Untapped Potential

Better protecting rivers at lower cost

Dr Simon Less

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Policy Exchange

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Executive Summary

Water is increasingly scarce, in many areas, at particular times of year and in dry years. Many rivers and natural environments are suffering damage on a regular basis as a result of over-abstraction of water. Over-abstraction means taking more water from rivers and aquifers than is naturally replaced, and not leaving enough to maintain a healthy ecosystem. Some rivers are drying up completely at certain times, which can be fatal for the wildlife that relies on them. Additional significant water level drops can mean sewage and chemical contaminants become more concentrated, rivers slow down, fill up with sediment and may get warmer, all of which severely affects habitats for fish, insects, animals and plants, sometimes irreversibly.

There are about 20,000 abstraction licences across England and Wales, which enable the holder to draw water from the environment, for example from rivers or boreholes. Water companies are the largest group of abstractors, accounting for around half of licensed abstraction volumes. The power generation sector and other industrial users are also large water abstractors. Agriculture accounts for only around 1% of abstraction on average across England and Wales (although this proportion varies very considerably between regions and seasons).

As we grow wealthier as a nation we tend to place greater value on having a healthy natural environment. But the demands from a growing population are putting increasing pressure on river flows and water supplies. Climate modelling, while uncertain, points to changed rainfall patterns, with drier summers and increased rainfall variability, further increasing pressures. A third of catchments are already classed as over-abstracted or have too much abstraction licensed, and two-thirds of catchments are closed to issuance of new abstraction licences. The Environment Agency has estimated that on average between 1,100 and 3,300 megalitres more per day is abstracted than the environment can sustain. (A megalitre is equivalent to the daily household water use of about 7,000 people.) At the same time, the costs of developing new infrastructure for collecting or abstracting, treating and transporting water are increasing as cheaper options are exhausted. Water itself is becoming more valuable as its scarcity, costs and competition for it increases.

> “Some rivers are drying up completely at certain times, which can be fatal for the wildlife that relies on them grateful recipients”

The costs of addressing the problem of damaging over-abstraction under current arrangements are estimated at between £3.7 billion and £27 billion. Progress is currently very slow, and at current rates it could take between 45 and 335 years to achieve sustainable levels of abstraction (without taking into account trends such as population growth and changes to rainfall patterns).

The absence of an effective strategy for achieving sustainable abstraction levels

causes uncertainty for abstractors' about the future of their licences. Abstractors expect that they might lose some of their abstraction rights, but they do not know for sure, how much they might lose nor when. In these circumstances:

- abstractors are less able to plan ahead and commit to long-term investments based on their licensed abstraction;
- they are likely to hoard their existing licensed volume, even if they do not currently need it;
- water companies are less likely to enter into new bulk supply agreements with their neighbours; and
- abstractors have less incentive to trade licences as their future value is uncertain.

Some actions by the Environment Agency have tended to exacerbate regulatory uncertainty, including attempts to claw-back licensed abstraction using an (on average) 69% 'tax' on abstraction trades. This has clearly been a disincentive to trading abstraction licences (out of a total of 20,000 abstraction licences, there were only 51 licence trades 2003-10), yet has succeeded in clawing back a licensed abstraction equivalent to only 0.5% of over-abstraction levels. Uncertainty leads to higher costs for water supply, and lack of trading means water is unlikely to be allocated efficiently, to where it has greatest benefits.

The key to making better progress on securing sustainable levels of abstraction is to bear down on its costs. This requires reforms to regulation of both water abstractions and public water supply.

There is often trade-off between restricting abstraction to better protect the environment, and the costs of delivering public water supply, since typically a water company would need to replace lost abstraction. If the costs of matching water supply and demand can be minimised, the costs of eliminating damaging over-abstraction can be reduced. An understanding of what drives the costs of supplying water is therefore critical.

A key driver of both supply costs, and environmental damage itself, is *variability* in water scarcity (value). Both demand for water and water's availability in the environment are highly geographically and temporally variable. For example, demand tends to peak in summers, driven by outdoor water use; river flows may vary dramatically between years; the level of over-abstraction varies to a great extent between even closely neighbouring areas; and the costs of building new water supply vary substantially between different areas. As the general value of water has increased, the importance of the variability in its value has also increased. An important type of variability for driving costs is infrequent peak periods of water scarcity, which may occur when a very dry period coincides with peak summer demand for, perhaps, a few weeks or months each decade or quarter-century. Such periods usually establish the quantity of supply infrastructure capacity needed.

Water's increasing value means it is worth increasing the sophistication of regulatory processes and incentives for efficient use of available water and investments. In particular, regulatory arrangements need to incentivise efficient responses to variability. However many aspects of the existing regulatory regimes are a legacy from a period where water was low value and so sophistication and effective incentives did not matter so much.

Current regulatory arrangements make achieving sustainable abstraction more costly

Only 20% of abstraction licences have conditions which curtail allowed abstraction when the environment is at risk, for example, from low river flows. Absent are more sophisticated licence conditions which, for example, varied the volume which can be abstracted – up or down – according to river flows.

Charges for abstraction licences are fixed based on the maximum allowed abstraction under a licence, not based on volumes actually abstracted. The marginal cost of abstracting water is therefore zero. Nor are there any price incentives for water companies, and other abstractors, to choose less environmentally risky water sources where they have a choice.

Current institutional arrangements for managing the abstraction licensing system appear to lead to lack of focus and confusion between objectives. There appears to be an insufficiently clear focus either on the objective of ending environmental damage (where only very slow progress is being made) or on maximising economic benefits from available water (where the Environment Agency regulates in a way which sometimes exacerbates uncertainty, increasing costs and impeding efficient allocation of water).

The UK remains one of the few remaining western European countries where most households do not pay for water on the basis of what they use. Moreover, those 35% of households which are now metered generally pay a tariff which is averaged both geographically and over time – a flat rate. Averaged water tariffs are unlikely to send signals for efficient use of water at times of peak demand and scarcity. High costs of (a) keeping 'reserve' supply infrastructure to meet demand at peak scarcity, and (b) environmental damage caused by running rivers dry to meet peak demands, mean that the true cost of water in dry summers can be much higher than at other times. Watering a garden in a dry year summer peak for an hour could effectively be costing £25 per hour or more. But with temporally averaged tariffs, the owner of the sprinkler does not pay. Instead all customers pay – a regressive cross-subsidy to those without large gardens. Unmetered and flat rate metered tariffs are no longer sufficient to send signals about the value of water, particularly at demand peaks in dry periods. The current situation leads to both higher levels of environmental damage and unnecessarily high spending on new supply infrastructure.

Current regulatory arrangements, and cultural factors, tend to bias water companies towards proposing traditional capital intensive supply-side infrastructure in order to match future demand and supply. Capital-intensive new supply infrastructure is often a very expensive response to infrequent episodes of peak scarcity. For example, Thames Water has built a desalination plant, with a capital cost of around £200 million, in order to meet a projected water supply shortfall expected to arise for perhaps a few weeks once every 20 years, at 60 times the average cost of a litre of water in Thames' area. The capital bias may lead to potentially cheaper solutions being overlooked, such as operational expenditure on demand reduction, leakage detection, purchasing water from a neighbouring water company, or installing water meters to the extent that these reduce demand. For example Ofwat estimated that, compared to companies' existing investment plans, developing a number of new interconnectors to transport and trade of water from low cost water company areas to high cost areas could save around £1 billion (NPV).

The process for determining the investments to match future public water supply and demand is characterised by bilateral discussions between monopoly water companies, on the one hand, and Ofwat on the other. Such a process is now insufficient. Going forward the process needs a wider range of players able to propose alternative approaches and innovative solutions, and a means to select the right approach on a level playing field. Ofwat is highly constrained in its ability to challenge companies' proposals, by an asymmetry of information (and by the general lack of information that characterises monopoly industries). It is hard for Ofwat to scrutinise companies' plans, let alone make counter-proposals for alternative demand/supply solutions. While the Water Resource Management Plan process has been an important step in requiring water companies to consider a range of options, such a process is no substitute for getting a range of market players involved. But there are a range of legislative and regulatory barriers to competition from new entrants or neighbouring water companies, who wish to propose alternative, competing ways of matching demand and supply.

Innovation is key but levels of innovation in the water sector are low. The amount of reported water company operational expenditure on research and development has fallen from £45 million a year in the early 1990s, to £18 million. While water sector research does not need to be undertaken by the monopoly water companies themselves, these companies do need to engage with innovators, helping them to demonstrate and develop their ideas, and providing a willing market for new approaches. Regulatory arrangements which, necessarily, bear down on operational costs may disincentivise innovation.

Reforms to regulatory arrangements need to make achieving sustainable abstraction cheaper

Responding to over-abstraction through focusing on cuts to maximum licensed abstraction volumes is unlikely to be the least cost way to address environmental damage caused by 'peak' scarcity periods. Instead, more use needs to be made of sophisticated abstraction licence conditions, which restrict water when it is scarce in the environment and enable more abstraction when it is plentiful. Allowed quantities of abstraction could be graduated in specified 'tiers,' or alternatively each abstractor on a river could be entitled to a particular 'share' of overall flows. As river levels fall, so does the amount of water that can be abstracted. Where river levels become very low, permissible abstraction can fall to zero – equivalent to a 'hands-off flow' condition (which specifies the low flow level at which abstraction must cease). Similar approaches have been applied to manage abstraction in rivers in Spain and Mexico, for example. They would better protect the environment, while minimising the restrictions needed to do so.

Annual charges for abstraction licences should be based on actual volumes abstracted, and the structure of such charges should send signals about which abstraction sources are most environmentally sensitive, and about periods when water is becoming acutely scarce and the environment is at risk of damage. (It may be easier in the shorter-term to make progress on the structure of abstraction charges, than to secure new abstraction licence conditions as a result of the potential need to compensate for curtailed property rights.) Signalling environmental costs through the structure of abstraction charges would influence water companies' operational decisions. Where they had a choice of sources, companies

might be incentivised to use environmentally sensitive, but cheap, sources less often. It is likely that much could be achieved simply by restructuring existing charges, without increasing the total level of Environment Agency charges. Total abstraction charges paid by all water companies are of the order of 10% of companies' total direct water operating costs. Abstraction charges therefore represent a significant operational cost for water companies on average, and, if better structured, could deliver significant incentives. Such incentives could achieve environmental benefits in the short-term, at low economic costs. WWF has modelled such an approach on a River Dart abstraction, and found that the necessary level of environmentally-based abstraction charge needed to protect low flows on the Dart in the 1995/6 drought would have been in the region of £75,000, compared with the alternative of replacing the Dart abstraction source at a capital cost of up to £100 million.

