under special provisions of the 1963 and 1991 Water Resources Acts, and the 2003 Water Act. No one, for example, may abstract from any controlled water (e.g. river, lake or aquifer), unless they hold a licence from the EA specifying the authorised purpose and quantities, or alternatively have explicit exemption (examples here being fire fighting and dewatering to protect works). The first licences were granted in mid 1965, but the conditions of issue allowed very little scope for the authority at that time to exercise effective control. The legislation entitled anyone who could demonstrate proper existing use of a borehole or other recognised source of supply to a licence "as of right" for the appropriate quantities – and in perpetuity. With few exceptions, this provision, almost by definition, had to be applied automatically to all public water supply undertakings (the largest abstractors), and some fairly large industrial users. Effectively, this put many river catchments and aquifers into deficit almost from the outset, and the subsequent 40 years of water resource management have been largely dedicated to attempts to redress this imbalance in the face of rising demand and increasing pressure on the water environment. Public water supply represents the greatest proportion taken from both surface (non tidal) and groundwater sources, and in an average year accounts for approximately 80% of the authorised total.

CPRE SE believes it is this legacy and mindset of the perceived right to continue abstraction that is working against the adoption of more sustainable supply strategies.

3.2 Supply and demand

Fig 3.1 shows the disposition of the supply areas of the 11 water companies serving the South East, and Table 3.1 compares their combined deployable output (water availability) with the actual abstraction (at 1997/98 levels) required to meet the demand from all the principal use categories. And it can be seen that even under average (non-drought year) conditions, total demand for both regions is running close to water availability: 5,410 against 5,500 Ml/d. If we assume that demand growth since around 2000 will have been more or less offset by reductions in leakage that were demanded by Ofwat together with the implementation of more domestic metering, we can probably work on the basis of rough parity for the daily supply/demand up to 2006. However, the test of sustainability lies in the capacity of a resource to meet demand under *drought* conditions. Current standards of service require companies to maintain supplies for a 1-in-10 dry year when resources will, by definition, be depleted and demand running 10 to 15% above average rates. Furthermore, the critical period demand could be 20 to 30% above the daily average. Hence, for the Thames and Southern regions together, we could expect something corresponding to the following range in demand levels:

Average year	5,410 Ml/d.
1-in-10 dry year	6,200 Ml/d.
Dry year peak	7,000 Ml/d.

In light of this, it has to be concluded that there is insufficient capacity within either Thames or Southern regions to ensure security of supply even under average-year conditions. The question then arises as to the prospects for meeting the forecast growth

Table 3.1 Water Demand and Availability (Average Year) Ml/d (Based on 1997/98 data)

1	2	3	4	5	6	7	8	9	10
EA Region	Annual Renewable Resource (Effective Rainfall)	Water Available To Meet Demand	Public Supply				Direct Abstraction		Total Demand (7+8+9)
			Domestic	Non Domestic	Leakage	Total (4+5+6)	Industrial	Agriculture	
Southern	10,200	1,400	660	240	210	1,110	180	30	1,320
Thames	8,500	4,100	1,930	860	1,150	3,940	130	20	4,090
Total	18,700	5,500	2,590	1,100	1,360	5,050	310	50	5,410

1. Col. 2 is taken from EA National Water Resource Strategy 2001 Tables 3.2 and 3.4 (Represents average annual rainfall minus actual evaporation and transpiration).
2. Col. 3 represents total deployable water company output plus direct abstraction for industry (excluding power generation) and agriculture. (includes Three Valleys at 877Ml/d) Ref EA Southern Region Water Resource Strategy 2001 Fig 7.1 and Thames Region Water Resource Strategy 2001 Fig 7.1.
3. Col. 4, domestic demand for Thames, excluding Three Valleys, would be 1,930-420 = 1,510 Ml/d.

Fig 3.1 Water Company Supply Areas

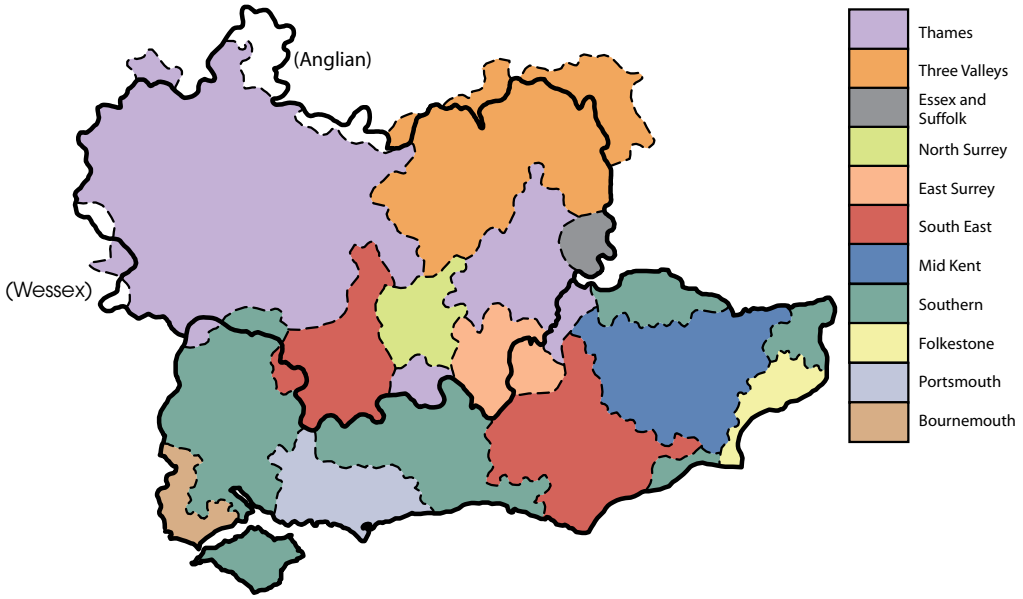
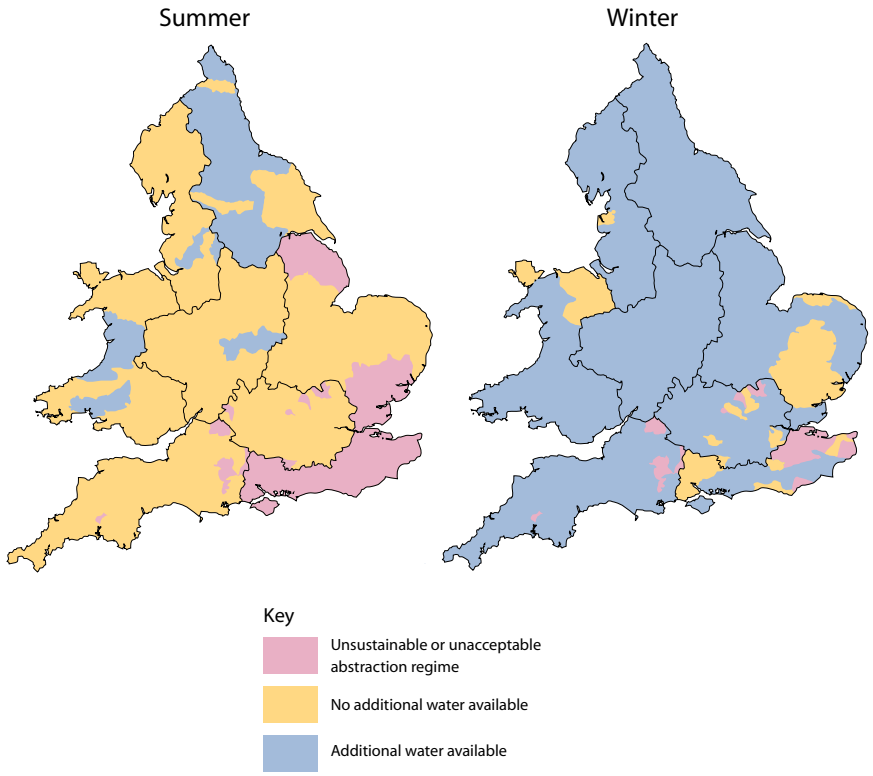


Fig 3.2 National Water Resource Availability



Maps from *Water Resources for the Future* - Environment Agency, 2000

in demand arising from the developments planned for the South East, while at the same time addressing the environmental deficit and the challenges of climate change.

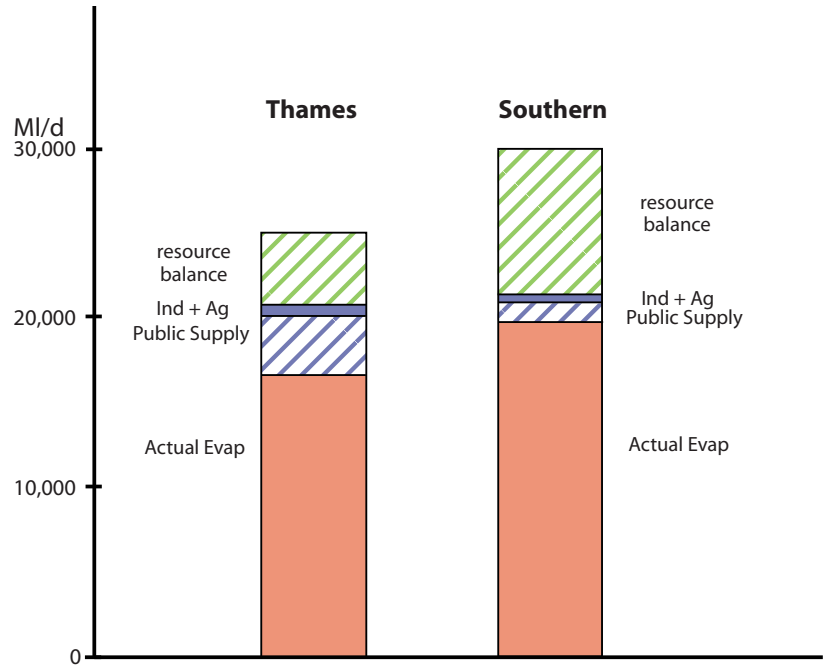
It is clear that the 1-in-10 dry year criterion as a trigger for emergency drought measures is becoming more frequent. CPRE SE does not believe that this should be invoked as a pretext for consumers taking the primary burden of drought management. A sustainable approach would spread the burden more equitably with water companies adopting broad based long term strategies.

3.3 The balance of resources

3.3.1 The results of resource assessments carried out by the EA for their Thames and Southern regions and discussed in the 2001 strategy documents (Refs 8 to 10) are also summarised in map form as reproduced in Fig 3.2. They reveal the contrast between the heavily stressed areas in the South East, and the relatively healthy state of river catchments and groundwater units elsewhere in England and Wales. Southern region, in particular, stands out as having a virtual year-round deficit and this is recognised in the designation of both surface and groundwater regimes as "unsustainable" or "unacceptable" in terms of the environmental deficit incurred. As such, there are few areas offering scope for any significant development of new sources of supply. Conditions in the Thames region appear more favourable, but even here the opportunities for increasing abstraction from rivers or aquifers would seem to be mainly confined to the winter/spring period.

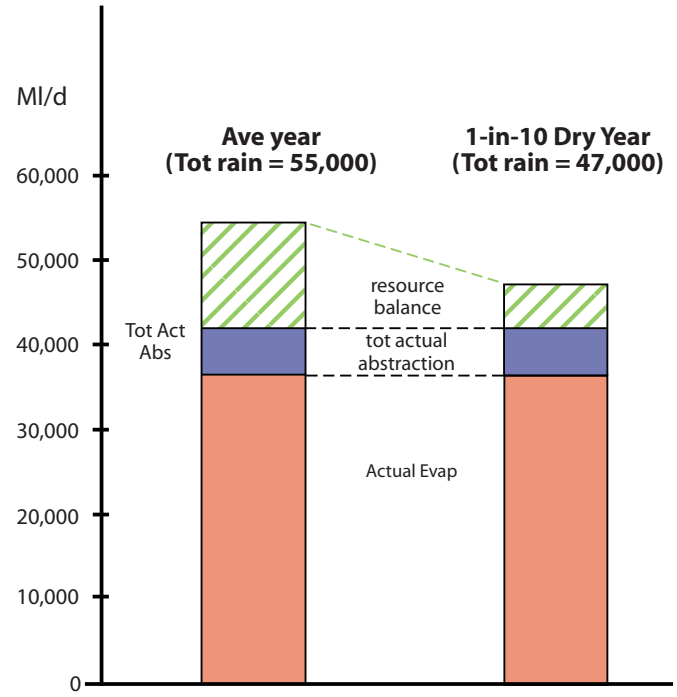
3.3.2 Some idea of the overall potential for the South East can be gauged from Fig 3.3, which compares the balance of resources for the two constituent EA regions. We can see from this that the Thames component, although

Fig 3.3 Regional Resource Balances



Based on data from "Water Resources for the Future." A strategy for England and Wales EA March 2001 (Table 3.2).

Fig 3.4 Thames and Southern Regions Resource Balances for Average and Dry Year Conditions



having a relatively low average annual rainfall (as shown by the column height in Fig.3.3), has to support a level of abstraction three times greater than that of the Southern EA region. In consequence, Thames comes out with a commensurately reduced balance of resources (4,500 against 8,900 Ml/d). At first sight this would seem to conflict with the picture presented by the sustainability maps (Fig 3.2), where the South is clearly under the greater degree of stress. In fact, the apparently high uptake reflects the high degree of long established waste-water re-use which characterises much of the surface water abstraction in the Thames catchment, where the river itself provides the location for the larger wastewater discharges and public supply intake works. By contrast the Southern EA region, with its high proportion of coastal discharges, has traditionally had fewer natural opportunities for re-use. This may tell us something about the region's potential for further resource development based on re-use. Also, the areas of highest average annual rainfall in the Thames region (800-900mm) are mainly concentrated on the outcrops of the major aquifers which therefore receive greater rates of groundwater recharge than the North Downs, which lie in a comparatively low rainfall belt (600-700 mm). This may, in part, also help to explain the relatively favourable Thames balance.

The component labelled in Fig. 3.3 as "public supply" represents the total actual abstraction recorded for the region in this category and can be taken as corresponding to the demand plus leakage losses. This has to be matched against the total capacity of all sources of supply serving each region. Other than at times of drought, there will generally be a working surplus which, when not called into use e.g. to meet rising demand, forms part of the resource balance (the "environmental dividend"). But this will be limited by the maximum quantities authorised under the companies' abstraction licences. The balances can therefore be taken as the maximum volumes available for sustaining river flows, wetlands and water table levels throughout the two EA regions and, as Fig.3.4 shows, this can be severely reduced under drought conditions.