Institutional reform in the Environment Agency is needed to ensure a clearer focus on, on the one hand, protecting the water environment, and, on the other hand, regulating available water to maximise the benefits for all users. These are different objectives, and the related functions need an appropriate degree of separation and specialisation in terms of skills. There needs to be a strong water environmental regulator function within the Environment Agency, to understand and act on behalf of the environment. A separate 'abstraction system and market operator' function, within or outside the Environment Agency, should be focused on maximising the economic and social benefits from available water. Its roles would include translating environmental limits into abstraction licence conditions, allocation of licences, setting charges, and enabling clear property rights and water trading. Consideration should be given to the location of the latter function, with one option being locating it within Ofwat. (Ofcom provides an existing model for a sectoral regulator combining an economic regulation role with a system and market operator role in relation to spectrum.)

"There needs to be a strong water environmental regulator function within the Environment Agency, to understand and act on behalf of the environment"

Better structured tariffs for water customers need to be developed over time, enabling water charges to vary over time, in order to send signals about when water is in peak periods of scarcity. This would incentivise reduced demand and water efficiency efforts in precisely those periods which (a) drive spending on expensive but infrequently-used new supply infrastructure, and (b) cause much of the environmental damage from over-abstraction. Such peak/off-peak tariffs would also allocate costs more fairly, charging closer to the actual costs of taking more water during peak scarcity periods, such as for garden watering in dry summers. Vulnerable households, with high all-year round water use, should be better off as charges become fairer. Tariffs which better reflect the actual costs of each customer's water use also put power into the hands of customers: they are able to reduce their water bill by adjusting their water use in peak periods. This proposal is about the structure of tariffs, not about increasing overall charges to customers. If charges are increased during a dry period, they should be equivalently reduced during periods of relative plenty.

To enable better structured water tariffs, increased levels of metering are needed, and meters which are 'smart' enough. Yet some water companies are

continuing to install 'dumb' meters. The government and Ofwat have roles to play in setting minimum standards for new meters and ensuring that the full potential benefits from smart meters are taken into account in appraising companies' business plans.

The government and Ofwat should take steps to begin to open water supply markets to competition, in order to stimulate a wider range of innovative, competing options for matching demand and supply. For example, enabling competition between separated water retail service companies (businesses providing water customer services, such as billing, metering and water efficiency services) could deliver more water efficiency and demand-side response measures, as an alternative to traditional new supply-side infrastructure. (In Scotland, which has had competition in water retail supply for non-household customers since 2008, water efficiency services have grown.) Neighbouring water companies should also be better able to compete to supply water to each others' customers, transporting water across company boundaries where this is a cost-effective and environmentally sustainable approach. This could stimulate new interconnection between water company areas, and a partial 'peak reserve water grid' might emerge over time, such that more water flowed between areas at peak times, when water was at its most valuable and therefore worth transporting furthest. A number of legislative barriers to market opening need to be removed, as recommended by the Cave review. Ofwat should also solicit and incentivise competing proposals for matching future supply and demand as part of the periodic price review process.

Ofwat needs to consider a number of further reforms in relation to the regulatory incentives on companies in the periodic price review process. Ofwat should identify ways to mitigate companies' bias towards capital solutions, for example, by equalising incentives in relation to companies' capital and operational expenditure (for example between capital spending on a new desalination plant or operational expenditure purchasing water from a neighbouring company). Ofwat should also consider a specific new regulatory incentive for innovation.

A process for delivering sustainable levels of abstraction

The regulatory reforms outlined in this report would make addressing damaging over-abstraction cheaper, in particular by encouraging less costly solutions for matching future demand and supply. But they will not make it costless, nor will progress happen automatically. The government needs to set a strategy and process for achieving sustainable abstraction, and one which reinforces least cost approaches.

Key is the government committing to a timetable – perhaps 15 years – for achieving broadly sustainable levels of abstraction, with sanctions (such as charges which reflect full environmental costs) for abstraction which continues to be damaging after that point. Such a timed commitment would, for the first time, provide a clear direction and destination to inform abstractors', and Ofwat's, decision-making. There may be a case for legislating in relation to the commitment, to maximise regulatory certainty. This would incentivise abstractors to engage in a process of identifying the investments needed.

Abstractors should be encouraged to work together to respond to catchment-level goals for sustainable abstraction. Empowering abstractors in this way could

reduce regulatory uncertainty. This process should establish firm new property rights, so that abstractors are incentivised to act early to remove current regulatory uncertainty and enable them to plan, invest and trade. The new rights should aim to be in the right ballpark to protect the environment, based on existing knowledge, and not seek perfection. In the longer-term, the regulator would be able to adjust abstraction property rights – as scientific knowledge improved or rainfall patterns changed – by participating in the market (buying back rights). Sustainable abstraction is not an end-point but an ongoing process.

For water companies, the Ofwat periodic price reviews in 2014 and 2019 should be the processes for scrutinising proposals, incentivising efficient investment choices and providing funding. Once tasked with meeting a clear government commitment, Ofwat is the right organisation to protect the interests of customers during the process of achieving sustainable abstraction.

Recommendations

This report makes recommendations for Defra, Ofwat and the Environment Agency, listed below. In the government's white paper, *The natural choice: Securing the value of nature*, released in June, the government made the following welcome commitment:

> *"We will reform the abstraction regime. The new regime will provide clearer signals to abstractors to make the necessary investments to meet water needs and protect ecosystem function. We will also take steps to tackle the legacy of unsustainable abstraction more efficiently. The forthcoming Water White Paper will set out further details."*

The government's water white paper, expected later in 2011, is the key opportunity to take forward the reforms needed to secure environmentally, economically and socially sustainable water.

1. **The abstraction licensing toolbox should be broadened. A range of licence conditions should be deployed to achieve abstraction licences that are more responsive to environmental scarcity, while maximising available abstraction. As well as more hands-off flow conditions (which curtail abstraction at low river flows), the scope for use of graduated quantity limits should be examined.**
2. **Abstraction charges should be reformed so that (a) charges vary by volume actually abstracted and (b) the structure of abstraction charges should better reflect locations and times of environmental risk.**
3. **The Environment Agency should be reformed, with its distinct functions in relation to abstraction regulation separated. A strong, focused water environmental regulation function, acting on behalf of the environment, should be separated from abstraction 'system and market operation' functions that manage the abstraction licensing system in order to maximise the overall benefit to society of water. The latter functions could be located separately from the Environment Agency, for example in Ofwat.**
4. **Defra should set out minimum standards for new water meters, to ensure they are sufficiently smart to support structured tariffs (at least Automated Meter Read standard).**
5. **Defra guidance should set out the government's view that 'smart'**

metering and associated structured tariffs have substantial benefits for customers and for the environment. These benefits should be fully taken into account in Water Resource Management Plans, investment appraisals and 2014 price review decisions, and there should be a presumption that such metering will be part of any substantial new demand/supply investment by a water company.

6 **Water companies should develop structured water tariffs that vary over time to signal scarcity and incentivise reduced demand, particularly at peak times. Such tariffs have the potential to reduce the need for the most expensive peak supply infrastructure, to secure environmental benefits and to improve fairness in water charges.**

7 **Ofwat should use its sign-off powers over water tariffs to require water companies to make the structure of 'smart' metered tariffs reflective of water's values at different times. As part of this, Ofwat should require companies to make transparent estimates of cross-subsidies between relevant customer categories for the costs of demand and scarcity peaks.**

8 **The government should legislate to enable an opening-up of the water supply market to competition, with neighbouring water companies, new separated water service companies and new entrants able to compete to supply customers, encouraging alternative and innovative ways for matching supply and demand.**

9 **In particular, legislation should implement the recommendations of the Cave review, and include mandatory legal separation of water companies' retail services businesses; new operating licences which enable companies to provide selected water supply activities; removal of the 'eligibility threshold' currently preventing most non-household customers from choosing their supplier; and regulatory separation of water companies' 'network system operation' functions.**

10 **Alongside such market-opening, and subject to a sufficient degree of regulatory vertical disaggregation of water companies' businesses, restrictions under the special merger regime for water companies should be eased to enable mergers between companies' water retail services businesses, and between pipe network businesses.**

11 **Ofwat's periodic price review process should solicit and incentivise competing proposals for matching future supply and demand, with the level of regulated companies' price caps reflecting only the most cost-effective set of competing solutions.**

12 **Ofwat should consider specific new regulatory incentives for innovation outputs.**

13 **Ofwat should identify ways to mitigate companies' bias towards capital-intensive supply-side solutions, for example, by capitalising a fixed percentage of costs across both capital and operational expenditure in the Regulatory Capital Value; developing scarcity-based demand reduction targets; or requiring a minimum proportion of companies' programmes for matching demand and supply to consist of demand-side measures and interconnection, for a time-limited period.**

14 **The government should set a clear timetable for achieving sustainable abstraction across all catchments, for example over the next 15 years,**

with a commitment in legislation that any abstraction that subsequently significantly damaged the environment would be subject to enforcement or bear a charge to reflect the full costs of that damage.

15 **The Environment Agency should translate the government's commitment into catchment-level goals, starting with the most at risk catchments first, setting out the overall catchment-level outcome sought and allowing water companies and other abstractors the flexibility to work out the best plan for achieving sustainable abstraction.**

16 **Implementing catchment plans should establish firm water property rights, within the limits of current information. Licences should be refined over time, as information improves and potentially as rainfall patterns change, only through the regulator participating in the market to buy back rights.**

17 **Moving to sustainable catchments will require substantial investment by water companies, which should be funded though their revenues and determined by Ofwat's periodic price review processes in 2015 and 2020. Once the government has set the timetable, so that water companies have incentives to engage, Ofwat has expertise in incentive regulation to secure the investments needed at lowest cost.**

18 **Ofwat should consider developing competition between water companies (for example, through reverse auctions) for additional allowed revenues to enable them to go further, faster towards sustainable abstraction.**

1 Introduction

While we often take water availability for granted in England and Wales, expecting it to always be available cheaply at the turn of a tap, this year's drought conditions across much of the country, with the driest spring for 20 years and drought orders beginning to be imposed in some areas, highlight the issue of water scarcity. In fact water is increasingly scarce in many areas, not just in drought years. Many rivers and natural water environments are suffering damage on a regular basis as a result of over-abstraction of water.[1] The Environment Agency has estimated that on average between 1,100 and 3,300 Ml more per day is abstracted than the environment can sustain. For example, the Mimram and Beane Rivers in Hertfordshire provide a mixture of habitats in which birds, plants and animals can thrive, including the rivers themselves, marsh, fen, meadows, ponds, lakes, and wet grasslands and woodlands.

"Climate modelling, while uncertain, points to changed rainfall patterns, with drier summers and increased rainfall variability over the coming decades, further increasing pressure on rivers and on water supplies"

They are also important to local people for fishing, walking, wildlife watching and other recreational activities. But in 2006 the Environment Agency's assessed the rivers to be "over-abstracted with insufficient flows to meet the environmental need at all times, even at times of high flows".