3.3.3 For both EA regions, the high levels of historic exploitation for public supply and industry have had their inevitable impact on the water environment, with a significant reduction in the flow of springs issuing from the Chalk and Oolite aquifers of the Chilterns and Cotswolds and the Chalk of the North and South Downs. The resulting progressive decrease in base-flow has shown itself in the degraded quality and impoverished habitats of the affected streams and associated wetlands. True wetland areas are now either very small or greatly fragmented, with estimates published by the EA putting the various total area designated under the European Habitats and Bird Directives at less than 5% of the Thames catchment. Of this, only 10% comprises wetland habitat (even though taken overall the Thames region has more than 450 SSSI sites, 100 of them containing designated river and wetland sites). The degree of disruption of the migration pathways has left the main river corridors as the only recourse for much of the wildlife and it will require a large-scale low-flow-alleviation programme to reverse the loss of biodiversity (Ref Chap 4). Examples from the Southern region include the Darent and Great Stour, where baseflows have been depleted as a direct result of over-abstraction from the Chalk of the North Downs.

CPRE South East shares the view of others that the fragile state of the environment is in part a direct result of the priority historically given to public supply abstraction. CPRE South East believes that there must now be a change to a more balanced approach.

3.4 Some lessons from the long droughts

3.4.1 For many of the resource areas that can be described as groundwater-dominated, the levels of authorised abstraction can often account for more than three quarters of the effective rainfall (or "recharge"), even in an average year. In parts of the North Downs of Kent, the commitment during the 1989-92 drought exceeded 100%, which effectively amounted to the "mining" of aquifer storage. Any material changes in the balance of aquifer resources are therefore bound to have a profound impact on water conservation and supply strategies throughout the region. The droughts of recent years have been marked by some notably dry winter and spring periods, and the consequent shortfall in aquifer recharge has highlighted the vulnerability of those water undertakings which are either wholly or largely groundwater based.

3.4.2 If the increasing frequency of drought events can be taken as part of the process of climate change in south-east England, then it should be possible to apply the lessons learned in the long-term management of water resources. The long drought of October 1988 to September 1992 produced, in east Kent, a cumulative deficit of 600mm; equivalent to an average year's rainfall. Corresponding rates of groundwater recharge were estimated at little more than 50% of average and historic minimum water table levels were recorded throughout the aquifer. Total annual runoff for the major spring-fed streams fell to less than 40% of average, while smaller watercourses suffered an almost total loss of summer baseflow. Post-drought recovery was slow and erratic, with large areas achieving only 30% of the normal recovery range by mid-winter 1994. Many of the conditions experienced during 1989-92 were revisited in the summer and autumn of 1995; and the severe winter drought of 1995-96, which produced less than half the normal rainfall, continued to have its effect, with groundwater storage and baseflows again reaching record minimum levels.

3.4.3 Taken in the context of long-term climate change, the droughts of the late 1980s to mid-1990s have to be seen as part of a progressive deterioration in the balance of water resources in the South East. The corresponding long-term depletion in groundwater storage is considerably steeper than can be accounted for solely by the recorded increases in borehole abstraction. The implication for the long-term management of groundwater resources is that there is no remaining scope for exploiting aquifer storage without lasting detriment to river and associated wetland environments. In extreme cases we face the prospect of mining groundwater, in the sense that further general increases in borehole abstraction would almost certainly preclude full recovery of storage except in years of above-average winter rainfall. This would effectively increase the critical period of any given aquifer system, with consequent loss of operational flexibility and an almost inevitable fall in drought-output capacity for many public supply sources.

3.4.4 A groundwater resource can only be managed effectively on the basis of long-term minimum reliable recharge. Current levels of abstraction will not therefore be sustainable if the drought events of recent years are in any way indicative of the conditions likely to obtain as a future consequence of climate change. Notwithstanding all this, a view still persists in some water-supply circles that exploitation of groundwater storage is a practical resource management option. Its supporters further assert that those water companies which are wholly dependant on borehole supplies are likely to cope better under drought conditions than those reliant on the yield from winter-filled reservoirs. Experience suggests otherwise, as for the most part the companies which have

come through the drought years with least difficulty are those operating very flexible supply networks which draw on a mix of sources.

3.4.5 Another popular myth is that adequate reserves of groundwater remain for further development and that there is "plenty to be had" by those companies prepared to sink deeper boreholes. This pre-supposes broadly uniform aquifer characteristics irrespective of depth, which is manifestly untrue. It disregards the evidence for progressive storage depletion and the impact that such a supply strategy would have on our spring-fed streams and the river environment in general. The extent of groundwater and base-flow depletion was conclusively demonstrated by the NRA National River Survey 1990 which led to the low-flow alleviation programme covering 40 of the most seriously affected streams in England and Wales. The view also once persisted that groundwater was able to recover quickly without problems, but the recent experience of hose pipe bans, supply restrictions, loss of river flows, fish deaths and habitat destruction has exposed this fallacy.

4. What's the Problem?

4.1 New challenges

The South East faces an unprecedented increase in the demand for water over the next 20-25 years, arising from:

- the need for a greater proportion of catchment resources to be diverted to the improvement and protection of our rivers, lakes and wetlands via the national programme for the restoration of sustainable abstraction;
- the ongoing impact of climate change, increasing demand while at the same time reducing rates of natural replenishment of river and groundwater resources; and
- the planned housing growth for the South East and inward migration, with the consequent increase in public-supply demand, coupled with concurrent growth in agricultural use.

4.2 Regional demand assessments

Separate assessments have been made by the EA for their Southern and Thames regions and both take into account the combined impact of housing growth and climate change.

4.2.1 Southern region

Climate change will impact most severely on sources dependent on river abstractions with little or no supporting storage. Coastal sources could also be vulnerable to sea level rise and saline intrusion but no estimates are available for the impact on water availability or demand. The draft South East Plan provides for approximately 325,000 new houses for the Southern EA region by 2026. Estimates assume a continuing trend toward single occupancy. It is expected that single occupancy will account for up to 75% of new housing demand, half of this originating from within the region; each single occupant using 20 litres/day more than a member of a shared household. The EA estimates have assumed a total housing increment of 379,650, with a corresponding public water supply (PWS) demand increment of 66 Ml/d.

4.2.2 Thames region

Climate change is expected to bring an increase in summertime use for most households (mainly garden watering and personal washing), and the EA estimates that this could add 50 Ml/d to PWS demand by 2025. The impact on industrial and commercial usage is more difficult to calculate, and no allowance has been made for these categories. Clearly there will be an impact on agricultural usage, particularly irrigation, but no estimates appear to have been attempted at this stage. The more recent UKCIP (UK Climate Impacts Programme) model forecasts indicate lower summer rainfall totals and higher average annual temperatures with correspondingly greater rates of evaporation and transpiration. For the groundwater-fed rivers, we must expect a progressive decrease in late summer flows, and drought episodes of increasing frequency and duration. However, few public supply systems are expected to show significant decreases in yield, while some winter-fed reservoirs may even have small increases. In general, however, there is a wide margin of uncertainty for any long range impact forecasts, and this again must favour flexible

management strategies that allow phased development of new sources of supply. The South East Plan provides for construction of 253,640 dwellings in the Thames region. If we assume that 75% of new properties will have single occupancy and the remaining 25% an average of two occupants, the equivalent population increment comes out as 317,253.

Taking the corresponding per capita demand for the single and double occupancies at 180 and 160 litres/head/day (l/h/d) respectively gives a total consumption increment of 54 Ml/d.

4.2.3 Summary for South East region

Total housing growth water demand increment for the EA Southern and Thames regions is estimated at 120 Ml/d.

4.2.4 The supply/demand assessments undertaken by the EA as part of the WRSE (Water Resources for the South East) programme, and reported in 2004, included a comparison of the two estimated 2025 resource balances for two housing growth scenarios.

- Medium growth at 29,500 pa, corresponding to RPG9 with the additional new housing under the draft South East Plan;
- High growth at 36,000 pa, which exceeds the highest rate (32,000) considered in the draft South East Plan.

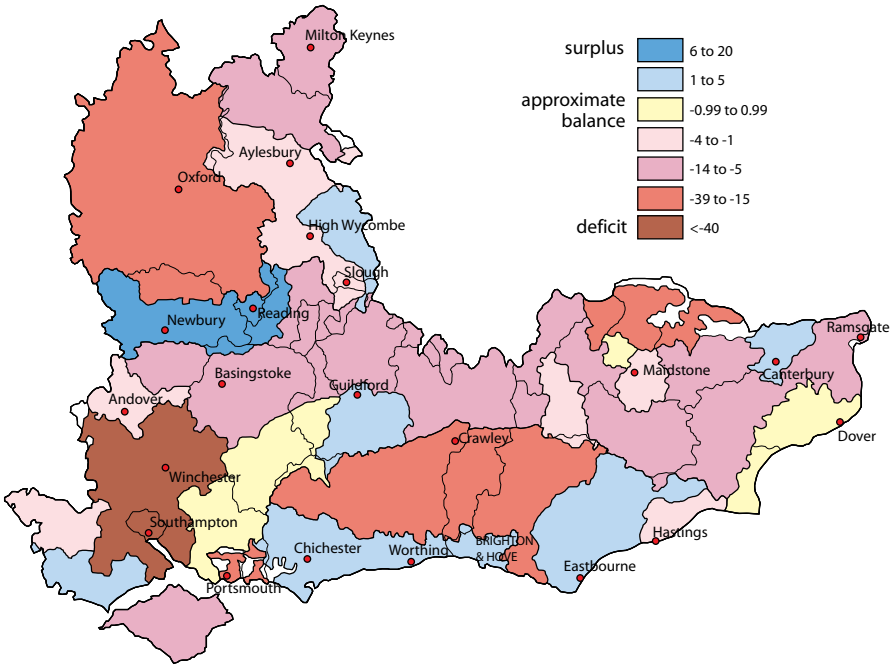
4.2.5 Some general assumptions were applied in both EA assessments, notably:

- Appropriate planning permissions and abstraction licences for supply side options are delivered in a timely way. But abstraction licences need to be approved by the Environment Agency, and reservoirs can take years to plan and are often opposed by local communities;
- Enabling mechanisms would be put in place to encourage greater demand management (e.g. water-efficiency fittings in new homes). But take-up of water-efficiency measures will be low unless there are regulations or financial incentives to encourage them;
- Over 55% of the households of the SEERA region will be metered by 2020. But this is an optimistic assumption, as most South East water companies are failing to meet their metering targets;
- The impacts of climate change are no greater than those allowed for in the modelling. But there are still uncertainties surrounding future predictions of the impact of climate change, particularly at the regional level;
- Adequate funding will be provided to implement water-resource plans. But long-term funding for water infrastructure is by no means certain.

CPRE SE notes that even these assumptions included considerable caveats indicating the EA's caution under present institutional arrangements. We also note that this list excludes any reference to either water recycling or investment criteria and pricing as incentives for change. This latter is probably because such matters are the remit of Ofwat, not the EA.

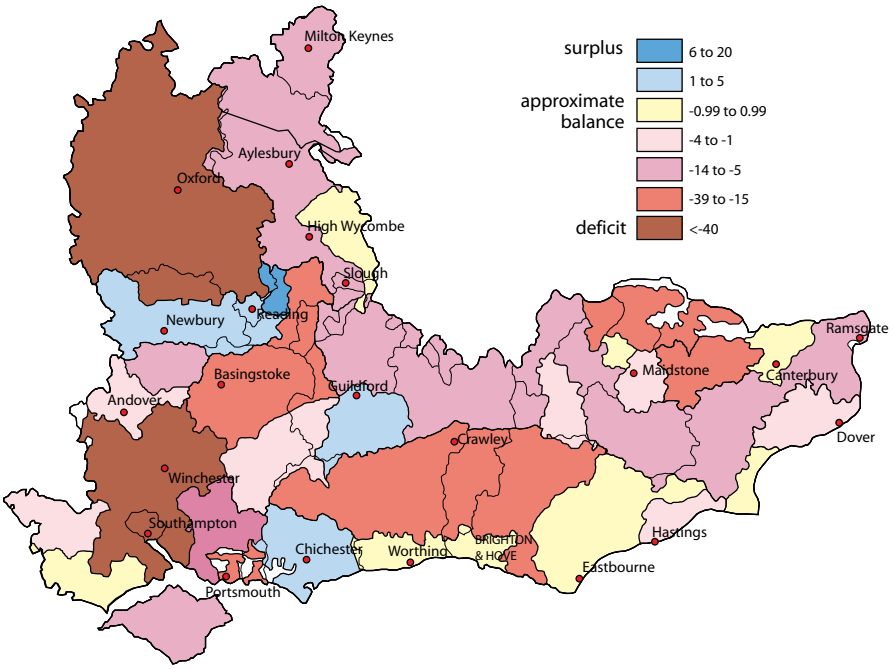
Fig 4.1 WRSE Projected Supply Demand Balances for 2025

A Projected water resources surplus-deficit forecast, 2025: Medium housing growth, no new resources, no improvement in water efficiency



Environment Agency 2006

B Projected water resources surplus-deficit forecast, 2025: High housing growth, no new resources, no improvement in water efficiency



Environment Agency 2006

4.2.6 Figs 4.1 A & B, reproduced from the EA 2004 report, show the projected balances for the two scenarios. In both cases the South East would be heavily in deficit, with the greatest shortfalls anticipated in Oxfordshire and Hampshire. The region would be drought vulnerable and subject to frequent restrictions on non-essential water use. The EA concludes that to achieve and sustain a balance for the plan period would require three quarters of the deficit to be met from new supplies (mainly new reservoirs), with the remainder covered by water-efficiency measures, aiming at a reduction in per capita consumption of 21% as an average for all new households created in the region.

Such a heavy reliance on reservoir capacity would seem optimistic in light of the questionable viability of some schemes (ref. Section 5.4) and the long lead times involved. Furthermore, no allowance appears to have been made for the influence of housing growth in London or other neighbouring regions and it is still unclear as to how much of the capital's supply is currently met from resources in the South East. For example, the development proposed for Thames Gateway, an area already under stress, could have a direct or indirect impact on the balance for other supply areas elsewhere in the region.

CPRE SE notes the EA's caution about reliance on reservoirs. We share this concern and believe the situation should be a trigger for changing to a different strategy with modelling based on more conservation by companies and consumers and indirect recycling as a strategic part of water supply plans.

4.2.7 The 2001 EA Strategy "Water Resources for the Future" incorporates scenario-based forecasts of alternative public supply outcomes representing what might be regarded as the best and worst cases for the plan period in terms of resource impact. These are set out in Appendix I, the outcomes presented as four alternative demand totals for 2025/26, ranging from 3,300 Ml/d to 8,700 Ml/d.

4.3 A CPRE South East view

4.3.1 CPRE SE has attempted an alternative forecast of demand growth over the next 20 years by assessing the collective influence of the three factors listed in Section 4.1. The following summaries provide an outline of the arguments and assumptions adopted in their evaluation, and draw heavily on authoritative sources for each category of water and environmental management. In Chapter 5 we have compared the out-turn total demand with the results of the scenario-based estimates derived by the EA as the starting point in the formulation of its 2001 strategy. Most of the scenarios anticipate significant reductions in public-supply demand between 2010 and 2025. Unfortunately, recent events lead us to a different conclusion, pointing to the need to plan for a future in which, even assuming the most effective water-saving and demand-management measures, we will still be facing a progressive increase in the supply/demand deficit for much of the South East region.

4.3.2 Demand growth to 2025

We have taken this to comprise:

- Housing growth, in accordance with the South East Plan, with increased demand on public supplies, including domestic, industrial and agricultural categories;
- Leakage losses from public supply distribution systems;

- Unplanned growth arising from inward migration in excess of the levels already envisaged in the South East Plan;
- Direct abstraction for agriculture;
- Climate change;
- Restoring the environment including the condition of ground water and wetlands.

4.3.3 Planned growth and public water supply (PWS)

The forecasts under the South East Plan envisage 578,000 additional households (approximately 324,000 for Southern and 254,000 for Thames region) created at an average rate of 28,900/year. Assuming an average occupancy of 2.0 per household and usage at 160 litres/head/day for the plan period, (Ref E.A Nat Strat 2001), this would represent an additional demand by 2025 of 185 Ml/d (excluding distribution leakage). This does not include the non-domestic categories of public supply, which comprise industrial and agricultural usage and together account for 15% and 22% respectively of the totals for Southern and Thames regions. Defra calculates that approximately 20% of all agricultural and horticultural irrigation water in the South East is mains fed. Comparison with the direct abstraction data would give 8 and 5 Ml/d respectively for Southern and Thames regions, but as they are relatively small we have treated them as part of the PWS category for purposes of demand-growth forecasting.

The industrial component of public supply has remained relatively stable in recent years. This reflects the drive for water efficiency, coupled with a progressive reduction in annual abstraction accompanying the shut-down of traditional high-use processes and the adoption of water-saving technology. The likelihood is that this continuing trend will, at least, off-set any underlying demand growth, and for some sectors there may in fact be scope for further reductions in consumption.

4.3.4 Distribution leakage

The report of the House of Lords Select Committee on Water Management (Ref 2) records the conclusion by Ofwat that, with the exception of Thames Water (and United Utilities) all companies operating in England have now reached "economic levels of leakage". The current status of the companies operating in the South East region is summarised in Table 4.1, which also shows the recommended 2010 target levels. If the targets are met in full, there would be an additional saving of nearly 200 Ml/d, but there would still be 21% losses. In the opinion of Ofwat this represents the best that can reasonably be achieved in practice (see also Section 4.6.5). Three Valleys lies outside the South East region and the Water Into Supply (WIS) for this area will therefore need to be deducted from the total water available. An allowance will also need to be made for water exported from Thames SE (Lea Valley).

4.3.5 Unplanned growth

In calculating a resource balance for the plan period, it seems sensible at the present time to include some additional contingency for inward migration. Estimates are at best conjectural, but on the basis of the few official figures available for the SE we have assumed an increment of 100,000 over the last two years (2005/6). A cautious assumption would be an average net inflow of 25,000 over the next 20 years. At 100 l/h/d average this would add 50Ml/day by 2025, not counting distribution leakage.

Table 4.1 Current and Target Distribution Leakage as a Proportion of Water into Supply (WIS)

Water into Supply		Distribution Leakage					
		Current			Target 2010		
Water Company	WIS Ml/d	Ml/d	Litres Per Property Per Day	% Loss	Ml/d	Reduction Ml/d	New % Loss
Thames*	2,809	915	261	33	725	190	26
Three Valleys	877	149	120	17	140	9	16
Southern	586	92	89	16	92	0	16
South East	391	69	116	18	69	0	18
Portsmouth	180	30	102	17	30	0	17
Bournemouth	164	22	116	13	22	0	13
Mid Kent	163	29	116	18	27	2	17
E Surrey	161	24	90	15	24	0	15
Folkestone	46	8	114	17	8	0	17
Total	**5,377**	**1,338**	**1,124**		**1,137**	**201**	
Weighted Average				**25**			**21**

* The higher loss rates are mainly concentrated in the Lea Valley supply area which, although for the most part lying outside the region, could be treated as indirectly influencing the demand on resources within the South East.

4.3.6 Direct abstraction for agriculture

This looks set to increase with the forecast impact of climate change on irrigation demand for horticulture and market garden field crops. Under the 2003 Water Act (Ref 11), trickle as well as spray irrigation is now subject to licensing control, and this should help to reduce some of the pressure on the more vulnerable resource areas during the summer months. It may also encourage the creation of winter storage and this would in turn relieve the pressure on public supplies. The last 25 years have seen a substantial increase in the irrigation of high-value crops but with a corresponding decline in grass and cereal application. Field vegetables now represent over 25% of the total irrigation demand compared with less than 20% in 1977. The findings of a Defra survey published in 2003 identified a number of risks facing agriculture and horticulture over the next 20 years, including climate change, legislation and the interaction of domestic and global markets. A relatively moderate climate-change trend could, for example, be expected to produce a demand increase for the South East of between 20 and 25% within 20 years. This could be doubled if we assume a reduced CAP framework and a more attractive market for high-value irrigated crops. Under this scenario, it would therefore seem reasonable to work on the basis of a 50% increase in demand by the end of the SE Plan period. The same report, however, noted that expansion of irrigation in some regions was already being restricted by lack of available water and there could of course be further restrictions imposed by the EA in order to meet the new, more demanding, targets that have been set for the rehabilitation of river and wetland wildlife sites. The growth estimates presented in Table 4.2 are based on the findings summarised in Appendix II. No allowances are made for demand increases in any other agricultural use category e.g. arable.

Table 4.2 Direct Abstraction for Agriculture Ml/d

Region	Current Level[1]	Forecast Increase At 50%[2]	2025
Southern	30	15	45
Thames	20	10	30
Total	**50**	**25**	**75**

[1] Based on Defra 2003 survey for the SE
[2] Based on Defra 2003 + 50% as estimated by Defra for the effects of climate change and trends towards more local food production.

4.3.7 Direct abstraction for industry

Although a relatively cost-effective option, direct abstraction accounts for only 20% of the total industrial demand in the Thames region, and there is a continuing decline reflecting the cut-backs in manufacturing and the drive for waste minimisation. Demand in the Southern region has stabilised in recent years following a period of decline throughout the 1970s and 1980s. Best practice studies carried out in recent years have also revealed significant scope for further reductions in both industrial and commercial usage, with estimates of possible savings ranging from 15 to 25%. The Lords Select Committee report saw further benefits to be gained from a wider uptake of the Defra/DTI "Envirowise" programme, which offers practical advice to business on water-efficiency opportunities along with other environmental management measures.

The Environment Agency expects industrial abstraction to decline further, at least in the medium term. This trend could be augmented by incentives to comply with the Kyoto targets for global emissions. As from April 2005 the regulators have required the larger companies to prepare operating and financial reviews that consider environmental impact, including water use.

4.3.8 Climate change

Global warming must now feature as the most important single influence on future trends in catchment water balances and public supply demand. The most recent forecasts by UKCIP (UK Climate Impacts Programme) 2002 for south-east England give a picture of increasing average annual temperatures and a trend toward more extreme fluctuations in seasonal rainfall – popularly interpreted as "wetter winters and drier summers". We must therefore expect to see an increasing frequency of severe and protracted summer droughts, with high soil-moisture-deficit levels persisting for longer periods. This latter factor in particular could negate any resource benefit likely to accrue from a higher winter rainfall, especially as some forecasts indicate that this could take the form of relatively short and intense storms producing high rates of flood runoff, which would contribute relatively little to groundwater replenishment and offer few opportunities for diversion to storage. This scenario of an increasingly erratic climate must add to the uncertainties already inherent in the management of water resources. If the future means more severe droughts, we will have to plan for greater peak-season demands for public supply and

irrigation. Extreme conditions are inevitably harder to manage – wet winters do not necessarily compensate for dry summers, and this could present new challenges in sustaining supplies and protecting the water environment.

By contrast, the evidence for rising temperatures is more consistent – and this could, in the long run, prove to be the most important factor, bringing in its train higher evaporation and plant transpiration rates and driving up summer demand peaks. Just what these changes may mean for our water resources can perhaps be gauged from their effect, so far, on river flows. The baseflow of Kent's Great Stour, for example, appears to have decreased by 25% over a period of 35 years. Only about one third of this loss can be accounted for by increases in water supply abstraction. Most of the changes that we see taking place almost certainly result from a combination of factors, including climate change and demand growth. Appendix III includes a summary review of historic trends and forecasts for the South East.

As to what this could mean for the future public supply/demand balance: findings from recent Defra studies reported in the EA 2004 review (Ref 12) suggest increases in demand, as a UK average, of around 2% by 2025. The corresponding effect for the South East would be more pronounced, and if we take 3% as a working estimate, this would be equivalent to an increase of around 150 Ml/d by 2026. Recent model studies by UKCIP have shown that annual river flows could fall by the 2020s with "significant reductions in summer averages". The EA has also forecast a decrease in the deployable output of public supply boreholes drawing on the North Downs Chalk aquifer.

4.3.9 Restoring sustainable abstraction – the environmental imperative

Much of the existing legislation relating to the management of water resources has been framed with security of supply given priority over environmental sustainability. However, recognition of the increasing stress on river and wetland habitats, and the need to protect biodiversity has, in recent years, led to the introduction of European and national legislation dedicated to restoring a balance between water use and the water environment. Many of the key provisions of the 2003 Water Act have, for example, been put in place to facilitate compliance with the European Water Framework Directive (EWFD) of 2000. This now sets the parameters for national water-management policies. It requires all member states to take measures for the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and ground waters. These measures are being implemented as elements of River Basin Management Plans (RBMPs), formulated in accordance with specific environmental objectives and reviewed on a six-year cycle. For water resources, these have been summarised as:

- No further deterioration in status
- Restoration to good status
- Compliance with the water-quality objectives for protected areas

The timetable for implementing the EWFD alongside the Habitats Directive includes the following key stages;

2006 Publish and consult on a timetable and work programmes for the production of RBMPs;

2007 Publish and consult on an interim overview of significant water management issues for each River Basin District;

2008 Publish and consult on drafts of RBMPs for delivery of environmental objectives;

2009 Publish first RBMP for each district (including environmental objectives);

2010 Ensure proper water pricing policies are in place;

2012 Establish operational programmes for delivery of environmental objectives. Follow with interim progress reports;

2015 Meet main environmental objectives. Thereafter, review plans at six-year intervals.

The emphasis on integrated river basin planning, coupled with the provisions for setting quality standards, will also benefit biodiversity and inform the statutory process for controlling diffuse pollution. Taken in combination with the Habitats and Birds Directives, it will also address the impact of abstraction on designated sites. The principal objectives of the RBMPs were anticipated by the EA in the formulation of the Catchment Abstraction Management Strategies (CAMS), and some of the concerns raised by CPRE in Water for Life (Ref 13) are now being addressed in the constituent water resource assessments (water "audits") and sustainability appraisals. The aim of these is to establish a more balanced regime of abstraction and environmental needs for each major river catchment ("Water Resource Management Unit") or aquifer ("Ground Water Management Unit"). Taking each unit in turn, the balance of resources determined in the initial assessment stage is then compared with whatever might reasonably be regarded as the minimum requirements for a satisfactory environmental status. A conclusion is then reached as to whether the unit in question is in surplus or deficit in terms both actual or licensed abstraction (Fig 4.2). The sustainability appraisal stage which follows is essentially a qualitative process by which a unit is "scored" under the four headings of environment, economics, society and resource use.

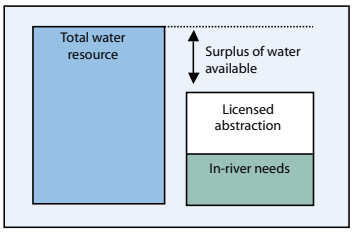
For some catchments, the CAMS process has already identified major public supply sources that will either need to be closed down or substantially reduced in output by the due date of 2015. This should add impetus to the formulation of more sustainable resource development plans and water company business plans, leading to a more equitable balance between supply-side and water-efficiency components. An "appropriate assessment" is also required under the Habitats Directive (Ref 4) in order to satisfy the competent authority (Natural England) that current levels of abstraction allow adequate flow of fresh water into or within any designated "high priority" sites; and for this they can invoke the precautionary principle.

The CAMS process, if carried through as envisaged, will provide the impetus for a more sustainable resource management strategy, bringing with it the prospect of a progressive improvement in the environmental quality of the region's rivers, wetlands and aquifers. It requires, however, that certain water companies relinquish a proportion of their public supply capacity (surface or groundwater) and the success of the strategy will rest on their ability to secure viable alternative sources. This is easier said than done, bearing in mind the limited scope for further development of existing resources. Assessments have not yet been completed for all of the CAMS catchments and a full picture of the implications for the water companies is not likely to be available before 2008. On the basis of the initial findings it would seem that there will be a need for some substantial reductions in abstraction in the more heavily stressed management units. Taken together, the constituent water companies could be facing a total shortfall of up to 260 Ml/d (80 for Southern and 180 for Thames), as a minimum, with a replacement deadline not later than 2015. This is a substantial quantity, but represents less than 6% of the current total deployable

output. No separate allowances have been made for compliance with the Habitats Directive, which cannot be quantified with any confidence at this stage (particularly as it allows the competent authority to apply the precautionary principle in the assessment of environmental impact and any subsequent setting of abstraction-control conditions).