The demands from population growth are putting increasing pressure on water supplies. Climate modelling, while uncertain, points to changed rainfall patterns, with drier summers and increased rainfall variability over the coming decades, further increasing pressure on rivers and on water supplies. The costs of developing new infrastructure for collecting or abstracting, treating and transporting water increase as cheaper options are exhausted. In some areas, very expensive infrastructure is being built to prepare for peak demand in dry years, such as desalination.[2] Water itself is becoming more valuable. In the face of these challenges, this report examines whether government policy and regulation of water abstraction and supply is still fit for purpose.

Water is heavily regulated, and current regulatory arrangements have grown up over many decades. The Environment Agency (established in 1996, taking on the role of the former National Rivers Authority) regulates abstraction levels and water discharges and Ofwat (established in 1989) regulates water companies' prices and the water supply market. (In addition, the Drinking Water Inspectorate regulates drinking water quality.)

1 WWF (2010), *Riverside tales: Lessons for water management reform from three English rivers*.

2 A desalination plant creates freshwater by removing the salt from seawater, using a highly energy intensive process.

This report assesses relevant aspects of the current regulatory arrangements and identifies the need for reform in a number of areas, in order to meet the following objectives in future:

- the environment is better protected;
- we maximise the value, for people and for the economy, of available water;
- arrangements promote cost-effectiveness; and
- arrangements are robust to future challenges, including from climate variability and population growth.

Scope of the report

This report focuses on England and Wales. Separate regulatory arrangements apply in Scotland. The report addresses both the Environment Agency's regulatory regime, in relation to abstraction licensing, and Ofwat's regulatory arrangements, in relation to price and incentive regulation of water supply companies.

There is an important read across between regulation of water availability (quantities) and of water quality (for example, the quality of water discharges from sewage works). The natural environment is affected by both the quantity and quality of water in the environment. However, the focus of this report is on water quantity, and water abstraction in particular.

In addition to the objectives set out above, there are important equity or distributional considerations in relation to water policy. For example, the distribution of water charges across geographical areas and the impact of tariffs on poorer and vulnerable water customers. These issues are not the focus of this report. However, this report's recommendations are consistent with existing and potential future policy approaches for addressing these distributional objectives, such as the Water Sure scheme and geographically average water bills. This report highlights in relevant places how this might be achieved.

2
Background and policy context

The Department for the Environment, Food and Rural Affairs (Defra) is expected to publish a white paper on water before the end of 2011.

Amongst other areas, the white paper will need to pick up unfinished business following Defra's 2009 consultation that proposed the time-limiting of all abstraction licences, and recommendations from two independent reviews completed in 2009, which the Coalition Programme for Government committed to considering.

The first review, undertaken by Professor Martin Cave, explored competition and innovation in the water and sewerage sectors.[3] He recommended measures to enable greater competition with and between the existing monopoly water companies, improved regulatory incentives for innovation and the development of trading of, and scarcity-based charging for, abstractions licences. The previous government consulted on the implementation of Cave's recommendations.

The second review, undertaken by Anna Walker, undertook a review of charging for household water and sewerage services, supporting greater levels of water metering as well as charges to better reflect water's values.[4]

A number of EU environmental directives are relevant to water availability, including the Habitats Directive, and the broader Water Framework Directive (WFD), which requires EU member states to achieve good qualitative and quantitative status of all water bodies (rivers, lakes etc), in principle by 2015. The WFD allows for an extension to 2027, or less stringent objectives, after taking into account technical feasibility and whether solutions are 'disproportionately costly'.

Other relevant policy context includes Ofwat's ongoing review of its price regulation process and market-opening; changes within the Environment Agency in part as a response to Comprehensive Spending Review cuts; as well as the government-commissioned review of Ofwat by David Gray, a former executive member of the Ofgem board.

This report aims to influence the government policy, taking into account the work of the various reviews that have, or are being, undertaken.

Water abstraction

Water may be abstracted from rivers or from groundwater sources; it may be collected and accessed from reservoirs; or it may be 'manufactured' from desalination plants. Levels of water abstraction are regulated by the Environment Agency through a system of abstraction licences, some dating back many decades.

Abstractors wishing to abstract more than 20 m^3 of water per day must seek a licence from the Environment Agency. A new licence sets out a maximum volume

3 M Cave (2009), *Independent Review of Competition and Innovation in Water Markets*, Report to Defra.

4 Walker (2009), *The Independent Review of Charging for Household Water and Sewage Services*, Final Report to Defra.

(e.g. per day) that may be abstracted, as well as any specific conditions attached to the abstraction, such as a 'hands-off flow' condition. A hands-off flow condition would typically require an abstractor to cease abstraction if river flows fell below a given level. A new abstraction licence typically runs for 12 years. However, many existing abstraction licences date back many decades, and are not time-limited, nor subject to licence conditions. For example, over 80% of licences (69% of surface water licences) have no hands-off flow conditions meaning that abstraction may continue even if low river flows are damaging the natural environment.

There are around 20,000 separate water abstraction licences across England and Wales. Water companies are the largest group of abstractors, accounting for around half of licensed abstraction volumes. The power generation sector and other industrial users are also large water abstractors. Agriculture accounts for only around 1% of abstraction on average across England and Wales, but this proportion varies very considerably between regions and seasons. Different uses of abstracted water have different impacts on the environment, depending on how much water is returned to the environment after use and where it is returned. For example, most water used for power generation cooling is returned to the environment close to its point of abstraction.

The roles of the Environment Agency include both identifying the limits to abstraction at a particular location that the natural environment is able to bear, and managing the system of abstraction licences to protect both the environment and the rights of water abstractors (since the operation of one abstraction may affect another). One of the ways in which the Environment Agency discharges its functions is through the Catchment Abstraction Management Strategy process, which divides England and Wales into around 130 water catchments, and develops a strategy for managing each catchment.

A third of catchments are classed as over-abstracted or over-licensed, and two-thirds of catchments are closed to new issuance of abstraction licences. Climate change and population growth could further exacerbate over-abstraction problems. The Environment Agency is in the process of conducting reviews, under the Restoring Sustainable Abstraction programme (RSA), of selected water abstraction licences in England and Wales to identify where environmental damage may be occurring as a result of over-abstraction. The Agency has so far identified about 500 conservation sites and about 600 water bodies that need investigation.[5]

Water industry regulation

There are 21 main private 'appointed' water companies in England and Wales. Each has an appointed area within which it is effectively the monopoly supplier of water. The appointed water companies are vertically integrated, meaning that they undertake all the various water supply business activities, from the abstraction or collection of water, through its treatment and transport, to provision of customer services. Ten of the water companies are also monopoly sewerage companies, with appointed areas between them covering England and Wales.

The appointed water companies are not under pressure from market competition to be efficient, to keep their prices down nor to provide good levels of service. Customers cannot choose to switch their water company if they are dissatisfied with service or price (except, theoretically, very large business customers). For this reason, at the time of water privatisation in 1989, the economic regulator

5 Environment Agency (2010), *Managing Water Abstraction.*

Ofwat was established with powers to cap water companies' prices, incentivise efficiency and regulate service standards. Ofwat has statutory duties to protect the interests of customers, while enabling water companies to finance their (efficient) activities. Ofwat also has a range of secondary duties, including in relation to sustainability.

Ofwat scrutinises individual water companies' plans for capital expenditure and attempts to incentivise operational efficiency using performance comparisons between companies. Given the high capital intensity of the water industry, companies' revenues depend to a substantial degree on Ofwat's decisions about how much capital expenditure is allowed into companies (deemed 'Regulatory Capital Value') and the cost of financing that capital (the deemed 'cost of capital').

These overall arrangements have enabled £90 billion of capital investment across the water and sewerage sectors since privatisation, a large proportion of which has been to improve environmental standards. Prices for customers have risen relatively modestly in most regions.[6]

However, as Ofwat itself recognises, new challenges, including from population growth, climate change and increasing consumer expectations, mean that existing regulatory arrangements need to become more flexible and parts of the industry need to open up to competition in order to enable and incentivise more innovation in response to the new challenges.

In Scotland, the economic regulator, the Water Industry Commission for Scotland, has already begun the process of market opening. Since 2008, the retail services business of Scottish Water has been legally separated, and non-household customers have been able to choose between it and new entrant water retail service suppliers.

6 Prices have risen more substantially in the South West Water area as a result of higher than average environmental capital expenditures since privatisation.

3
Problems and challenges

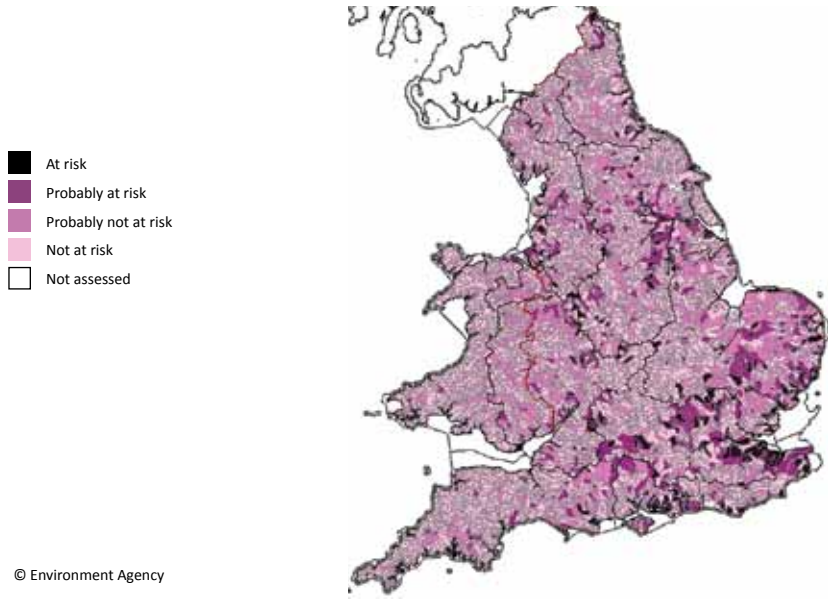
The regulatory arrangements for water are currently leading to major problems: damage to the natural environment; lack of access to water and inefficient allocation of available water between users; and unnecessarily expensive approaches to matching demand and supply. A number of trends and challenges, including population growth, economic growth, climate change and rising water supply costs are likely to exacerbate these problems.

Damage to the natural environment

The natural environment is being damaged by over-abstraction of water. The Environment Agency has estimated that on average between 1,100 and 3,300Ml more per day is abstracted than the environment can sustain. But the situation is more usefully understood not through averages but through examining specific locations (and times).

Figure 1 shows the areas where surface water bodies (rivers, lakes, marshes, etc) are at risk from over-abstraction.[7] Many water bodies are at risk, particularly in the South East though there are areas at risk right across England and Wales.

Figure 1: Surface water bodies at risk from abstraction[8]



7 The Environment Agency compiled this map using information from the Catchment Abstraction Management Strategy (CAMS) process, identifying those water bodies likely to be at risk or probably at risk of failing Water Framework Directive (WFD) objectives by 2015 as a result of abstraction pressures.