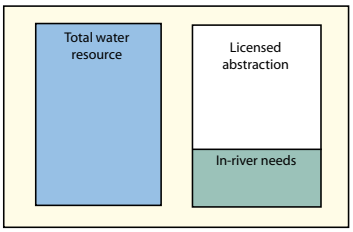
Fig 4.2 Resource Assessment & Availability

Water available



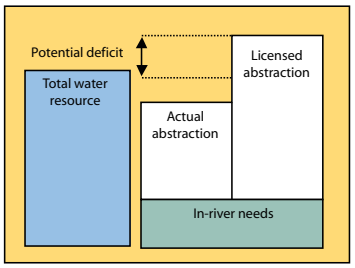
Water likely to be available at all flows including low flows. Restrictions may apply.

No water available



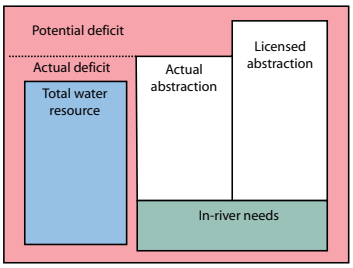
No water available for further licensing at low flows although water may be available at higher flows with appropriate restrictions.

Over licensed



Current actual abstraction is resulting in no water available at low flows. If existing licences were used to their full allocation they would have the potential to cause unacceptable environmental impact at low flows.

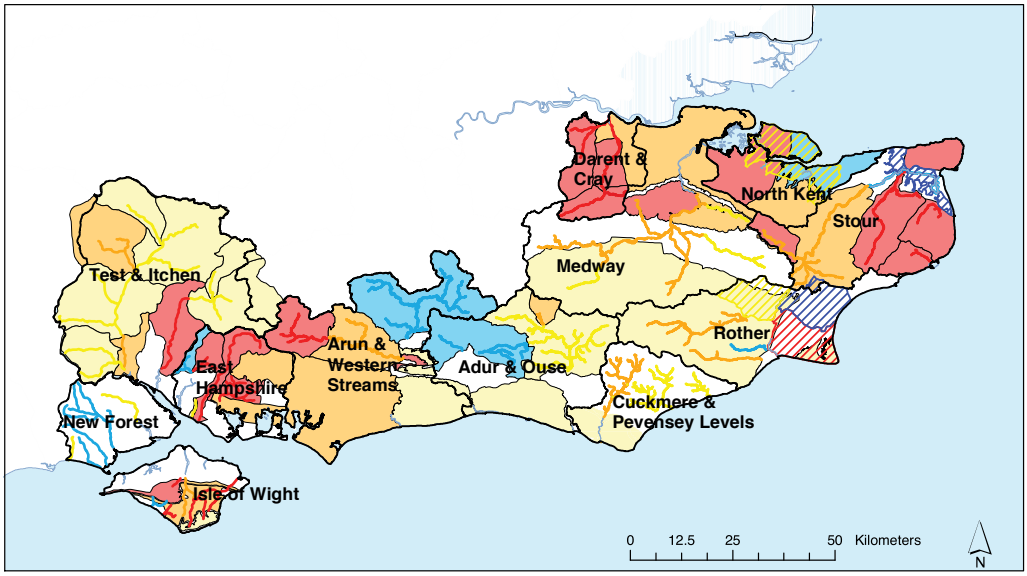
Over abstracted



Existing abstraction is causing unacceptable environmental impact at low flows. Water may still be available at high flows with appropriate restrictions.

Reproduced from Environment Agency Catchment Abstraction Management Strategy

Fig 4.3a CAMS Resource Availability Status for Southern Region

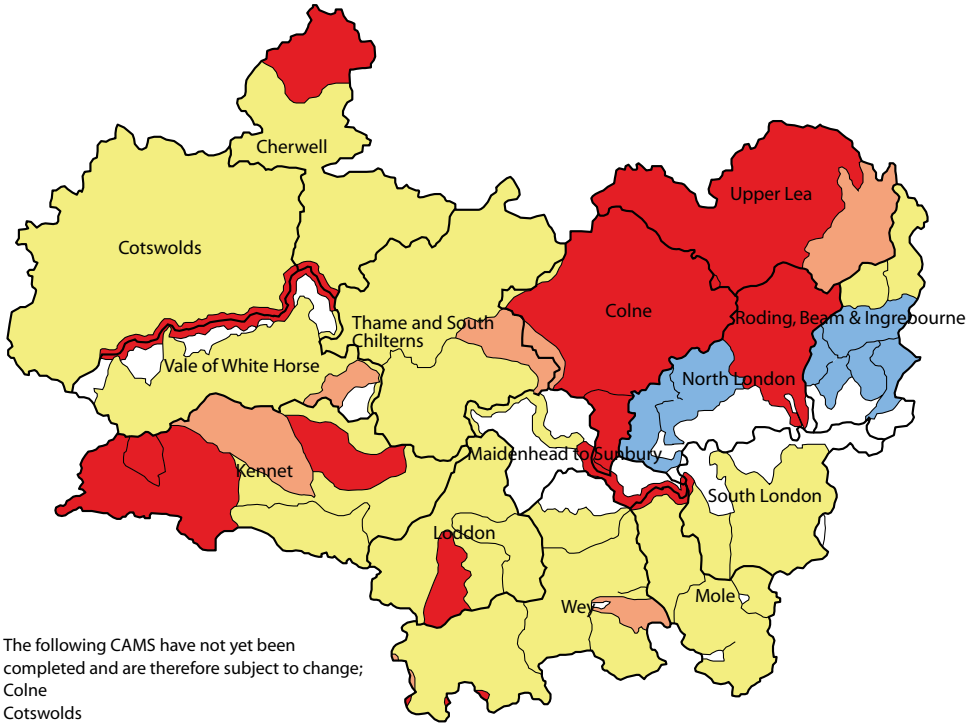


Figures 4.3a and 4.3b summarise the resource availability status for the EA Southern and Thames regions. With the exception of the few areas marked "water available," virtually no further development of resources is likely to be achieved without adverse environmental impact. This reinforces the general picture for the South East presented in Fig 3.2, and seen in this light, the strategies favoured by many water companies, with their emphasis on resource development, begin to look increasingly fragile.

4.3.10 Summary of estimates for the South East region

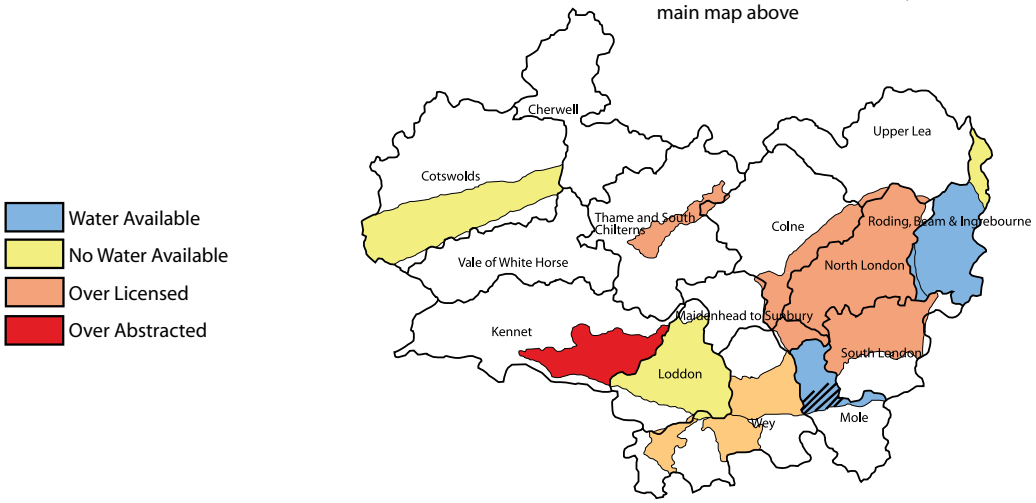
Table 4.3 provides a summary of the out-turn demand estimates for 2025. The figure of 5,447 Ml/d falls within the mid range of the scenario estimates derived by EA for their Southern and Thames regions.

Fig 4.3b CAMS Resource Availability Status within the Thames Region



The following CAMS have not yet been completed and are therefore subject to change;
Colne
Cotswolds
Mole
Wey

Groundwater units that have a different resource availability status from the main map above



The Resource Availability Status shown in Figure 4.3a and 4.3b takes into account *all* licensed abstractions and known discharges and it is determined using a number of techniques as part of the Resource Assessment Methodology (RAM). The resource balance may be approached in a number of different ways depending on the hydrological type and degree of detail appropriate for the management unit. This balance is then compared to the ecological needs of a given river reach, or wetland area, and the licensed and actual abstractions affecting that reach (Figure 4.2) to give an overall Resource Availability Status.

This approach includes a number of important assumptions and simplifications that are necessary to get a nationally consistent approach so that when all the information is brought together in regional maps, like the ones presented here, there can be some meaningful comparison between areas. However, this does not mean that an area marked "over-abstracted" suffers ecological damage from abstraction all the time in all water features, but it does mean there is a high risk in dry years, or when abstraction is particularly high. These risks are compounded by poor water quality associated with discharges from wastewater treatment works, other point source discharges and diffuse pollution from agriculture, industry and road runoff.

Table 4.3 South East Region*: Public Supply Demand Growth To 2025, Average and 1-in-10 Dry Year Conditions Ml/day

Condition	Current demand	Demand growth components				Out-turn with 3% added for climate change
		Planned	Unplanned	Leakage	Tot.PWS	
Ave. Year	4,323	185	50	46	4,604	4,742
1-in-10 Dry Year	° 4,971	° 213	° 58	46	5,288	5,447

* EA Southern + Thames Region - Three Valleys
° Average Year + 15%

4.4 Supply/demand in 2025

Fig 4.4 represents the CPRE SE interpretation of the current supply/demand balance as the basis for a forecast of conditions in 2025. It compares the 20-year demand trend based on Table 4.3 with a water-availability profile which takes account of notional efficiency gains up to 2010 and a subsequent loss of 260 Ml/d to reflect the PWS capacity that may need to be relinquished by the water companies in compliance with EWFD and HD requirements. No other supply-side adjustments such as new reservoirs can be anticipated at this stage, and on this basis, a 1-in-10 dry year out-turn of 5,447 Ml/d would represent a drought deficit of **1,007 Ml/d**.

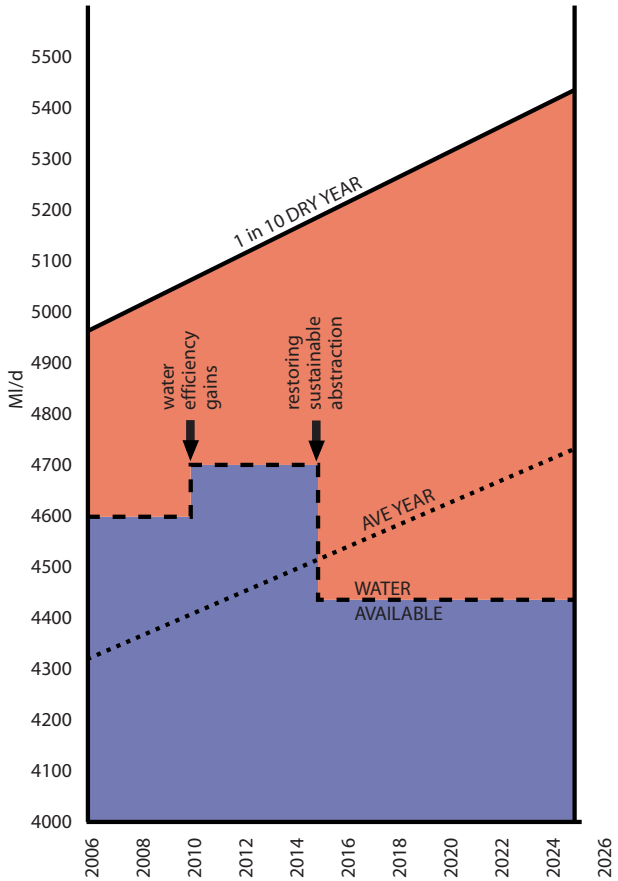
4.5. Unfinished business – EA reviews

4.5.1 No strategies have yet been formulated for the South East region which measure up to a deficit of this magnitude. It is also clear from the EA's own findings that there is little to be gained by further development of indigenous river and groundwater resources. The extent of the projected shortfall calls, instead, for a more broad-based programme, with an emphasis on water efficiency and conservation measures. This view seems to be reflected in the more recent annual strategy reviews carried out by the EA.

4.5.2 The 2004 EA review (Ref 12) was able to report some good news on a few fronts, including progress with meter penetration, a reduction in industrial usage and a slow-down in the increase in per-capita domestic consumption. Weighed against this, however, is the relatively poor progress on leakage reduction and the continuing scepticism of the water companies with respect to the benefits of demand management and water-efficiency initiatives. It was noted that the latest water-management plans were "too heavily dominated by resource developments," these being taken to include both groundwater and reservoir-based schemes. Also, notwithstanding the continuing and increasing impact of climate change, there was little sign of any progress in the formulation of an effective counter-strategy – this at a time of increasing development pressure on resources in the regions (such as the South East) with the highest populations and lowest rainfall.

CPRE SE's view is that water companies are unlikely to make the necessary strategic changes until this is reflected in the investment and pricing models that are set and controlled by Government through Ofwat.

Fig 4.4 Supply/Demand Projections: Public Supply SE Region (Excluding Three Valleys)



1 in 10 dry year out-turns for alternative housing-growth targets, Ml/d (ref SE Plan)			
annual target	planned growth PWS demand by 2025	total PWS out-turn	increase on SE Plan out-turn
28,900*	213	5,447	-
32,000	236	5,470	23

* Current SE Plan target

4.5.3 The Agency's conclusion, not surprisingly, was that there was still room for improvement, as demonstrated by their long list of key actions, many of which are aimed at water efficiency and environmental improvement targets. They include the following:

- Make changes to abstraction licences (with compensation where appropriate) wherever necessary to protect important wildlife sites;
- Conduct further research into the relationship between water quality, river flow and good ecological status;
- Assess the likely impact of future trends in climate change on river flow, water quality and aquifer recharge;

- Review water company water-resource plans and report to ministers;
- Publish drought plans annually (and make available for public scrutiny);
- Work with farmers, food processors and supermarkets to improve environmental performance while maintaining food production and quality.

4.5.4 At the same time the water companies were called on to:

- Make a commitment to further leakage reductions over the next 20 years and to the rationalisation of leakage-control performance indicators;
- Keep all drought plans and associated baseline monitoring programmes up to date;
- Undertake further studies to quantify water-savings from metering and formulate appropriate tariff structures that will encourage good conservation practice and also protect vulnerable consumers;
- To take the initiative, in line with the Water Act 2003, in the active promotion of the benefits of water efficiency and demand management.

CPRE South East notes that this list of actions does not include the necessary measures to help consumers benefit fully from metering and tariff incentives. Dual flush toilets and water efficient taps are equally necessary.

4.5.5 The 2005 Review (Ref 14) noted the environmental improvements at some sites where abstraction had already been cut back, and took some encouragement from the establishment of "Waterwise", funded by the water companies to promote a co-ordinated approach to water efficiency (with a five-year target to reverse the rising trend in domestic demand). However, the clear message is still one of unfinished business in the promotion of water efficiency and further reductions in distribution leakage. In the latter case the gains have been modest, and some zones in fact record significant increases in losses. The companies, as a result, have been tasked with improving their monitoring and reporting procedures. There was also little progress to report on meter penetration, with a number of companies remaining to be convinced with respect to the value of active promotion of the benefits to consumers. Folkestone and Dover Co was highlighted as an example of effective action in a stressed area and the point has been made that there is clearly scope for compulsory metering elsewhere in the South East. Otherwise, apart from some heartening progress on improving environmental awareness and promoting water efficiency, there is little in the action plan that moves us very far toward a strategy for addressing the future supply deficit.

Key actions include:

- Progress the case for compulsory metering where appropriate (including the South East);
- Promote water-sharing initiatives between companies in the South East and encourage strategic raw-water transfers;
- EA and companies to publish draft drought plans for public consultation;
- EA to issue revised water-resource management guidelines for companies (late 2006) for publication early 2008;
- Carry out further research into irrigated crop requirements.

4.6 A case to answer – the 2006 House of Lords Select Committee report

4.6.1 The House of Lords Select Committee report on water management, June 2006 (Ref 2) provides a comprehensive review for England and Wales and reaches some conclusions which are likely to present difficult choices for the water companies and regulators. Many of the issues would seem to stem from the fact that, at least in the opinion of the Committee, responsibility for water management is "dispersed and unclear". Some of the key conclusions and recommendations are summarised below.

4.6.2 On water management in general

There is a need for clearer lines of responsibility and accountability with respect to the funding procedures. The boundaries between Ofwat, EA and DWI are not clear. At present, neither the water industry nor the regulators have an agreed methodology for including sustainability within the decision-making process.

4.6.3 On regulation and legislation

Ofwat should allow sufficient long-term funding to enable water companies to undertake the necessary resource development to maintain security of supply. The current system also discourages long-term investment in R & D, for which there should be a separate allowance, exempt from efficiency targets.

There should be a balance struck between resource development and demand management, with promotion of water efficiency treated as a top priority. Each River Basin District should have an integrated water-management plan and the EA should have a statutory duty to draw up plans and advise Ofwat at the national level. Price setting should take account of economic, environmental and social sustainability criteria, while also ensuring security of supply.

4.6.4 On the demand for water

It is considered "unfortunate" that the growth areas are all located in the driest region of the country and the government has not considered water demand and supply when making its selection. It is also regrettable that ODPM failed sufficiently to consult the water industry or give due consideration to the water-management implications when formulating the Sustainable Communities Plan and selecting the growth areas. It is recommended that, in future, such consultations are held at the earliest possible stage rather than taking the supply of water for granted.

The committee was "completely unconvinced" by the Government's figures on the relationship between housing growth and water use. The Minister also misinterpreted them as indicating that growth would have a very small effect (0.1%) on water demand. The methodology is fundamentally flawed. Housing growth plans have not, for the most part, been factored into water company long-term plans and the process should be overseen by Defra and DCLG, "who must both take responsibility for the problems that their earlier lack of consultation has caused".

4.6.5 On water supply

There was insufficient evidence to convince the Committee that the potential consequences of climate change are being adequately factored into the

long-term management plans. Due to increasing demand, climate change and abstraction reductions, significant additional water resources will need to be developed alongside promotion of water efficiency. They also found it necessary to question Ofwat's criterion of "economic level of leakage" (ELL) as the sole measure of performance, insofar as it only compares the cost of leakage repairs with that incurred in providing an alternative or additional supply. Leakage levels could be reduced further and ELL should be replaced by a broader concept embracing economic, environmental and social sustainability, constituting a "Sustainable Level of Leakage".

The strategic potential of inter-regional raw-water transfers was also discussed with special attention to the prospects for exploiting the resources of the relatively high rainfall areas of the country (the contrast between Snowdonia at 4,000 mm/yr and East Anglia at 550 being noted). It was seen as a more modest and realistic aim than the "national grid" concept and could make effective use of existing inter-connections between water company supply areas.

There was considerable support for large scale re-use of treated wastewater. For some companies this has been a long-standing practice, usually carried out as an indirect operation involving discharge to, and re-abstraction from, the receiving watercourse. The time has probably arrived, the Committee concluded, for this approach to be adopted, and they recorded their disappointment that Southern Water had missed the opportunity with respect to the current Margate/Broadstairs wastewater treatment scheme. CPRE SE had identified this as a much-needed resource-development option that could have been implemented for the same capital expenditure as that incurred in the sea-disposal scheme which is now going forward. The Committee was therefore moved to recommend that the Government, EA and Ofwat encourage and support schemes for the planned indirect re-use of treated wastewater by water companies, especially in the driest areas.

4.6.6 On water efficiency

The Committee noted that the water companies have little genuine incentive to promote efficient use unless facing difficulty in maintaining supplies, and that such efforts as were made were relatively small scale and piecemeal. There was a need, therefore, for more energetic and imaginative promotion, particularly as most domestic users remained unaware of the need for water conservation, and for un-metered properties there was no financial incentive.

Meter uptake was still below 30% nationally – though somewhat higher in parts of the South East – and there was therefore scope for savings, given that an area with 100% metered supply and appropriate tariffs could be expected to reduce average demand levels by up to 20%. It was therefore recommended that Government should make it easier for companies in water-stressed areas to obtain water scarcity status as the pre-condition for universal compulsory metering.

Building Regulations should also reflect the need to set challenging water-efficiency standards for new and existing homes.

4.6.7 On water and the environment

The committee noted that the Water Framework Directive had broad support but the objective of "good ecological status" needed clarification. There are approximately 600 sites where licensed abstraction may be causing environmental degradation, particularly in the South East, but there was little

understanding of the detailed requirements of the associated freshwater ecosystems. Furthermore, climate change can render previously sustainable abstraction unsustainable. The Catchment Abstraction Management Strategy was welcomed as an instrument of the directive but WWF UK saw a risk of bias in favour of abstractors, particularly as the "ecological reserve" was, in their view, crudely and inappropriately set; with insufficient application of the precautionary principle. A contrary view was represented by Southern Water, who were concerned that CAMS could put the company into a supply deficit. As this could not be quantified at this stage, however, the company was unable to make any allowance in its resource-management plans. The Committee, in summary, recognised that under the Habitats Directive, the EA is required to take a precautionary approach in the review of licences while at the same time giving adequate consideration to security of supply.

4.7 Some conclusions

4.7.1 It is evident from the Environment Agency and House of Lords' findings that the South East must be treated as a special case in terms of the pressures on water resources arising as a combination of housing development, climate change and environmental commitments under the European Water Framework and Habitats Directives.

4.7.2 The House of Lords' report goes further in concluding that none of the three key influences have been adequately evaluated or factored into the assessment of the supply/demand deficit likely to arise during the SE Plan period. They are convinced, however, that for the South East at least it will be significant, but in spite of this, no responsibility has been assigned for formulating and implementing an appropriate region-wide resource-management strategy.

4.7.3 For the most part, the water companies would seem to favour reliance on new resource development and this reflects their continuing scepticism with respect to water-efficiency initiatives, coupled with a reluctance to pursue leakage control programmes beyond very narrowly defined ELL targets. The regulators, by contrast, envisage a more balanced strategy with a strong water-efficiency element, and this is to be welcomed. But to be effective, it must be under-pinned by robust statutory instruments and economic incentives. Other elements include wastewater re-use and strategic transfers, backed up by seasonal storage where practicable. This, in our view, makes for a more flexible basis for managing supply and demand in this climate of uncertainty.

4.7.4 In the absence of a coherent long-term strategy, it would seem that consumers in the South East must reconcile themselves to a future of almost routine hose-pipe bans and other restrictions on non-essential use. And in the more heavily stressed areas, there will almost certainly be increasing pressure by the water companies to have restrictions lifted, or at least eased, on abstractions from sources of supply (e.g. river intakes and boreholes) in order to meet demand peaks, notwithstanding that these controls were, in many instances, put in place by the EA expressly to protect vulnerable habitats in times of severe drought.

4.7.5 We also need to question the criteria that trigger the implementation of some of these emergency measures. In most instances, the conventional pre-condition requires that the relevant source of supply or company supply area is suffering drought conditions of a severity that is not, on average, exceeded more frequently than once in 10 years. However, if we take the record for Kent as an example (Ref Appendix IV): in the 19-year period from 1988/89 to 2006/07 there have been seven or eight years in which most of the

companies supplying the county have been obliged to impose hose pipe bans (in some cases together with other supply restrictions). This looks more like an average frequency approaching once every other year. We would not in any way question the severity of these events, but they can surely no longer be regarded as rare or extreme; and the companies should have long since positioned themselves to ensure continuity of supplies without recourse to crisis management. There will be no certain progress toward a genuinely sustainable resource and drought-management strategy while consumers and the environment continue to be treated as part of the problem, rather than as participants in the solution.

5. A Way Forward: A CPRE SE Regional Strategy

5.1 Introduction

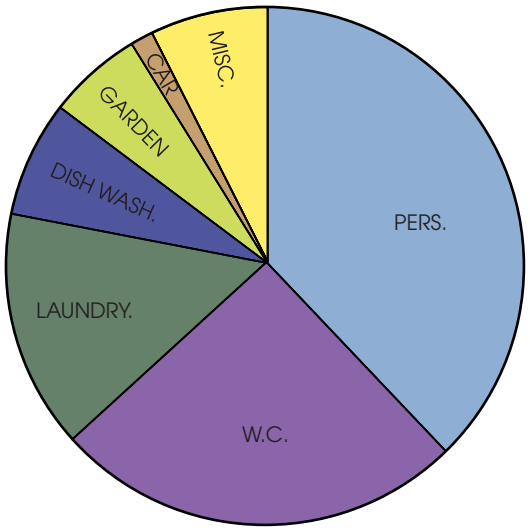
The supply/demand deficit forecast for the south east by 2025 is likely to be of a magnitude that can only be adequately addressed by a broad-based strategy comprising elements of both resource development and demand management. Taken together, they should provide a sufficiently flexible response to demand growth, one which is cost effective but above all environmentally sustainable and equal to whatever challenges climate and economic change may bring. The SE Plan has a declared aim to achieve growth while maintaining and enhancing the region's environmental assets. Its quality of life, landscape and biodiversity are key criteria in the sustainability of the region. The water strategy for the region must respect these limits and not put these assets at increased risk. Table 5.1 is a summary of options and candidate schemes, many of which have been incorporated in the Environment Agency's 2001 strategies for the Southern and Thames regions, and which are now undergoing detailed appraisal as part of the WRSE programme. In the following brief review, we have attempted a comparison of the listed options on the basis of a number of criteria defining economic, environmental and social sustainability. From this, we reach some conclusions with respect to what would seem, at first sight, to be the most practicable components of a long-term management strategy.

5.2 Water efficiency

5.2.1 Domestic use constitutes nearly half of the total demand for water in south-east England. Fig 5.1 shows the principal components based on assessments carried out by the EA for its Southern and Thames regions. Unmetered consumption averages between 160 and 180 l/h/d, Metered rates are 10 to 12% lower – around 150 l/h/d, with higher gains possible at times of peak demand. This makes the case for more general metering beyond the current 25%. There are clearly savings to be made in regulating the use of water for discretionary and luxury purposes, and there is also an important benefit in encouraging greater awareness of the value of water conservation and the avoidance of wastage in home and garden. For the average household, conversion to a metered supply generally means lower bills for both potable and waste-water services. Usage can be further reduced by water-saving installations such as dual-flush toilets, low-head showers, low-flow taps and rainwater capture. And it is estimated that an average household so equipped – and with a metered supply and tariff which rewards prudent use at times of peak demand – could reduce its consumption by at least 20%; and 15% should be achievable year-round.

5.2.2 A forecast saving of 216 Ml/d has been estimated for the region by 2025 using a target reduction of 15% for each metered household (App. V). The EA has identified nearly half of the region as unsustainable in terms of both surface and groundwater resources. If we assume that "water scarcity" status could be secured for up to 80% of the corresponding water supply area, then it would be reasonable to work on the basis of an uptake of at least 75%. Allowance has to be made for the fact that 25% of households in the region have already been metered.