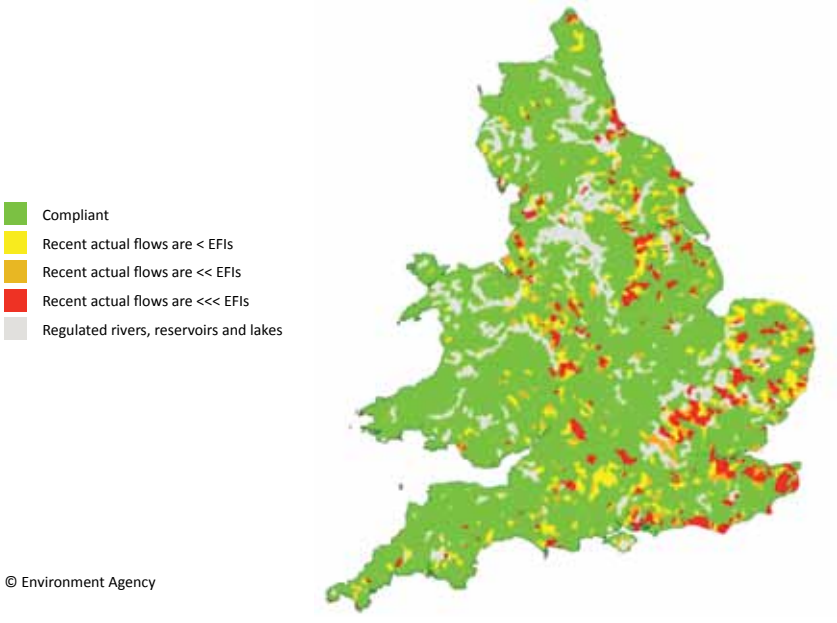
8 Environment Agency (2008), *Water resources in England and Wales - current state and future pressures*.

Impacts from over-abstraction can include loss of river and wetland habitats due to absolute loss in wetted area, insufficient water depth, increased sediment accumulation, increased temperature, increased vulnerability to pollutants and impacts on some plant and invertebrate species that are dependent on certain water velocities. While there are important exceptions, in the majority of freshwater systems in England and Wales this means that damaging impacts from abstraction are likely to occur at times of water scarcity and low flows, in particular during periods of low rainfall.

The impact of abstraction depends on the nature of the particular freshwater system. Groundwater-fed systems such as chalk streams are less 'flashy', i.e. have more constant flows than rain-fed river systems. This means that over-abstraction problems are, in general, likely to occur for briefer periods in rain-fed systems than chalk streams. In some systems abstraction has an impact at most times, in particular systems that depend on a relative abundance of water, such as wetlands.

Figure 2 is a map showing how actual river flows compare with Environmental Flow Indicators (EFIs).[9] An EFI is an estimate for the proportion of a water body's flow regime that can be abstracted without unacceptable risks to the water environment. Figure 2 shows a similar geographic pattern to Figure 1, with river flows in many areas across the country found to be lower than estimated flows needed for a healthy natural environment. (Figure 2 averages low flow periods across a number of years, so it may underestimate damage to rain-fed rivers in particularly dry years.)

Figure 2: Rivers' compliance with Environmental Flow Indicators [10]



To bring the plight of over-abstracted rivers a little more to life, Box 1 summarises a case study on the rivers Beane and Mimram in the upper Lee valley in Hertfordshire. This is drawn from WWF's recent report *Riverside Tales*.[11] The Beane and Mimram chalk streams provide a mixture of habitats in which birds, plants and animals can thrive, as well as leisure opportunities for local people. But the rivers are over-

9 Environment Agency (2010).

10 Environment Agency (2010).

11 WWF (2010).

Box 1: Rivers Mimram and Beane[12]

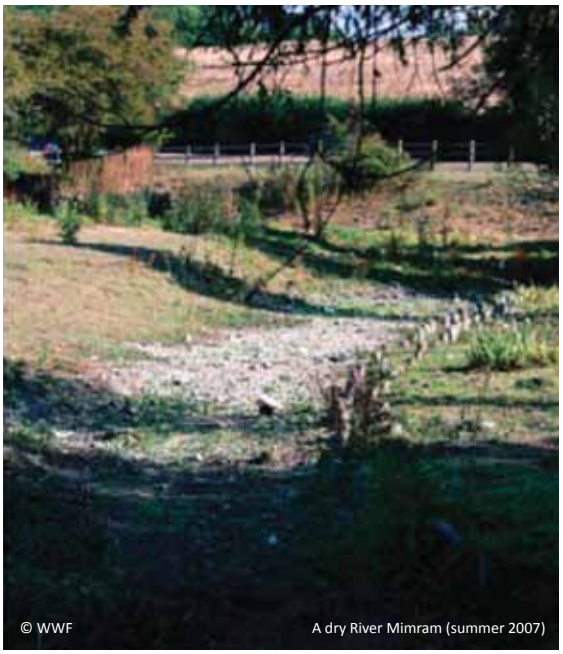
The Mimram and the Beane rise from Hertfordshire chalk before winding their way, for 12 miles or so, to meet the river Lee in Hertford.

The Mimram and the Beane – with their springs and high groundwater level – provide a mixture of habitats in which birds, plants and animals can thrive. As well as the streams themselves, the chalk streams create marsh, fen, meadows, ponds, lakes, and wet grasslands and woodlands. There are a number of places on the rivers that are special for wildlife. For example, the Beane near Watton is home to a colony of water voles. At Panshanger Park, the Mimram supports alder-rich woodland. And at Tewinbury, the Mimram is such a haven for wildlife that it has been designated as a Site of Special Scientific Interest (SSSI40). Over 20 species of birds visit each year, including grey wagtail, kingfisher, reed bunting, little egret, snipe, woodcock, water rail, moorhen, coots and ducks. Water crowfoot blooms on the river and, on the banks and over the wetted meadows, a bouquet of flowers and plants can be found – southern marsh orchid, golden saxifrage, butter-burr, marsh pennywort, lady's smock, ragged robin, meadow sweet, marsh marigold and several sedge species, through which grass snakes and slow worms can slither. Fish stocks are lower than they once were (which keeps the otters from settling), but brown trout, bullheads, sticklebacks and stoneloach can be found in the Mimram.

These rivers are important to local people for fishing, walking, wildlife watching and other recreational activities. There are a number of fishing clubs active on each river, and the Mimram supports watercress and fish farms. A 2001 survey found that people had significant willingness to pay to improve the Mimram. Local action groups have formed to campaign to restore and protect the two rivers, working alongside other community groups and the local Wildlife Trust.

The Mimram and the Beane are important sources of public water supply, managed by Veolia Water Central. On the Beane, on average a total of 42 million litres of water are pumped every day from the underground chalk for public supply, primarily to Stevenage (from licences totalling 49 million litres per day). On the Mimram, average daily abstraction amounts to 14 million litres (licences allow up to 21 million litres per day). During peak weeks, actual Mimram abstraction can be over 20 million litres per day, the majority of which is used to supply Welwyn Garden City and surrounding areas. The majority of this water is lost from the rivers, as the treated sewage is returned to the Lee, downstream near Hoddesdon.

Both rivers are significantly over-abstracted at both high and low flows, a problem that has long been



© WWF A dry River Mimram (summer 2007)

acknowledged by the Environment Agency (which has published related studies for over 20 years).

Demand for water from the Mimram and the Beane is likely to continue to increase due to increasing housing development. The East of England Plan designated the area as a "key centre for development and change". This translates into growth in housing and water demand. Within the upper Lee area this includes 15,000 new homes in and around Stevenage and 10,000 new homes in the Welwyn–Hatfield area. A further 37,700 homes are planned for the surrounding area (Harlow, Broxbourne, Epping Forest and east and north Hertfordshire).

In the early 1990s, the National Rivers Authority recognised the Mimram as one of the ten worst affected rivers in the region. It concluded that abstractions in the upper Lee catchment were not in balance with ecology, and that solutions would need to be implemented by 2010. Over ten years ago the Environment Agency presented a case for amending the Whitehall abstraction licence on the Beane, which was accepted by the government, but has yet to be implemented. The Environment Agency's CAMS in 2006 assessed the Mimram and the Beane to be "over-abstracted with insufficient flows to meet the environmental need at all times, even at times of high flows".

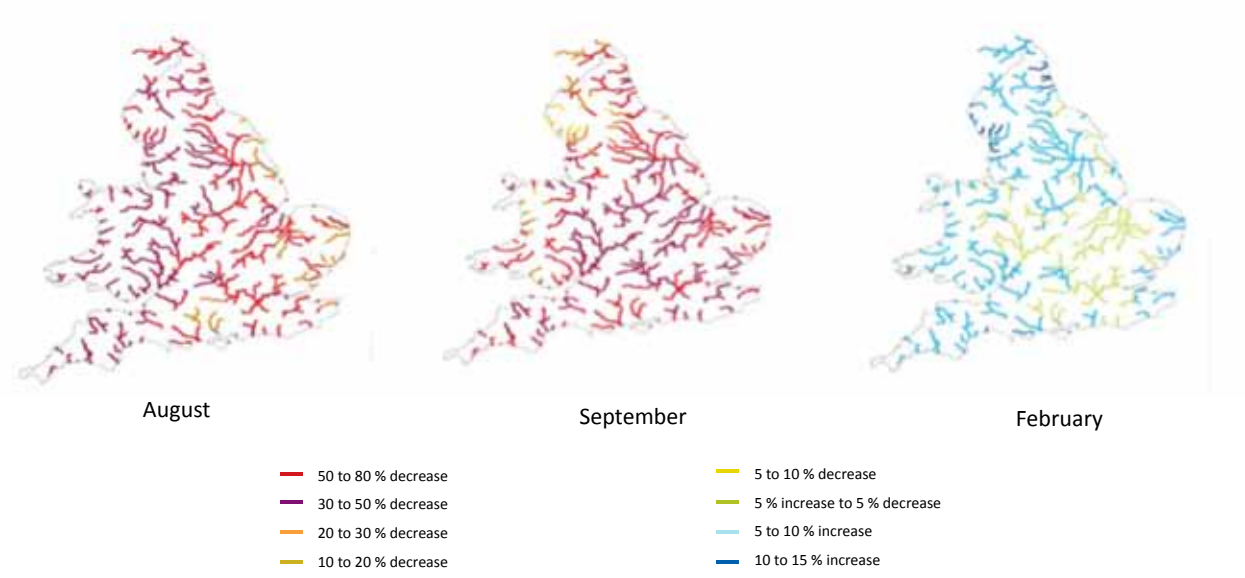
Because the historical, overinflated abstraction licences remain in place (creating a regulatory illusion that sufficient water is available), Ofwat has not allowed capital expenditure for alternative supplies, nor demand reduction measures. Today, the Environment Agency is attempting to take action on the Mimram and the Beane through its Restoring Sustainable Abstraction programme.

abstracted. For example, water equivalent to the *total* natural Mimram river is abstracted for 5% of the time in an average year. There are plans to build substantial numbers of new houses in the upper Lee area, which would further exacerbate pressures on the Mimram and Beane rivers.