Fig 5.1 Micro Components of Household Demand (Ave of Thames and Southern)



COMPONENT	%
Personal Washing	37.6
W.C.	25.8
Laundry	14.7
Dish Washing	7.2
Garden	6.0
Car Washing	0.9
Misc.	7.8
TOTAL	**100.0**

Table 5.1 Water Resource Strategy Options for S.E. Region

1	2	3	4	5	6	7	8					9				
							Constraints					Benefits				
Option	Scheme Examples	Design Yield M/d	Implementation (Years)	CAPEX (HML)	OPEX (HML)	Unit Cost £/Ml/d (HML)	R&D Input	Env. Impact	Energy Use	CO2 Output	Public Resistance	Env. Sustainability	System Reliability	Phasing Opportunity	Climate Change Resilience	Amenity & Recreational Value
Demand Management	Further leakage reductions	100	1 to 5	M	L	ND	L	L	L	L	L	H	M	H	H	L
	Compulsory metering	220	Phased over plan period	L	L	ND	M	L	L	L	L	H	H	H	H	L
	Domestic water efficiency increase			L	L	ND	L	L	L	L	L	H	M	H	H	L
	Rainwater capture	ND		L	L	ND	L	L	L	L	L	H	H	H	M	L
New Reservoirs	Abingdon (2019/20)	380	20	H	H	H	H	H	H	M	H	M	M	L	L	H
	Broadoak (2019/20)	42	15	H	H	H	H	H	H	M	H	L	L	L	L	H
	Clay Hill (2014/15)	18	10	H	H	H	M	H	M	M	H	M	ND	L	L	M
	Havant Thicket (2020/21)	23	15	H	H	H	M	M	M	M	M	M	ND	L	L	H
Reservoir raising	Bewl Water (2014/15)	14	10	H	H	H	H	H	H	M	M	M	L	L	L	H
	Bray	18	10	H	H	H	H	H	H	M	M	M	ND	L	L	H
Bulk supplies	From Graffham (pre-allocated to 3 Valleys)	20	1 to 5	M	M	M	L	M	H	M	L	H	M	M	L	L
Indirect waste water re-use	Includes Southern Water and Lee Valley Schemes	200	3 to 5	M	L	M	M	M	M	M	M	H	H	H	H	L
Strategic raw water transfers	Severn-Thames	50	5 to10	H	M	H	M	H	H	M	H	M	M	L	L	M
	Grand Union & Oxford Canals	15	3 to 5	H	M	H	M	M	M	M	L	M	M	L	M	M
Misc. ground water developments	London Groundwater	25	2 to 5	M	L	M	M	M	M	M	L	M	L	H	L	L
	Swanscombe Quarry	10	3 to 5	H	L	M	H	L	H	M	L	M	M	H	L	L
Aquifer storage and recovery	Hardham	20	5	M	M	M	H	M	M	M	L	L	L	H	L	L
	Thames	15	5 to10	M	M	M	H	M	H	M	L	L	L	H	L	L
De-salination	Mainly small peak-demand schemes	30	5 to10	M	H	H	M	H	H	H	L	L	M	H	M	L
Total		1200														

Scheme Assessments
H - High
M - Medium
L - Low
ND - Not Determined

Strategic Value Ratings
A (good)
B (fair)
C (poor)

Note: Columns 1-4 are drawn from EA 2001 strategies for Thames and Southern Regions. Columns 5-9 are CPRE SE qualitative expert estimates of feasibility and benefits.

5.3 Leakage Control

The likelihood of further major reductions in public supply distribution losses would seem to be constrained by Ofwat's reluctance to impose more challenging targets on any of the companies in the South East other than Thames. Losses here are still running in excess of 30% and the company is now expected to achieve a further improvement by 2010 of at least 100 Ml/d from the current level of around 850 Ml/d.

5.4 Resource development

5.4.1 Table 5.1 summarises some of the options for increasing supply now being evaluated by the EA and the water companies. The list comprises mainly pump-fed off-channel reservoir schemes and raw-water transfers, together with a few groundwater developments, including some fairly speculative aquifer storage/recovery initiatives. Taken at face value, the aggregate design output of the reservoir schemes alone, at nearly 500Ml/d, would, if it were achievable, cover a fair proportion of the residual out-turn deficit, and obviate recourse to major transfers until the later years of the plan period. Pumped storage schemes are, however, expensive in terms of both capital and operating costs, and they are by no means energy efficient. The nominated schemes, furthermore have yet to be assessed for reliable yield and environmental sustainability. and faced as we are with increasingly challenging EWFD and HD targets, such undertakings become ever more uncertain. To take the Broadoak proposal as an example: it is envisaged that the reservoir, near Canterbury, would be pump-fed from the River Stour, but two previous attempts to promote similar schemes at this location have failed. The more recent of these, in 1990/91, had a design drought output of 40Ml/d and this was abandoned in recognition of the restrictive river flow conditions imposed by the EA in order to protect a range of environmental and water-use criteria. Fifteen years on, and with CAMS/RSA delivering considerably tougher environmental targets, there is even less likelihood of a successful outcome. Any assessment of Broadoak will also need to take account of the increasing weight of historic evidence pointing to a progressive decrease in the average annual flow of the Great Stour, corresponding to a loss of more than 15% over the period 1965-2000. (A recent update using the records for 2001-04 suggests that, millennium floods notwithstanding, the average has continued to decrease.) Other studies involving measurement of late summer "base-flows" between 1965 and 2004 indicate losses of more than 50% in the discharge of the chalk springs which sustain the river above Canterbury. If we project the current trend, the conclusion could be drawn that, by the time Broadoak is due to come into operation, there will be virtually no natural spring flow entering the river between Ashford and Canterbury during the late summer months.

5.4.2 The vulnerability, under winter drought conditions, of large reservoirs with long critical periods has been illustrated by the recent failure of Bewl Water in East Sussex. With a yield of 75 Ml/d, this is the key source for supply areas in north and west Kent, but it is almost entirely reliant on winter abstraction from the River Medway. In order to refill following the heavy draw-down during the summer of 2005, the operating company had to obtain a "winter" drought order suspending the control flow which would otherwise have prevented river abstraction. The question therefore arises: if we are already facing difficulties in re-filling the existing reservoir under dry winter conditions (which, although undoubtedly severe, can no longer be regarded as exceptional), what chance is there of maintaining an enlarged unit with a design drought output nearly 20% greater than the current level? Its prospects are not improved by the fact that the company has recently secured a licence from the Environment Agency authorising the transfer of up to 35 Ml/d from Bewl to a neighbouring

water company supply area. As noted in the EA WRSE Sept 2006 report, (Ref 15) reservoirs are of little value unless they can be filled from a reliable source of water. These experiences and the much greater priority being given to environmental constraints through CAMS and Appropriate Assessment makes it increasingly clear that reservoir development should be at the end of the list of possibilities, not the first action assumed. Schemes in this category are almost certain to be called–in for public inquiry and it could be some years – possibly up to ten for the more problematic cases – before a final decision is reached as to whether or not they can be adopted as viable elements of the regional strategy. There are, certainly, some unresolved questions concerning the viability of Bewl and Broadoak; and the latter, together with Abingdon, is in any event scheduled too late in the programme to cover the critical mid-period deficit which will arise with the loss of source capacity that some companies will have to sustain in compliance with RSA targets. Abingdon, furthermore, may not be viable at 380 Ml/d without substantial supplementary transfers from outside the region. This alone could delay full commissioning beyond 2025.

We are left therefore with Clay Hill, Bray and Havant Thicket as the best prospects at this stage, but none of these would qualify as a genuinely regional storage element. Taken together, they add less than 60 Ml/d to the total output, and it would certainly be rash to plan on the basis of the reservoir option delivering more than 100Ml/d before 2020. Hence, some provision must be made for alternatives that can be deployed ahead of the 2015 deadline. And there are very few realistic candidates.

5.5 Effluent re-use

5.5.1 Although Thames region has the smaller renewable resource (8,500 Ml/a compared with 10,200) it is able to support an average annual demand three times that of Southern. That it can sustain this level without incurring a severe resource deficit would seem to be due to the relatively high proportion of wastewater re-use in the Thames Valley supply areas.

5.5.2 It has been estimated that as much as 2,000 Ml/d, or about 50% of all wastewater treated by Southern Water, is discharged to sea without making any further contribution to the supply or environmental needs of the region. The Margate/Broadstairs scheme is a recent example, one that has been the subject of much public debate and media interest. It involves the disposal to sea of up to 20 Ml/d of treated wastewater that could be further processed and put into supply as a wholly sustainable resource in an area facing an increasingly severe deficit; and the capital and operating expenditure would have been no more than that incurred in its disposal. Effluent re-use is one of few resource categories which could provide the necessary additional volumes for supply, and could be put in place before the EWFD 2015 deadline for the replenishment of resources, the lead times for implementation of most such schemes averaging from three to five years. For reasons of operational flexibility and public acceptability, most schemes take the form of indirect reuse systems, whereby the treated effluent is discharged to a receiving watercourse and a corresponding quantity re-abstracted further downstream for final treatment to the required potable standard. Some schemes also incorporate small storage reservoirs, which can aid treatment by extending the retention time. An example of a fully operational re-use scheme is summarised in Appendix VI.

5.5.3 Re-use is an inherently sustainable option insofar as the available resource (the effluent) must, by and large, increase with demand: the more you use, the more you get! Also, the required output can be phased to match demand growth. It

is also substantially more cost-effective than almost any other major resource development. Not only is it cheaper to use than throw away but, for every Ml/d of output, we save an additional sum corresponding to the costs incurred in the construction and operation of the new supply scheme that would otherwise have been necessary.

5.6 Raw-water transfers

5.6.1 This is not the "water grid" of popular imagination. We are not proposing major transfers from the north or north west. These are unlikely to be either cost effective or environmentally sound. But there is a case for making more effective use of the natural and artificial links that already exist between the South East and adjacent water-rich areas where capacity exists and some transfer is acceptable to all parties involved. Looked at from a South East perspective such transfers would represent "new water" and a genuine addition to the resource, albeit of a character different from that of most indigenous sources . This inevitably raises a number of other difficult questions of environmental sustainability.

5.6.2 While it is clear that most strategic water transfers are likely to be less cost effective and less acceptable than other more orthodox supply solutions (including pump fed storage), if the listed reservoir options fail on environmental or other practical criteria, or fail to deliver the total design drought output within the plan period, "raw-water transfer" using existing links may prove to be the next most practical alternative in those instances where waste-water reuse is not feasible. It would in any event offer a more resilient and dependable source of supply than reservoir based systems.

5.6.3 The EA has already completed preliminary assessments of a few candidate schemes covering a range of design yields (Ref 15). Calculations by the Institute of Civil Engineers for a transfer from Mid Wales to London using a Severn-Thames link puts the unit cost at £2.4M per Ml/d but this excludes any assessment of environmental impact, with all that this could imply for the additional capital and operating costs. Most of the schemes examined by the EA fall between £3 and £5M per Ml/d, which compares with £1.5 to £2M per Ml/d for a typical reservoir scheme. Aside from the more ambitious undertakings, there is however some scope remaining for improving transfers between adjacent supply areas within and bordering the south-east region. This would seem to offer a more practical and cost effective area for development in the first instance.

5.7 Summary of options

5.7.1 We have seen that the current balance of resources in the South East is, for all practical purposes, in deficit; with no scope for further development of groundwater resources on the scale required to meet the anticipated demand growth. In fact the EA has, since 1993, maintained a general presumption against the grant of licences for any further increase in abstraction for consumption (including public supply) from the major aquifers. If anything, we must expect, over the next 10 years or so, to see a material reduction in the quantities pumped each year from groundwater as part of the effort to improve the regime of the streams and wetland areas fed by spring flow.

5.7.2 The prospect for the development of new supplies from the region's rivers is little better, particularly in the light of recent drought experience and the

accumulating evidence of progressive depletion of baseflows in spring-fed watercourses. For much of the region, winter rainfall has frequently failed to support the rates of pumping required to replenish the larger off-stream reservoirs, and this must raise doubts as to the viability of future pumped storage schemes. It would seem to follow from this that any strategy developed for the region should have a much greater emphasis than hitherto on making better use, and re-use, of existing supplies. Should these fail to meet demand growth, the best recourse may then be to transfer raw water from neighbouring – or even distant – regions, taking advantage of existing trunk links and interconnected waterways.

5.7.3 In order to meet a forecast out-turn deficit of 1,010 Ml/d by 2025 the region could plan on the following gains in deployable output.

• Water efficiency savings[1]	220
• Further leakage reductions[2]	100
• Increased reservoir output[3]	100
• Indirect effluent re-use[4]	300
(assuming 15% re-use of current total discharge to sea)	
TOTAL	720 Ml/d

Notes.
1 Based on EA estimates
2 Based only on existing commitments
3 e.g. Raising Bewl
4 potential but in our view readily achievable

This would leave a residual deficit of 290 Ml/d to be met by other initiatives, including bulk transfers and further re-use or conservation schemes. It is our view that conservation targets and assumptions remain low and could realistically be more ambitious. Failing this, it is unlikely that the region would have sufficient deployable resources to support the increased public supply demand under drought conditions.

6. Conclusions and Recommendations

6.1 The balance of water resources for much of the South East has been assessed by the Environment Agency as unsustainable, and the demand on public supplies has now reached levels such as to create a virtual region-wide deficit under "design drought" conditions. There is a low level of awareness of the severity of the future resource deficit and the consequent need for early and decisive corrective action by the water companies and regulators.

6.2 Proposed housing development, when taken together with the forecast impact of climate change and the additional commitments under EU Directives for restoring sustainable abstraction, will impose an additional degree of stress that cannot be sustained by further development of the region's indigenous resources. These factors were not taken into account by the Sustainable Communities Plan.

6.3 CPRE South East believes there is an increasingly strong case for a region-wide strategy transcending water company boundaries – one which is environmentally sustainable and delivers best value for money for consumers and the community at large. Delivery may require the creation of a body with the expertise and resources to formulate an optimum strategy, and the authority to direct the water companies in its implementation.

6.4 Elements of a water-supply development strategy have been identified in the South East Plan, but there is a disproportionate emphasis on the creation of additional reservoir capacity which is unlikely, in our view, to prove hydrologically or environmentally sustainable. None of the schemes have as yet been fully assessed with respect to engineering feasibility and environmental impact, and some are on a scale that could only be sustained by drawing heavily on river sources that are already severely depleted. They cannot therefore be regarded as secure elements of a regional strategy.

6.5 This adds weight to the case for urgent action on demand management – in particular, the promotion of domestic metering and water-efficiency measures for new builds and existing households. To be fully effective, it requires the appropriate legislation and economic incentives to be put into effect as matters of the highest priority. It will also require the designation of much of the South East as "Water Scarce".

6.6 There should be an early review of the decision by Ofwat against setting water company leakage targets at levels more challenging than 25% of WIS. The current standard of performance, the Economic Level of Leakage (ELL), should be replaced by a broader-based assessment which also includes environmental and social sustainability.

6.7 Demand management will, however, only address a relatively small proportion of the forecast deficit within the time frame, and will need to be supplemented by a more fundamental approach to the conservation of the region's resources. We therefore urge an early review of the potential of wastewater re-use, starting in the more heavily stressed areas. More than half of the effluent processed in the Southern Region is discharged to sea. This is a unique resource which can be treated and put into supply at relatively low cost, and constitutes an inherently sustainable, drought-proof solution which can be phased to match demand and implemented within a short (three-to-five-year) time frame.