The UK's population is projected to rise to 70 million by 2030, and much of the growth is expected to be in the relatively water scarce South and East of England. Population growth increases demand for water and will increase pressures on rivers and water supplies over the coming decades.

Another projected future pressure arises from climate change. Changes to the climate, while uncertain, may cause greater rainfall variability and changed river flow patterns. Figure 3 shows modelled impacts of climate change on rivers across England and Wales. According to these models, climate change would reduce river flows in summer and autumn by between 20% and 80% across most of England by the 2050, while increasing river flows in winter.

Figure 3: Percentage change in mean naturalised monthly river flows by 2050 (using the medium-high UKCIP02 scenario) [13]

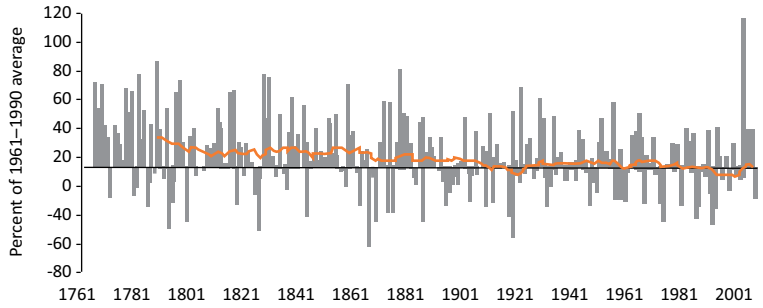


The important impacts from climate change are less likely to be from changed rainfall averages and more from changes to the frequency and severity of extreme events. Figure 4 shows long-term rainfall anomalies for England and Wales for May, June and July, dating back to 1761, alongside a 30 year moving average. This indicates that while there has been a long-term change to average precipitation over the last two centuries, this long-term change in the average has been dominated by short-term variability. For water supplies and the freshwater environment, it is these extremes, and any changes to them, that will be the core of the climate adaptation challenge.

12 WWF (2010).

13 Environment Agency (2008).

Figure 4: Annual variance from long-run average precipitation, England and Wales, May-July, 1766-2010[14]

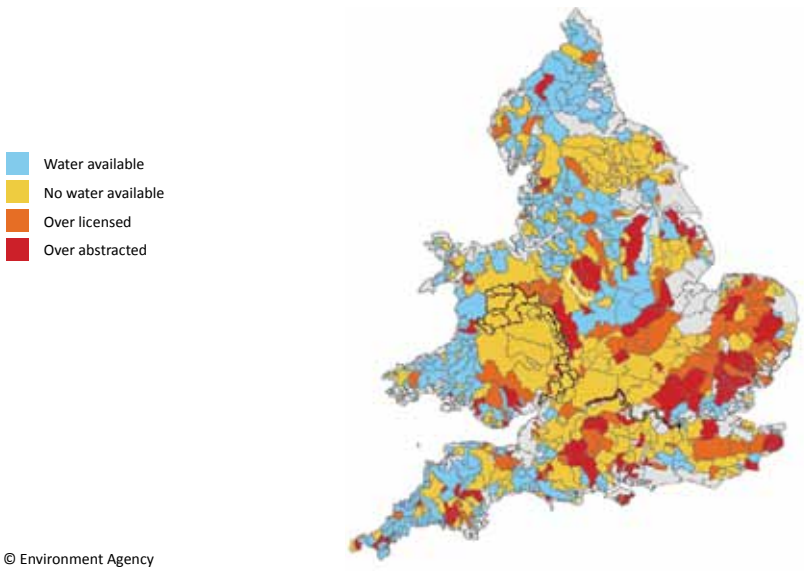


Water for people

Water abstraction licences are hard to obtain in the majority of areas, there is substantial uncertainty about future availability of abstraction under existing licences and few incentives for allocation of water where it has greatest benefits.

The Environment Agency has deemed 15% of catchments to be over-abstracted. A further 18% of catchments are deemed to be 'over-licensed' (in other words, if abstraction licence holders increased their actual abstraction closer to the allowed volume in their licences, then environmental damage would be expected to result).[15] In total, for two-thirds of catchment areas across England and Wales the Environment Agency is issuing no new abstraction licences.[16] Figure 5 is a map showing the availability of abstraction licences.

Figure 5: Catchment area water availability (surface water combined with groundwater)[17]



14 R Wilby (2010), Department of Geography, Loughborough University.

15 Over the period 2003 to 2007, only 44% of licensed volume was actually abstracted in England from non-tidal sources, with public water supply licensees abstracting 55% of their licensed volume, and 35% average utilisation for all other uses.

16 Environment Agency (2009a), *Response to Defra and Welsh Assembly Government consultation on 'Proposals for time limiting of water abstraction licences'*.

17 Environment Agency (2008).

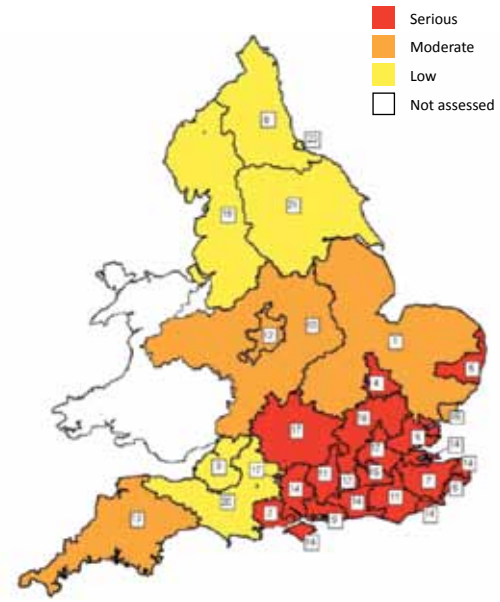
In over-abstracted and over-licensed areas, some abstractors may not actually be *able* to use all of their licensed volumes, particularly at certain times. The water may not physically be available. In the minority of licences, a hands-off flow licence condition will kick-in to stop abstraction at low flows (protecting minimum flows on behalf of the environment). For other licences, the physical limit to abstraction may be the river effectively running dry. Such physical limitations to availability may increase in future as abstractors increase their demand and as climate change reduces the availability of water in peak periods.

As well as there being no new abstraction licences available from the Environment Agency in two-thirds of catchments, there is little scope to obtain an abstraction licence in the secondary market, i.e. from the trading of existing licences. Out of a total of 20,000 abstraction licences, there were only 51 licence trades (permanent or temporary) between 2003 and September 2010.[18] There are a number of regulatory and cultural barriers to trading, discussed later in this report.

In the absence of being able to obtain an abstraction licence, water users may also look to obtain water from their local water company, and this will usually be restricted to paying for treated water. But water companies themselves face future challenges in obtaining water. According to the Environment Agency, most South East England water company areas are at risk of 'serious water stress', with much of the rest at risk of moderate water stress (Figure 6). 'Water stress' is assessed on the following criteria: current per capita demand for water; forecast growth in per capita demand for water; forecast population growth; current water resource availability; and forecast resource availability.[19] Many water companies will, therefore, need to take substantial action to continue to meet demand for water over the coming years, even before considering the need to reduce abstraction to environmentally sustainable levels.

Figure 6: Water company areas map showing relative levels of water stress[20]

1. Anglian Water
2. Bournemouth and West Hampshire Water
3. Bristol Water
4 Cambridge Water
5 Essex and Suffolk Water
6 Folkestone and Dover Water
7 Mid Kent Water
8 Northumbrian Water
9 Portsmouth Water
10 Severn Trent Water
11 South East Water
12 South Staffordshire Water
13 South West Water
14 Southern Water
15 Sutton and East Surrey Water
16 Tendring Hundred Water
17 Thames Water
19 United Utilities
20 Wessex Water
21 Yorkshire Water
22 Anglian Water (formerly Hartlepool Water)



18 J Harou (2010), Presentation to CIWEM conference on Regulation for a Sustainable Water Industry , 9 December 2010 entitled *What can water rights trading do for England?,* Department of Civil, Environmental & Geometic Engineering, University College London.

19 Environment Agency (2007), *Identifying areas of water stress.*

20 Environment Agency (2007).

Water companies, with their extensive distribution networks, have the greatest potential to trade with each other. However, while there are a number of 'bulk water supplies' traded between water companies, the level of bulk water trading has remained low and stable at around 5% of total supplies over the last 15 years, despite increasing demand and supply pressures. Again, there are a number of regulatory and cultural barriers to trading between water companies, which are discussed in Chapter 7.

Trading of water – whether the abstraction licences or the water itself – enables and incentivises water to be used where it has the greatest benefits ('allocative efficiency'). In an effective trading market, where water had a market value, those abstractors who gained greater value from selling rather than using their water, would have the incentive to sell to someone who valued the water more than its market price. Such a market would in particular encourage users to use water more efficiently, where the cost of doing so was less than the market value of the water saved. An absence of an effective trading market is strong evidence that water is allocated inefficiently between users and is likely to be used inefficiently.

Costs of water supply

Current approaches to meeting peak demand for water in dry periods lead to some very high costs.

Water companies are required to develop Water Resource Management Plans (WRMPs), assessing the options for matching demand and supply over the next 25 years. Figure 7 uses information in water companies' WRMPs to compare the costs of matching supply and demand between different Water Resource Zones (relevant sub-divisions of company areas) by 2034-35. It shows that the estimated costs are very high in many zones. Furthermore, WRMPs do not currently take into account the measures – new supply or reduced demand – which would be needed to address environmentally unsustainable abstraction.

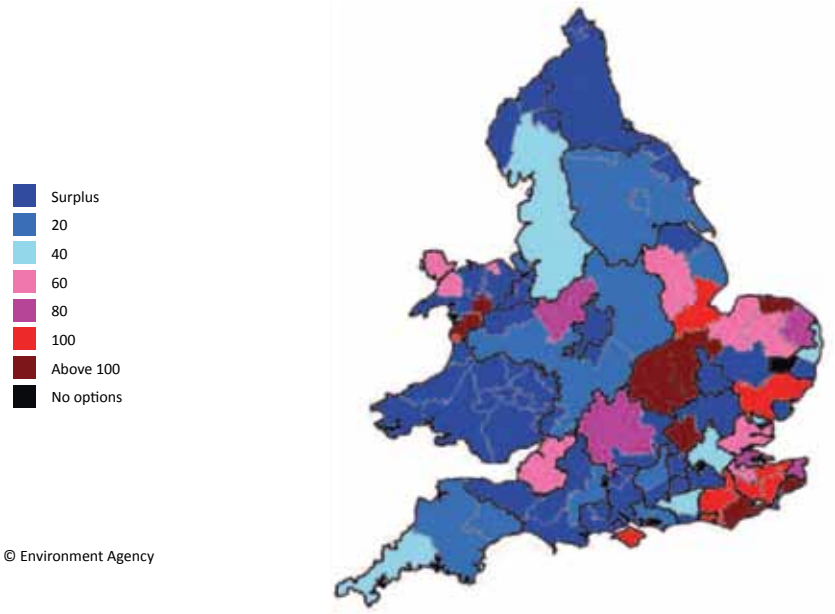
While new supplies can be obtained for less than 20 pence/m^3 (NPV) in a number of areas, costs are much higher in many areas, rising to over 100 pence in some areas. The reasons for high costs will vary. Often costs are high because companies have no more options for increasing borehole and river abstractions, and instead plan to build expensive new infrastructure such as large reservoirs and desalination plants.