6.8 Until we have put in place the essential components of a strategy that ensures security of supply under all but the most severe and genuinely exceptional drought conditions, there should be some measure of restraint. Development in those areas where resources have already been identified as unsustainable should only proceed where an integrated water supply strategy has been put in place and other planning criteria are satisfied. Failing this, government must be aware that many consumers in the region will have to be reconciled to a regime of crisis management in which the hose pipe ban will be a more or less permanent feature, marking the failure of the companies to achieve minimum levels of service.

Glossary and Abbreviations

Abstraction – The removal of water from a source of supply (e.g. river, spring or bore hole).

Aquifer – A permeable geological formation capable of storing and transmitting water.

Aquifer recharge – Replenishment of natural storage by rainfall or snow melt.

Baseflow – The proportion of a river's flow that originates as spring discharge or seepage from groundwater.

Biodiversity – A measure of the number of species represented in a given plant or animal community.

BREEAM – Building Research Establishment Environmental Assessment Method.

CAMS – Catchment Abstraction Management Strategies.

CAP – Common Agricultural Policy.

Catchment – The area of land contributing flow to a watercourse.

Confined aquifer – An aquifer overlain by impermeable strata.

Consumptive use – Use of water where a significant proportion is not returned either directly or indirectly to a source of supply.

Critical period – In the management of a reservoir or groundwater unit, the period required under average winter rainfall conditions for storage to recover from maximum depletion to full supply level. (Under severe drought conditions this may exceed the equivalent of one year's winter recharge.)

DCLG – Department for Communities of Local Government.

Defra – Department for Environment, Food and Rural Affairs.

Demand management – Measures that serve to control or influence the consumption or waste of water.

Deployable output – The reliable yield of a source of supply, taking into account all material constraints including licensed abstraction limits and conditions, pump capacities, water quality, aquifer properties, treatment plant and distribution mains capacities.

Drought – A general term for prolonged periods of below-average rainfall resulting in low river flows and/or low rates of groundwater recharge, and which impose significant strain on water resources, public supplies and the wider environment.

Drought orders and permits – Statutory instruments whereby, for reasons of exceptional shortage of rainfall, the Environment Agency can restrict the use of water or vary the conditions of abstraction.

DWI – Drinking Water Inspectorate.

EA – Environment Agency.

Effective rainfall – The proportion of rainfall remaining after allowance for losses by evaporation and transpiration, and which thereby contributes to surface runoff or accrues to groundwater storage.

Effluent – Urban and rural wastewater, including domestic sewage and discharges from industrial and agricultural processes.

ELL – Economic Level of Leakage.

EWFD – European Water Framework Directive.

Flood plain – An area of land periodically inundated at times of high river flow.

Flow duration – The period of time, expressed as a percentage of a total year's flow, during which a river exceeds a given rate (e.g. the rate which is exceeded 95% of the time is defined as the 95 percentile flow).

Gauging station – A river flow measurement point.

Groundwater – Water contained within the saturated zone of an aquifer.

HD – Habitats Directive (The European Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna).

Hands-off flow – A condition attached to abstraction licences, representing the rate of flow below which abstraction is not permitted.

HOL – House of Lords.

Hydrograph – A diagrammatic representation of variations in the flow or level of a watercourse.

Impoundment – A dam, weir or other work impeding or obstructing the flow in a watercourse.

L/h/day – Litres per head per day.

Ml/d – Megalitres (millions of litres) per day.

Mm^3 – Million cubic metres.

NEP – National Environment Programme.

NRA – National Rivers Authority.

ODPM – Office of the Deputy Prime Minister.

Ofwat – Office of Water Services.

Permeability – The capacity of an aquifer to convey water.

Potable water – Water of a suitable quality for human consumption.

Precipitation – Deposition of atmospheric moisture, including rain, sleet, snow, hail and dew.

PWS – Public Water Supply.

RAM – Resource Assessment Methodology.

RBMP – River Basin Management Plan.

RSA – Restoring Sustainable Abstraction.

Runoff – The total volume of water passing a given point on a watercourse during a specified time period. (This comprises surface runoff and baseflow).

SAC – Special Area of Conservation (Internationally important nature conservation site designated under the EU Habitats Directive).

SEERA – South East England Regional Assembly.

SE Plan – South East Plan – the draft South East Plan March 2006.

Soil moisture deficit – Usually expressed in terms of the amount of rainfall (in mm) required to return a soil to its normal "field" capacity.

SMD – Soil Moisture Deficit.

SPA – Special Protection Area. (Internationally important nature conservation site designated under the EU Wild Birds Directive).

SSSI – Site of Special Scientific Interest.

Storage coefficient – Corresponds to the specific yield or effective porosity of a permeable rock, and represents the quantity of water that can be obtained from a given volume of an aquifer. It is generally expressed as a percentage.

Surface runoff – Generally derived as total runoff minus baseflow.

Sustainable development – Development that meets present needs without compromising the scope for future generations to meet their own requirements.

Transpiration – The process by which water taken up by plants is returned as water vapour to the atmosphere.

UKCIP – United Kingdom Climate Impacts Programme.

Water Framework Directive – (See EWFD)

Watershed – A line of separation dividing the precipitation on adjoining catchments and which directs the resulting surface runoff accordingly.

Water table – The free surface of the saturated zone of an unconfined aquifer.

Wetland – An area of low lying land where the water table is at or near the surface.

WIS – Water Into Supply.

WRSE – Water Resources for the South East.

Yield – The reliable rate at which water can be drawn from a source of supply.

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[i] Defra – *Directing the Flow: Priorities for Future Water Policy*, November 2002.

[ii] UK Biodiversity Action Plan steering group – *The State of England's Chalk Rivers*, July 2004.

[iii] CPRE Thames Gateway – *From Rhetoric to Reality*, September 2005.

[iv] CPRE Kent – *A Water Resource Strategy for Kent*, May 2006.

[v] Water Resources Act 1991, HMSO.

[vi] Environment Act 1995, HMSO.

Appendix I: Environment Agency; Scenario–Based Demand Forecasts

Many of the factors influencing demand growth over relatively short periods can be assessed with some confidence, but there are others, associated with the impact of long-term political, economic and societal changes, which are more problematic. These can, at best, only be addressed by comparing likely outcomes from a range of possible scenarios. An approach on these lines was adopted by the EA in the formulation of the 2001 water resources strategy (Ref 8-10), using the DTI 1999 Foresight "Environmental Futures". The objective was to facilitate development of a single optimum strategy that would be sufficiently flexible and robust to accommodate a range of environmental outcomes by taking into account different social values and systems of governance. The range of possibilities is represented by four scenarios depicting different ways in which England and Wales, and the constituent regions, could develop over the next 25-50 years. These are:

a) Provincial Enterprise ("Alpha" scenario)

   The state disengages from international political and economic systems and institutions – a low-growth, low-wage and low-investment scenario. There is little concern for social equity and the environment has very low priority despite increased pressure on natural resources.

b) World Markets ("Beta" scenario)

   A closely integrated world trading system generating high levels of economic growth and personal affluence but again with social equity given low priority. Environmental awareness is low, particularly amongst the less well off.

c) Global Sustainability ("Gamma" scenario)

   Dominated by global institutions in the resolution of social and environmental issues, with an emphasis on sustainable development and alternative "clean" technology.

d) Local Stewardship ("Delta" scenario)

   Characterised by regional and local government. Sustainable development is fundamental in decision making, with environmental issues resolved by collective action.

The following table summarises the dominant economic and environmental characteristics of each scenario, together with the implications for water demand. Incremental demands for 2025 have been derived under the four headings of household, leakage, industrial (plus commercial) and irrigation. No allowances have been made for climate change – the EA justifies this on the grounds that the results from the climate model studies are still in their preliminary stage, though it is acknowledged that there will be an impact on household and irrigation demand. It has also been assumed that over the next 20 to 25 years most public water supply systems will retain their existing yields but again it is also accepted that there will be changes in demand and water availability.

Summary of EA Scenario-Based Forecasts

CHARACTERISTICS	ALPHA	BETA	GAMMA	DELTA
ECONOMIC GROWTH	Moderate	High	Moderate	Low
ENVIRONMENTAL IMPROVEMENT AND SUSTAINABILITY	Low priority with increasing environmental problems	Low priority	High on political agenda	High priority, influencing, strategic decision making
WATER DEMAND	Stable	Increases	Declines	Declines
FORECAST PUBLIC SUPPLY OUT-TURN FOR 2025 (Ml/d)	8,700	5,800	3,300	3,600

Appendix II: Water for Irrigation

The report Climate Change and Demand for Water, commissioned by the Department for Environment, Food and Rural Affairs (Defra) and published in February 2003, included a comprehensive review of trends in crop irrigation since 1980, together with a set of demand projections for 2020 and 2050. Table A1 summarises some of the horticultural data used in the 20-year historic review, and if we allow for the very wide natural variations in annual rainfall, the general trend would indicate a substantial, possibly three-fold, increase in equivalent dry-year demand. This was estimated in the report as corresponding to an overall annual (dry year) increment of approximately 2% for horticultural irrigation in England.

Table A.1

YEAR	**1982**	**1984**	**1987**	**1990**	**1992**	**1995**	**2001**
Rainfall	Average	Average	Wet	Dry	Wet	Dry	Wet
Irrigated Areas in hectares							
Fruit & Veg	21,520	24,270	14,600	32,040	25,230	33,460	44,530
Potatoes	30,860	42,330	34,880	52,000	53,470	62,120	77,120
Total	**52,380**	**66,600**	**49,480**	**84,040**	**78,700**	**95,580**	**121,650**
Irrigation volumes in mm³							
Fruit & Veg	11	17	6	25	15	32	38
Potatoes	20	37	17	58	45	84	76
Total	**31**	**54**	**23**	**83**	**60**	**116**	**114**

As to the expectations and concerns of today's growers for the next 20 years and beyond: most of the significant risks facing the industry would, at least from the findings in the Defra survey, seem to relate to either climate change, economics (including the interaction of domestic and global markets) and legislation, both European and national.

Climate change now features as one of the single most important influences on future trends in soil-water balances and crop demands. The latest forecasts for the Midlands, eastern and southern England give a picture of increasing average annual temperatures and a trend toward more extreme fluctuations in seasonal rainfall, popularly interpreted as "wetter winters and drier summers". As an indication of what this may produce in terms of effective rainfall, we have the experiences of the early-to-mid-1990s droughts, which tested the resilience of water company supply and distribution systems and revealed some critical weaknesses in the management of the nation's water resources. There was frequent recourse to emergency drought orders to control water use and ensure the continuity of essential public supplies – in some instances, this was to the detriment of irrigators. Some of the provisions of the 2003 Water Act reflect the lessons learnt during this period. The predicted increases in average annual potential evapotranspiration rates translate into correspondingly greater soil moisture deficits, and these are in turn reflected in correspondingly higher irrigation demands. Furthermore, the periods of maximum crop demand will, as often as not, coincide with peaks in public supply distribution, bringing added pressure on river and groundwater resources, particularly for the more heavily developed catchments in the East and South East.

The Defra forecasts for long-term demand trends have also taken climate change into account in terms of the degree to which the predicted increases in atmospheric CO_2 levels

are likely to stimulate more vigorous plant growth, with corresponding improvements in crop yields, (some recent work has shown that doubling the atmospheric CO_2 can add 30% to the effective crop growth) and this could, in the long run, improve the net return on irrigation input.

The Hadley Centre Global Climate Model was used to assess the extent to which rainfall, air temperature and potential evaporation have changed historically as a result of the global-warming process, and this data set has in turn been used as the basis for the correction factors used in the creation of a synthetic record representing possible future trends under four different degrees of greenhouse-gas emission. As a result, we now have what amounts to a set of alternative "what if" trends, representing a range of estimates of what climate change might be expected to do to the shape of the rainfall and evaporation map for England and Wales, five, 10, 20 or 50 years hence. Depending on one's view of the most likely future trend, the appropriate synthesised record can be fed into a daily water-balance irrigation-scheduling model to obtain final-demand totals for each crop and site. In very broad terms, a roughly mid-range forecast for central, southern and eastern England would produce reduced summer rainfall totals and elevated year-round evapotranspiration rates, with the greatest increases in the summer months. For many sites, the modelled results also show small increases in winter rainfall and this holds the promise of some scope for seasonal storage.

The next stage in assessing the prospects for any candidate scheme involves some more futurology, this time in the even more uncertain world of socio-economics. The aim here is to arrive at the most likely course and outcome, over the next 10, 20 years and beyond, of any significant changes in the domestic political landscape as well as any shifts in geopolitical influences on, for example, Common Agricultural Policy (CAP) and the World Trade Organisation (WTO). The method adopted for the Defra study employed a scenario-based approach developed by the Environment Agency under the Foresight Environmental Futures framework. This comprises a range of possible outcomes. At one extreme they are represented by a continuing intensification of cultivation in a free, market-driven (no-CAP) economy, characterised by very high water use for maximum return. At the other extreme is the "green" extensive alternative, requiring lower levels of water use in a more self-sufficient regime where domestic economic development is balanced against environmental sustainability. The "most likely" scenario adopted for the study envisages a reduced CAP framework with 15% of the current total agricultural area taken out of production. Horticulture is, however, seen as being largely unaffected and likely to become relatively attractive, albeit with a continuing strong supermarket influence where "quality" assurance targets continue to drive increased irrigation demand for the higher-value produce. What would all this mean for the irrigation of horticultural crops in 2020? The figures for agricultural irrigation, assuming a relatively moderate climate-change trend, would produce a national demand approximately 20% above 2001 levels – slightly more perhaps for central and south-east England. Adding the effect of the "most likely" socio-economic scenario would be expected to increase this to between 40 and 45%. This in turn would need to be factored-up for a relatively high-value crop, and it would therefore not be unrealistic to envisage an overall increase in demand of approximately 50% – equivalent to around 2% annual growth over the 20-year period. The implications for any individual grower will, of course, also depend on regional location, with the South East expected to be the most susceptible to the change process and where water resources are already under stress. The choice of a source of supply – i.e. mains or direct abstraction from on-site borehole or river intake – can therefore prove decisive. The Environment Agency routinely imposes tight restrictions on summer-period abstraction from rivers and major aquifers. The Agency's own Catchment Abstraction Management Strategy (CAMS) has also identified a number of locations where existing rates of abstraction will need to be reduced in order to restore river base-flows and protect water-table levels. Substantial cut backs are, for example, scheduled for areas where pumping rates are found to be detrimental to the integrity of designated wetlands, and in this respect the Agency is anticipating the imposition of some tough environmental targets under the European Water Framework Directive. This was formulated in October 2003 as a new integrated approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The targets, furthermore, have been set

without special reference to the additional impact of climate change; CAMS having no global warming factors built into its resource assessment process. So if anything, the conditions will by the due target date (2015) become even tougher than envisaged at present.