Figure 7 is likely to underestimate some of the costs of new supply. This is because the costs are quoted for developing a water supply *capacity*, not for actual water expected to be supplied. Much new supply infrastructure is needed only for short peak demand periods in infrequent dry years (at least in its earlier years) so the cost per cubic metre of water actually supplied could be much higher. For example, while Thames Water estimates the cost, in its South West Oxfordshire area, of the proposed Abingdon Reservoir to be 87 pence/m^3 of *capacity*, it estimates this could rise to 536 pence/m^3 of water actually supplied.[22]

So water supply costs are set to be high in many areas, but it is also far from clear that such high costs of matching supply and demand are necessary. Typical capital-intensive new infrastructure can be a very expensive approach to infrequent needs to provide reserves for short periods of peak demand in dry years, which may only occur once every few decades. Alternatives could be more cost-effective, such as improved demand-side response to water scarcity and use of

21 Thames Water (2009), *Revised draft water resources management plan.*

Figure 7: Cost of matching supply and demand by 2034-5 in each Water Resource Zone (incremental costs ('AISC') in pence per m³, rounded up to nearest 20p/m³)[21]



interconnection between water companies' areas to increase effective reserves. For example, the substantial differences in the costs of developing new water supply between neighbouring water company areas in Figure 7 would suggest benefits from increasing movement of water from cheaper to more expensive areas. Yet such 'bulk supplies' between water companies have barely risen as a percentage of total water supplied since 1997.[23]

Box 2 gives some examples of new or proposed supply infrastructure that, on the face of it, appears unnecessarily expensive.

Box 2: Examples of costly new infrastructure to meet peak summer demand in dry years

This box outlines the costs and projected benefits of a number of recent or proposed schemes for developing water supply. The appraisal of schemes, and their comparison with other options, is complex and requires access to detailed information. It is beyond the scope of this report to draw firm conclusions about the choice of particular schemes. This box is simply intended to highlight that a range of capital-intensive new water supply schemes are being developed to cover very infrequent shortfalls in supply at consequently very high costs per litre of water delivered.

Thames Water desalination plant

Thames Water has built a desalination plant in the Thames Estuary to meet London's projected peak demand for water in dry years.

Thames Water's justification for the 140Ml per day capacity plant (significantly less than 10% of London's daily water demand), was that it was the best measure to forestall the risk of rota cuts to water supply and standpipes in a very dry year. They put the risk of such a dry year, at the time of the planning inquiry, at 5% per annum, i.e. a once every 20 years event. The capital cost of the plant was £200 million.

22 Ofwat, (2010a), *Harnessing upstream water markets - what's to play for?*

23 Ofwat, (2010a).

The planning authority originally objected to the scheme arguing that Thames Water had exaggerated demand forecasts and underestimated resources, and that preferable options existed for matching demand and supply in the rare periods of projected shortfall. Objections were dropped after the new Mayor was elected.

Given that the justification for the desalination plant was to address an event expected only once every 20 years, the water actually supplied will come at a very high cost indeed per litre. For example, if the projected once in 20 years dry event were to occur once in the plant's lifetime[24] and the desalination plant were to supply water at full capacity for 2 months in late summer/autumn in that drought,[25] then broadly the cost is £24,000 per Ml (or 2.4p litre) *in capital costs alone.* This is already 60 times the average cost of a litre of water in Thames' area.[26] In addition, the desalination plant will have substantial maintenance costs and operating costs.

Abingdon reservoir

While Thames Water estimates the cost, in the South West Oxfordshire area, of its proposed Abingdon reservoir to be 0.087 pence per litre of *capacity*, this figure rises to 0.536 pence per litre of water actually supplied, likely to be well over ten times Thames Water's current average cost of abstraction and treatment of water.[27] The driver of the higher figure is the fact that, at least in the early years of the reservoir, its capacity would be needed only at peak times in dry years. Any alternative non capital-intensive schemes, which were able to address such peaks and thus delay or negate the need for Abingdon could therefore secure significant costs savings.

Havant Thicket reservoir

In their Water Resource Management Plan,[28] Portsmouth Water project a small shortfall in their supply/demand balance by 2035 of around 14Ml/day (equivalent to the average water use of about 35-40,000 households) for a single week in an average year. The shortfall is projected to be larger in a year with a critical hot, dry period at a volume of around 40Ml/day for two weeks.

Under the Water Resource Management Plan process, the company concluded that the best option was to build a new reservoir in Havant Thicket (an ancient woodland) at a capital cost of £34 million.

That amounts to almost £1,000 capital expenditure per household's worth of water for one week each average year.

24 In this crude calculation, any second dry event during the plant's lifetime is ignored as it would likely be sufficiently far in the future for it to be largely discounted.

25 Clearly the desalination plant, having been built, may be used outside such severe drought events, but nevertheless the justification for the £200 million capital spend was the once every 20 years event.

26 Thames Water claims that its water costs on average 0.097p/litre. Since the costs of transport and retail services constitute constitute around 60% of the costs of water on average across England and Wales (Ofwat (2008)), the cost of Thames desalination plant is compared to an average cost of abstraction and treatment of 0.04p/litre.

27 Thames Water (2009).

28 Portsmouth Water (2010), *Updated 2009 Draft Water Resources Management Plan*.

4

The current approach to addressing over-abstraction is broken

Existing approaches for addressing the problem of over-abstraction are woefully inadequate. It could take scores or even hundreds of years and many billions of pounds to address over-abstraction under the current approach. In the meantime, uncertainty for abstractors about how over-abstraction will be addressed increases their costs and reduces the economic benefits from available abstraction.

Restoring Sustainable Abstraction programme

The Environment Agency's first Catchment Abstraction Management Strategies (CAMS) took a catchment by catchment approach identifying available resources and the location of potential over-abstraction problems. CAMSs have provided the basis for capping the issuing of new licences but have not, provided enough information to enable decisions to be made in relation to existing over-abstraction.

The main mechanism at present for addressing over-abstraction is the Environment Agency's Restoring Sustainable Abstraction (RSA) programme. Broadly, under this programme sites under threat from over-abstraction are identified and investigated. Where needed, solutions enabling reduced abstraction are identified and funded.

RSA is currently focusing on a number of specific sites of high conservation value, including Habitats Directive sites and Sites of Special Scientific Interest. The Environment Agency has completed more than 300 local investigations into the environmental impact of abstraction. 148 schemes are being further examined to identify the most effective restoration solution.[29] There has been agreement to fund, through water bills, schemes to enable reduced abstraction in 61 Habitats Directive sites by 2015. The Environment Agency has also agreed to compensate a water company for two abstraction licence reductions at another site through the RSA compensation scheme.[30]

When an abstraction licence needs to be revoked, reduced or have more restrictive conditions applied, the abstractor, in many cases a water company, may need to invest in alternatives to the lost abstraction. Funding for such water company investments to resolve over-abstraction of Habitats Directive sites is scrutinised and allowed by Ofwat in the periodic price review process (i.e. funded from water bills). Compensation for all other licence reductions, including remaining water company abstractions identified under the RSA programme, and all non water company

29 R Benyon (2010), Response Parliamentary Question to Minister for Natural Environment, Hansard, 14 June.

30 Environment Agency (2009b), Open Board Paper 9 February 2010.

abstractions, comes from the Environment Improvement Unit Charge (EIUC), a levy raised through the Environment Agency's abstraction charges. Ultimately abstractors, and water company customers, pay for all the licence reduction schemes. In total, the funding for water companies to redress over-abstraction of Habitats Directive sites totals £350 million, while funding projected to be required for other RSA 'high conservation value' sites through the EIUC scheme totals around £100m, which the EIUC scheme is designed to raise over ten years. The EIUC is classed as a tax and its level is controlled by the Treasury.

Progress is slow so far under the RSA, at least on those areas of over abstraction outside the Habitats Directive. In addition to this, the majority of areas where the natural environment is at risk from over-abstraction action are not even included in the current work of the RSA scheme.

Projected costs and timescales under current approach

The Water Framework Directive (WFD) requires EU member states to achieve good qualitative and quantitative status of all water bodies, in principle by 2015. The WFD allows for an extension to 2027, or less stringent objectives, after taking into account technical feasibility and whether solutions are 'disproportionately costly'. While no clear guidance was provided in the 2009 River Basin Management Plans on changes to abstraction that would be required to meet the WFD, some preliminary indications of the scale and cost were provided.

If all Environmental Flow Indicators (EFIs) were to be achieved across England and Wales (by 2015), Defra has estimated the cost at between £3.7 billion and £27 billion.

Environmental Flow Indicators provide the proportion of the flow regime of a water body that can be allowed for abstraction without causing potentially unacceptable impacts on the water environment. It needs to be recognised that much is unknown about the ecological impact of flows lower than the EFI, which are locally-dependent. Any estimate of ultimate costs of securing sustainable abstraction, as part of meeting the objectives of the WFD, is therefore very hard. But it seems clear that the costs estimated under current arrangements are very high indeed.

Using the above cost estimates, and current, already substantial, rates of spending on restoring sustainable abstraction (i.e. £400 million over five years), it would take between 45 and 335 years to address the estimated over-abstraction problem in England and Wales. And that does not take into account the degree to which trends such as population growth and changes in rainfall patterns may add to the existing problems of over-abstraction.

Tactics tried to make more rapid progress

A number of tactics have been tried to make more rapid progress. None have been successful in addressing over-abstraction, and a number have had adverse economic impacts.

Clearly one option was to levy a higher EIUC levy in order to pay out compensation faster for abstraction licence reductions. However the Treasury strictly controls the level of the EIUC, which is accounted for as a tax.

The Environment Agency and companies have attempted to persuade Ofwat to fund, through the periodic price review process, schemes to replace current damaging abstraction beyond those statutorily driven under the Habitats Directive.

Ofwat has generally refused to fund such schemes, because water companies have, on the face of it, sufficient licensed water resources. Given its necessarily narrow statutory remit on protecting customers and financing companies, Ofwat is not particularly well-placed to fill the gap left by inadequate abstraction licence regulation. In particular, it cannot easily make discretionary judgements about whether or not a particular environmental improvement should be paid for by customers, in a particular period.