For high-value crop irrigation, therefore, the future is likely to be one of increasing demand to meet progressively higher and more protracted soil-moisture deficits against a background of diminishing water availability at source. We also need to remind ourselves that the "design drought" adopted for the Defra study (with an exceedence of about one in five years), falls well short of the intensity and duration of the mid-1990s episodes and provision for events of this magnitude would require levels of investment that raise questions of long-term cost effectiveness for all but the highest-value crops. Even here, Defra has concluded that the hardest-hit regions will not have the resources to support schemes on this scale. In those situations, therefore, the choice of supply source can have a direct influence on the viability of a scheme. The mains option carries a commitment to high operating costs but offering a relatively secure supply. Direct abstraction, on the other hand, although requiring a heavy capital outlay (particularly if lined storage is required), combines comparatively low operating costs with security of supply, even under severe drought conditions – in fact it is probably true to say that it is at such times that this approach comes into its own. Lined reservoirs can also be used in conjunction with rainfall collection ("harvesting") systems, taking drainage from irrigation plots and runoff from glass and paved areas. This is useful in situations where opportunities for direct abstraction under licence may be infrequent, erratic or likely to incur excessive pumping costs.

Defra has estimated that about 3% of all agricultural and horticultural irrigation in England and Wales is mains-fed, but the figure rises to 20% in the South East, where there would seem to be a continuing drift towards dependence on public supplies. Clearly, in making the choice, growers have to weigh up the respective climatic and economic risks but, in some respects, the decision can be influenced as much by the extent to which abstraction legislation and, in particular, drought restrictions, are likely to determine long-term security and cost effectiveness. The 2003 Defra report concluded that scarcity of water was already restricting expansion of irrigation in some regions. Faced with the prospect of increasing climate-change impact on the soil-water balance and a forecast 50% rise in irrigation demand by 2020, growers throughout England and Wales have the additional challenge of further restrictions on direct abstraction imposed by the Environment Agency in pursuit of new and more stringent environmental targets. This has led to a move toward greater dependence on mains supplies which, although very expensive in terms of annual charges, are seen as more reliable and secure. The water companies in the South and East, however, have their own supply and distribution problems at times of peak demand and, with increasing risk of severe and protracted droughts they will need to plan for tougher restrictions in order to protect essential supplies. These regions already receive less rainfall per head of population than many parts of the Middle East and the pressure on sources of supply will continue to grow if the housing developments planned for the next 20 to 25 years are carried through, and irrigators are then likely to find themselves competing with other users for a greater share of a diminishing resource.

The alternative of winter-fed lined storage, encouraged by both Defra and the Environment Agency, represents a more cost-effective and, in the long term, increasingly competitive option. Here, the Defra report concluded: "… some irrigators already need to plan for substantial water resource increases within the planning horizon for major investment, particularly reservoirs." For many growers, however, the set-up costs are prohibitive, and unless this apparent impasse can be resolved it is difficult to see how the full potential of crop irrigation can be realised for high-demand, high-value regions of the Midlands and South East. (The current EU-funded research project examining the impact of the Water Framework Directive and CAP on irrigated cropping across Europe may produce some useful supporting evidence.)

Defra, having at least acknowledged the problem, now needs to be persuaded to look on the necessary investment as a political priority, representing something more than just good

business sense and which, by helping to ameliorate peak-demand pressures on public supplies, will make a positive contribution to sustainable management of the community's water resources. As such, it should therefore attract realistic levels of grant-in-aid for those growers ready to make the commitment.

Appendix III: Climate Change Indicators for South East and Central/Southern England

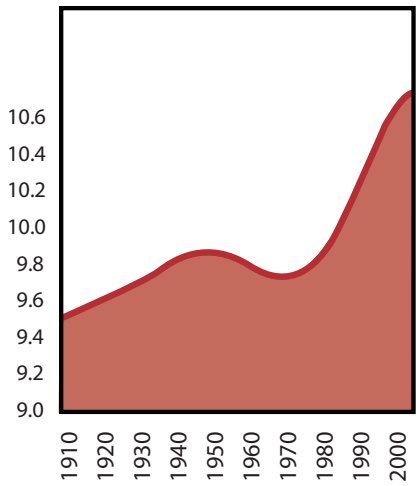
Rainfall: 1914-2004 Smoothed Averages, % Changes

Spring	Summer	Autumn	Winter	Annual
+ 4.6	- 16.0	+ 8.5	- 5.6	- 1.4

Average intensity on rain days has increased by approx 6%; concentrated mainly in the winter period. The number of days of snow cover has decreased from 15 in 1961/62 to 7 in 2004/05.

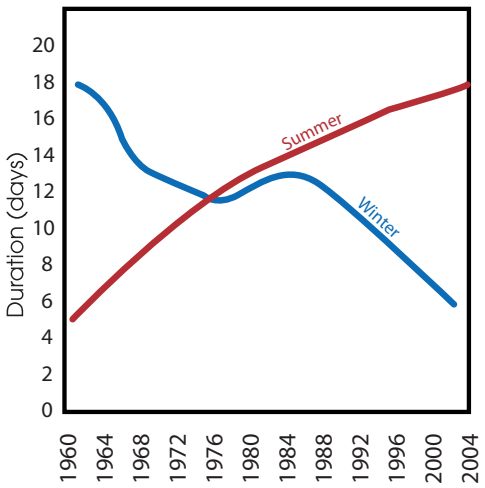
Temperature

Smoothed Annual Means °C, 1914-2004



Summer daily maxima have increased from 20.1 to 21.5 and winter minima from 1.6 to 2.2. The number of airfrost days has decreased by 22 since 1961/62.

Summer heatwaves and Winter cold spells; changes in duration 1961-2003



The summer trend is of special significance with respect to related increases in peak demand.

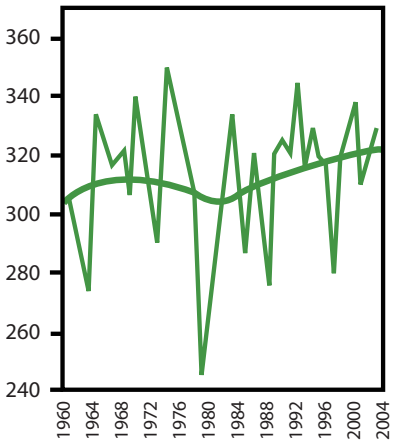
Sunshine

% change in total sunshine duration 1929-2004:

Spring	- 2.1
Summer	+1.1
Autumn	+11.3
Winter	+12.3
Annual	+ 3.2*

* Represents an increase of approx 80 hours.

Growing Season Length (days) 1961-2003



Data source, Met Office National Climate Information Centre, Climate Memorandum N° 21 June 2006.

Forecasts for the plan period

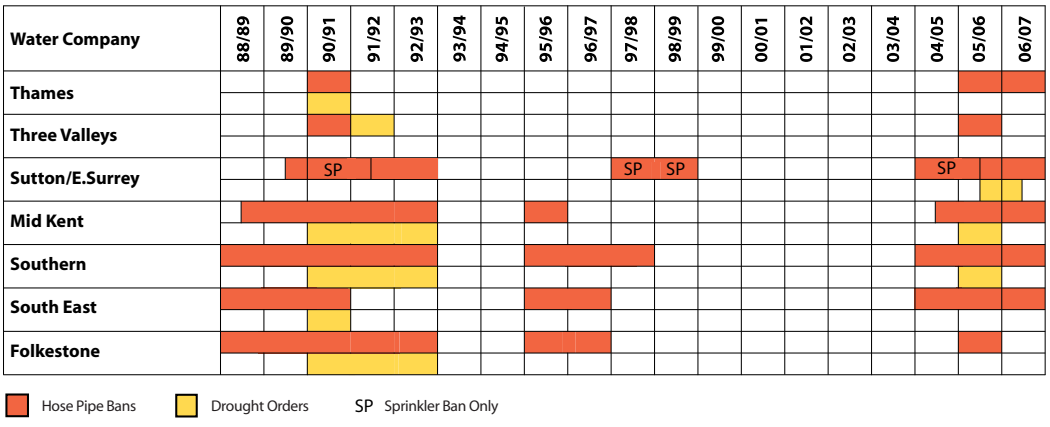
Some tentative forecasts for the South East can be derived from the model outputs discussed in UKCIP2002. These are based on four scenarios representing different levels of CO_2 emission that could be reached by the mid 2080s; the highest and lowest rates estimated at 810 and 525ppm respectively. All four scenarios are taken to have equal probability.

For most indicators there are intermediate forecasts; annual mean temperature for example being expected to increase by approximately 1°C by 2020 relative to the 1961-90 long term standard average; and corresponding increases for the summer period come out at around 1.5°C. The 2020 forecasts for mean annual rainfall indicate a decrease of 5% relative to 1961-90. Winter averages are seen as increasing by 10% over the same period but summer averages decrease by 15 to 20%.

We have a general picture therefore of rising temperatures coupled with a progressive decrease in effective rainfall; and this has implications for soil moisture, aquifer recharge and river flows. No SMD forecasts have been found for the mid 2020s but the model outputs for 2080 show summer/autumn deficits increasing by 20 and 50% respectively for the low and high emission scenarios.

Ref Met Office Hadley Centre, UKCIP02 Report; Climate Change Scenarios in the United Kingdom. April 2002.

Appendix IV: Hose Pipe Bans and Drought Orders in Kent – Water Years 1988/89 – 2006/07



Appendix V: Potential Water Efficiency Savings, Southern and Thames Regions (excl. Three Valleys)

		AVE YEAR. Ml/d
A) Future savings on existing households (25% already metered) Ref Table 4.4		
1 Current PWS domestic demand = 660 (Southern) + 1,930 (Thames) - 420 (Three Valleys)	=	2,170
2 75% of current demand unmetered	=	1,628
3 Assume 50% falls in an EA "Unsustainable resource" area	=	814
4 Assume 80% of this is designated as a "water-scarce" area	=	615
5 Assume 75% is subsequently metered	=	488
6 Net saving at 15% reduced domestic consumption	=	**73**
B) Future savings on existing households in non-"Water Scarce" areas		
1 60% falls outside a water scarce area = 60% x 1,628	=	977
2 On average, 2% of these will voluntarily convert to a metered supply each year. Hence by 2025 this gives a saving of 20 x 2% x 15% x 977	=	**59**
C) Total Savings for all Existing Households = A) + B)	=	**132**
D) Add 15% for corresponding saving in a 1 in 10 dry year. Total	=	**152**
E) Future Savings on new households		
1 Demand (1 in 10 dry year) is forecast to grow from 4,971 (current) to 5,447 by 2025. Increase	=	476
2 Assuming 90% uptake with a 15% saving	=	**64**
F) Total dry year water efficiency savings on domestic consumption within plan period = D) + E)	=	**216**

Appendix VI: Waste-water Re-use – The Langford Recycling Scheme

A scheme for the indirect recycling of effluent from Chelmsford sewage treatment works for re-use as a potable resource evolved from 10 years of research and development by Essex and Suffolk Water, a company serving one of the driest regions in the British Isles. It has now been fully operational for approximately five years but the idea had its origins in a project undertaken in 1964, when the company secured a drought order authorising the diversion of treated effluent from a tidal outfall in the Blackwater estuary to a discharge point on the River Chelmer. The purpose of this was to augment low flows and to support abstraction for refilling a public-supply reservoir. Subsequent research pointed to the feasibility of treating the waste-water to levels of quality sufficient to permit the discharge on a permanent basis and to re-abstract further downstream for final treatment to the requisite standards for public supply.

Essex and Suffolk Water carried out a range of preliminary studies, including water-resource surveys, population studies and forecasts to determine the need for, and timing of, the scheme. Environmental impact assessments were also undertaken for the receiving waters and these included extended monitoring of siltation in the estuary. The Langford recycling plant has the capacity for tertiary treatment of up to 40Ml/d of effluent and incorporates processes for the removal of phosphate, nitrate, ammonia, oestrogen and pathogens (99.89% removal of e.coli). In many respects the recycled product can be said to exceed the microbiological quality of the receiving river water. The consent conditions imposed by the EA were framed to ensure that:

a) all river quality standards are met;

b) there is no deterioration in river quality;

c) in areas of uncertainty, the precautionary principle should apply.

Specific limits for volume, flow and quality are applied, and UV disinfection has been included with rigorous microbiological monitoring of the receiving water. Stringent total nitrate and "dangerous substances" limits are also applied, some of which are more demanding than those set for drinking water. There is a comprehensive environmental monitoring programme, including surveys of benthic invertebrates and indicators of endocrine disruption in fish.

The Chelmer has an average annual flow at Langford of 220 Ml/d, which includes an existing 11% of effluent loading from other sources. With the additional maximum daily discharge of 40 Ml/d (equivalent dry weather flow of 30 Ml/d), this would give a total loading of approximately 25%.

In recognition of its commitment to sustainable water management, the company received a "special commendation" under the Environment Agency 2005 Water Efficiency Awards.

Ref. The promotion of a planned indirect wastewater re-use scheme in Essex.
D. Walker, J.Ch. Instn. Wat & Env. Mangt. November 2001.

Campaign to Protect
Rural England
SOUTH EAST

Campaign to Protect Rural England

The Campaign to Protect Rural England (CPRE) exists to promote the beauty, tranquillity and diversity of rural England by encouraging the sustainable use of land and other natural resources in town and country. We promote positive solutions for the long-term future of the countryside to ensure change values its natural and built environment. Our Patron is Her Majesty the Queen. We have 59,000 supporters, a branch in every county, nine regional groups, over 200 local groups and a national office in central London. Membership is open to all. Formed in 1926, CPRE is a powerful combination of effective local action and strong national campaigning. Our President is Bill Bryson.

CPRE South East is the Regional Group for the South East of England, campaigning on regional policy topics together with CPRE branches in Hampshire, Berkshire, Oxfordshire, Buckinghamshire, Surrey, Sussex, Isle of Wight and Kent.

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