The Environment Agency also attempts to claw-back licensed abstraction volume when abstractors propose to trade a licence (in over-licensed and over-abstracted areas). The Environment Agency's approach deters development of licence trading between abstractors that would be welfare-enhancing (water is moved from lower to higher value uses). From 2003 to September 2010 (for the trades where data is available) abstractors in total 'sold' 5,800 Ml per year of licensed volume, but their buyers received only 1,800 Ml of licensed volume – a 69% claw-back by the Environment Agency.[31] This 'tax on trade' is clearly a huge disincentive to trading abstraction licences.[32] Unsurprisingly, only 0.003% of annual abstraction is traded each year. Claw-back also results in very little environment gain in terms of reduced over abstraction. The Environment Agency has estimated that on average between 1,100 and 3,300Ml more *per day* is abstracted than the environment can sustain, so over nine years it succeeded in clawing back licensed volume totalling around 0.5% of that over-abstracted volume (and much of which will not actually have been contributing to damaging over-abstraction).

In addition, in 2009 Defra consulted on time-limiting all existing abstraction licences without compensation, so that they would come to an end in the 2020s and would be renewed at the Environment Agency's discretion.[33] This proposal would threaten all abstractors with the potential loss of their current abstraction rights. This would increase regulatory uncertainty and (further) restrict the ability of abstractors to plan ahead or to trade licences. Opposition from water companies, abstractors and Ofwat led to Defra deciding to consider the options further.

Consequences of current position

The absence of an effective approach to securing sustainable abstraction levels has a number of ongoing adverse consequences.

Clearly, while progress is not being made, the problems identified in Chapter 3 continue, including continued damage to rivers and the natural environment, as well as barriers to the availability and efficient allocation of water for people and the economy. These problems are likely to worsen as a result of trends such as population growth and changed rainfall patterns.

In addition, the lack of a clear and credible strategy for addressing over-abstraction creates uncertainty for abstractors. Abstractors do not know how the Environment Agency will eventually decide to proceed. They expect that they might lose some of their abstraction rights, but they don't know for sure, nor how much they might lose nor when. In those circumstances:

- abstractors are less able to plan ahead and commit to long-term investments based on their licensed abstraction;

31 Harou (2010).

32 G. Yarrow (2008), *Competition in the provision of water services, Regulatory Policy Institute, Oxford.*

33 Defra (2009), *Consultation on proposals for time limiting of water abstraction licences.*

- they are likely to hoard their existing licensed volume, even if they do not currently need it;
- water companies are less likely to enter into new bulk supply agreements with their neighbours. (Uncertainty in the status of licences that the Environment Agency has identified for investigation due to unsustainable abstraction, was cited as the most important barrier to water companies entering into bulk supply agreements.);[34] and
- abstractors have less incentive to trade licences as their future value is uncertain.

Hoarding, and reluctance to enter into licence or bulk supply trading, will reduce the efficiency with which water is allocated between users. It further restricts the ability of users to gain access to water, and prevents the reallocation of available water from lower to higher value uses.

The uncertainty resulting from current policy drift is therefore itself costly. Box 3 gives one example where current uncertainty incurred a substantial cost to the customers of one water company.

Box 3: Example of costs arising from uncertainty about future abstraction rights

A water company faced an upcoming water resource deficit in one area and needed to include ways to address this in the 2009 periodic price review process. The company became aware of an opportunity to buy a redundant groundwater licence for in excess of 20 million litres per day, which had previously been used for agriculture. The price of the licence was less than a third of the cost of alternative schemes to address the deficit.

However the area in question had a number of abstraction sites being investigated under the Environment Agency's Restoring Sustainable Abstraction programme. As a result of the ongoing uncertainty about future abstraction rights, and the Environment Agency's policy of using trades as a way to try to reduce existing rights, the Environment Agency could not give approval for the trade in time. The water company therefore included the more expensive alternative schemes in its business plans. Based on the general capital costs of developing new water supply in the relevant company's area, this could have increased costs to customers by £30-50 million.

This case study has been anonymised at the request of the water company concerned.

34 Defra (2010), *Assessment of regulatory barriers and constraints to effective interconnectivity of water supplies.*

5
The value of water

To identify ways to approach current problems, we first need to consider the value of water. Many of the trends described in Chapter 3, including population growth, economic growth, climate change and rising water supply costs, are driving up the general value of water. But perhaps more importantly, water's value varies substantially by location and over time, and this becomes more important as water's general value rises. In particular water scarcity tends to be characterised by infrequent but marked peaks, driven by acute demand peaks and supply shortages.

Water is becoming more valuable on average

Water is often perceived to be a cheap commodity, but there are a number of drivers increasingly pushing up its general value.

Water's value includes economic, social and environmental elements. The value of a litre of water is not simply the cost of delivering the litre to a home or business. It involves the opportunity cost of not using that litre for an alternative purpose, including leaving it in the natural environment, or using it for crop irrigation or for industry. Water's value is a measure of its scarcity – the strength of competing demands for the available supply.

Water's value is – on average – rising, for a number of reasons:

- As society becomes wealthier, it places greater value on having available water, including as an input to economic activities.
- As we grow wealthier as a nation we also tend to place greater value on having a healthy natural environment, which in part means valuing adequate river flows.
- Population is increasing in England and Wales, increasing demand for water.
- The unit costs of increasing the supply of water tend to rise. The cheapest sources of water are generally exploited first, meaning that new supply requires the use of more expensive options, for example sources requiring more intensive treatment.
- Looking ahead, changes to the climate, while uncertain in their impact, may reduce rainfall at the peak demand times in summer, increasing water's scarcity (see Figure 3).

Existing regulatory arrangements need to be examined in the light of this upward pressure on water's value. Do those arrangements ensure that the value of water is optimised for people and for the environment?

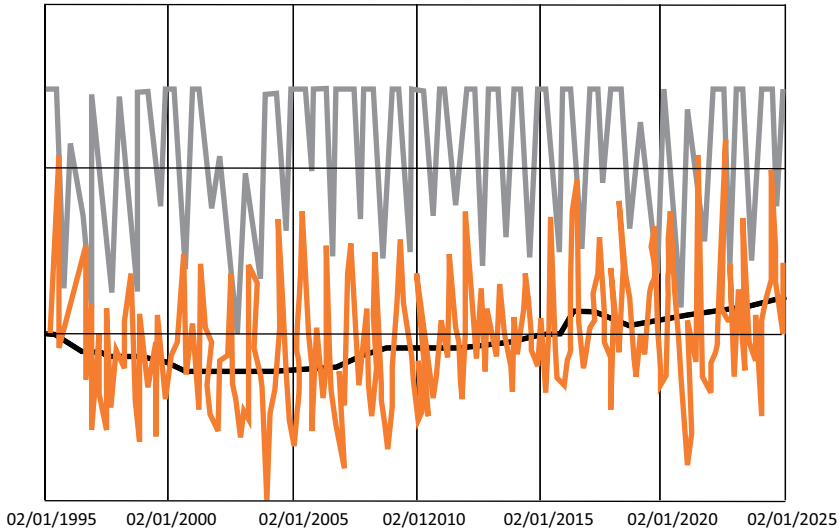
Water's values vary geographically and temporally

The value of water is generally increasing. It is notable, however, that the value of water varies fundamentally depending on location and time. Water has high value where and when it is scarce, but low or no marginal value when in abundance. This variability in water scarcity becomes much more important as the general value of water increases.

Figures 1, 2 and 5 showed how the availability of abstraction licences and risks to the water environment from over-abstraction vary between areas across England and Wales, indicating varying geographic scarcity – and thus value – of water. Figure 6 indicated how, in addition, the costs of building new water supplies vary dramatically between areas. So it seems clear that water's value shows substantial geographic variation.

Moreover, Figure 8 indicates how the value of water varies over time. The orange line illustrates how demand for water might typically vary over time in a particular area, varying by time of year and between years. The grey line illustrates how one measure of availability of water supply ('Deployable Output'), which depends in particular on recent rainfall, might vary over time. Scarcity depends on the balance between demand and supply. For example, during the short periods where demand exceeds 'Deployable Output', the value of water would be expected to be highest. Water's value in this example varies substantially over time, both within and between years.

Figure 8: A stylised representation of supply and demand variability[35]



To take the real example of the River Dart in South Devon, between 1958 and 2009 both the intra- and inter-year variability is substantial, with extreme summer flow volumes ranging from as low as 0.6 m^3 per second to as high as 100 m^3 per second.[36]

35 C Fenn and B Piper (1998), *Coping with Climate Change Uncertainties*, CIWEM Presidential Conference, 22-23 July, Oxford.

36 T. Le Quesne, R Timlett, C Fenn, S Less (2011), *The Itchen Initiative – Smarter water management for people and nature.*

Some of the most critical temporal variations are infrequent but marked periods where water scarcity 'peaks'. These peaks are likely to have both supply and demand side drivers. Typically there are demand peaks in summer, driven by outdoor water use (garden watering etc), which are larger in dry summers. Such demand peaks may in some years be exacerbated by supply side 'troughs', typically periods of low rainfall, to create the most severe water scarcity peaks. It is at such peaks that water has its highest value. Thus a customer sprinkling a large lawn in a dry summer following a period of low rainfall is likely to be using the most costly water.

Peak water scarcity episodes may be highly localised in both time and location. The degree to which two neighbouring areas suffer water scarcity episodes in a particular dry and/or high demand period will depend on:

- the characteristics of the water system in each area. Some rivers are groundwater-fed, some may be topped-up from reservoirs, others neither. Each will be differently affected by particular rainfall patterns;
- the demand characteristics in each area. For example, one area may have more large gardens leading to higher summer demand peaks; and
- whether water can be moved between the two areas and at what cost.

It is worth noting that the environmental externality associated with water availability is different in nature to environmental externality relating to carbon. A tonne of carbon dioxide has the same environmental impact wherever in the world it is emitted, and the timing of emissions, certainly over a given year, is also unimportant. But the environmental cost of using a litre of (cold) water is largely geographically and temporally determined. For example, it may crucially depend on whether the source river is currently at low flow or not in that particularly area. So while reducing carbon emissions per se is an appropriate environmental policy goal, a policy goal simply to reduce water use does not well target the desired environmental outcome.[37] While a carbon permitting scheme with an overall and declining cap on carbon emissions, is one effective way to address the externality of carbon, it would not be appropriate if applied to water. Rather, reducing water use at specific times and locations is key to better targeting the desired environmental outcomes.

This report focuses on the environmental externalities in relation to scarcity of water in the natural environment, which vary in the way discussed in this section. While water use also contributes to the environmental externality associated with carbon emissions, it does so mainly through the heating of hot water in the home, as discussed in Box 4.

Box 4: Water and carbon emissions

While 6% of UK carbon emissions are related to the water and sewerage sector, the Environment Agency estimates that the vast majority (89%) of these carbon emissions result from water use in the home, in particular the heating of water. Water and wastewater treatment account for most of the rest (9%), with only 2% of emissions from the abstraction and distribution of water.[38]

Key approaches to addressing the carbon-related environmental costs are to apply an effective carbon pricing framework across the economy, including for

37 Defra has an aspiration of reducing average per capita household water use across England to 130 litres a day.

38 Environment Agency (2009c), *Water for People and the Environment: Water Resources Strategy for England and Wales.*

water heating, supplemented by appropriate measures to encourage behaviour change in householders' use of hot water. The government's proposed Green Deal is relevant to encouraging household behaviour change. In addition, carbon cost estimates should be built into decisions about selecting options for matching supply and demand.

6
Overall approach to reform

Minimising costs of new restrictions on abstraction and maximising the economic and social benefits from available water are key to making better progress on addressing damaging over-abstraction. To achieve these, approaches need to take into account the implications of variability in water scarcity and particularly water scarcity peaks.

To deliver this, reforms to regulation of water are needed. To provide a brief background, Box 5 outlines from first principles why water is regulated as it is.

Box 5: From first principles – reasons for water regulation and institutions

Why is water subject to substantial regulation in the first place?

Because water is essential for life

So, for example, is food. Much of the regulation of food relates to health and safety. Similarly, the Drinking Water Inspectorate guards the standards of drinking water. But this doesn't explain the need for water's other regulatory arrangements.

Because water is essential for the natural environment

This is a key area of market failure. The environmental benefits of water are an 'externality', i.e. private water users will not necessarily take them into account in decisions about their use of water. An *environmental regulation function* is therefore needed (a) to establish scientific understanding of the environment's needs for water and (b) act to protect the environment, for example, by establishing abstraction limits. These functions are currently allocated to the Environment Agency.

Because coordination is required between different users of water

The use of one abstraction may affect another abstraction (or the environment), often in complex ways depending on rainfall, return flows and other factors. There may be negative 'spill-overs' between abstractors and information problems which may make it hard for abstractors to contract with each other to address them. These require a coordinating *system operation function* to manage, coordinate and enforce the use of abstraction licences and interactions between users, in a way which maximises overall economic and environmental benefits. This function currently also sits with the Environment Agency through its management of the abstraction licensing system.

Because of natural monopoly and market power in public water supply

Water supply transport infrastructure is important to the water system as a whole, and is, largely, a natural monopoly. In addition, water companies have substantial market power in their regions in relation to water abstraction. A *competition authority and economic regulator* are needed to limit rents from natural monopoly and market

power, ensure efficient levels of investment and to promote competition where appropriate. Ofwat carries out this function.

These characteristics of the water market explain, in broad terms, why we have the various water regulatory arrangements and institutions. Key to this report is examining how these regulatory arrangements might work more effectively.

A complex, changing pattern of increasing water values

Chapter 5 described the ongoing upward pressure on water's scarcity and therefore its general value. Water's increasing value means it is worth devoting increasing effort to allocating and using available water efficiently. This may include optimising between use of different water sources, greater transport of water between areas, improving market processes for allocating water between users, and improving process efficiency in water's use.

Chapter 5 also described how water's value varies geographically and temporally. These variations matter more as the general value of water increases. The pattern of water's values is complex, depending on local demand and supply characteristics, recent rainfall patterns, and other factors such as infrastructure outages. In particular, the pattern of water's values changes over time: through the seasons, between wet and dry years, as well as in response to long-term trends such a population and changes in climate.

This complexity means that maximising the benefit from available water and minimising the costs of securing sustainable abstraction levels will require processes which are responsive, innovative and adaptive to the varying and changing values of water. These should include:

- processes which incentivise use of abstractions where and when the environment is at least risk;
- processes which incentivise water use efficiency and demand reduction where and when water is scarcest; and
- processes which discover the most cost-effective approaches to matching variable public water demand and supply, and in particular peaks.

The regulatory regime is critical in enabling such processes. But many aspects of the existing regulatory regime are a legacy from a period where water was low value and so responding effectively to the variations in water's value didn't matter so much.

The implications of peak water scarcity

Chapter 5 outlined how some of the most critical temporal variations are infrequent but marked periods where water scarcity 'peaks', for perhaps a few weeks or months each decade or quarter century. These peaks have important implications for how to maximise the benefit from available water and minimise costs of addressing damaging over-abstraction.

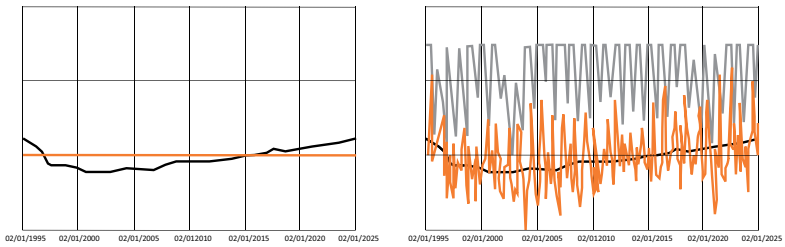
Firstly, simple cuts to maximum licensed abstraction volumes are unlikely to be the least costly way to address 'peak' environmental shortages. They will tend, unnecessarily, to limit abstraction most of the time, while failing adequately to protect the environment at peak scarcity.

Secondly, construction of capital-intensive new supply infrastructure is likely to be an expensive way of dealing with infrequent episodes of peak scarcity, i.e. high capital cost reservoirs or desalination plants that are not needed for the vast majority of the time. For example, Box 2 gave the example of the proposed reservoir costing almost £1,000 in capital expenditure to deliver one household's worth of water for one week each year, on average. (See Box 6 for an explanation of how projected future shortfalls in supply in water companies' 25-year Water Resource Management Plans often reflect the chance of very infrequent events).

Box 6: Projecting public water supply shortfalls[39]

Because it is not possible to know in advance when a dry or drought year will occur, in producing their Water Resource Management Plans, water companies must regard each year of the 25 year planning period as a 'design dry year'. Companies seek to ensure that the water available is sufficient to meet unrestricted demand, plus a margin of safety (target headroom), in each and every year of the planning period. Figure 9 (left-hand) depicts the 25-year planning problem defined in this way, with the annual minimum water available for use shown as the orange line and annual average demand (plus target headroom) shown in black. Projected demand increases (perhaps as population increases), exceeding minimum available water in the latter years, implying the need to develop new measures to prevent a shortfall in supply.

Figure 9: Stylised standard representation of annual supply and demand forecasts used in supply-demand planning (left), and more realistic stylised representation of supply and demand variability (right)[40]



In reality, the period is likely to be composed of wet, normal, dry and, potentially, drought years. In hotter, drier years, water available for use will be lower and water demand will be higher. As a result, in most years, even in the latter years of the planning period, demand will be lower than in the forecast 'design year' demand, supply greater than the forecast 'design year' supply, and there will therefore be a surplus of available water over demand. A stylised, but more realistic, representation of actual supply and demand over a 25-year period is shown in Figure 9 (right-hand), illustrating the variability in both water available for use and demand. In this case, the two curves do not coincide such that demand exceeds supply on any occasion.

For many companies apparently facing a 'shortage' of supply, the reality is that this shortage may only be a relatively modest shortfall against peak demand that may occur once every 25, 50 or 75 years – albeit we have no way of knowing in advance how frequently these events will actually occur. Understanding this has important implications for selecting the appropriate measures to address the risk of projected shortfalls.

39 Le Quesne et al (2011).

40 C Fenn et al (1998).

Thirdly, averaged water tariffs are unlikely to incentivise efficient use of water at peak times. Peak water scarcity often occurs when elevated summer demand occurs during a relatively dry year. Given the high costs of either (a) keeping 'reserve' supply infrastructure to meet these peak demands, or (b) environmental damage caused by running rivers dry to meet them, the true cost of water use in dry summers can be exceptionally high. Averaged water tariffs do not reflect the high marginal cost of water use at such times. As far as we can tell, peaks in summer demand are driven largely by outdoor water use – garden watering by households who, in dry years in particular, face nothing like the full costs of doing so. Box 7 explores the potential huge costs of dry summer watering, and the regressive cross-subsidies implied by current tariff arrangements.

Box 7: Cost of running a garden sprinkler in peak periods

Thames Water made the case for its desalination plant on the basis that it was needed to meet infrequent peak water scarcity events.

Garden sprinklers can use up to 18 litres a minute.[41] Using the costs for the Thames desalination plant estimated in Chapter 3 (2.4p litre using capital costs only), someone sprinkling a garden in a dry year summer peak for an hour could be costing £25 per hour or more. (An average total *annual* water and sewerage bill is only around £300.) This estimate does not include the running costs and maintenance of the desalination plant.

Where there is inadequate protection for the natural environment, through abstraction licences (i.e. a third of catchments), the costs of high summer peak water usage could also include damage to rivers.

Because water tariffs are generally averaged across the year, most of the costs of expensive peak usage do not fall on the water user, but are spread across all customers.[42] This is a significant cross-subsidy to households with significant outdoor watering from other water customers. And as outdoor water use tends to be focused in better off households, this implies a significant cross-subsidy from less well-off to better off households.

Overall approach to reform

This report aims to set out a package of reforms to abstraction and water supply regulation which maximise the benefit from available water and minimise costs of dealing with over-abstraction.

This report focuses on ways to make tackling over-abstraction cheaper, and, therefore, likely to be achieved more quickly. But, in addition, there is a choice for the government about just how rapidly it wishes to progress, in the light of expected costs, as well as the requirements and timetable of the Water Framework Directive.

New regulatory arrangements need to enable and incentivise processes which match water demand and supply, and allocate available water, in the most efficient ways, so that it is cheaper to reduce environmentally damaging over-abstraction while supplying people's water needs.

The following chapters explore reforms, based on the following headline principles.

Regulation of abstraction licences: Tackling environmental damage with minimum new restrictions on abstraction

Given the generally increasing value of water, and its complex variability, regulation which is insufficiently sophisticated has increasing environmental and economic costs.

41 Waterwise (2011), *How can you be water wise? Simple actions can make big differences* (waterwise.org.uk)

42 WWF estimates that it could cost as much as £50 per hour to run a hosepipe in a dry year summer peak.

To maximise economic benefits from available water, regulatory arrangements need to support well-defined water property rights, and thus avoid high levels of regulatory discretion. To achieve this, conditions on those rights need to better reflect knowledge about environmental sensitivity. To minimise costs, conditions on the rights need to restrict water's availability no more than is needed to protect the environment.

In addition, the structure of charges for abstraction licences can help to price environmental costs into abstractors' choices in the use of abstraction rights, further reducing environmental impact, at minimum costs.

These issues are explored in Chapter 7.

Water supply tariffs: Signalling when and where water is most valuable

Given the increasing scarcity of water, and the variability of water's values by time and location, non-volumetric (fixed) and averaged water charges send signals for wasteful and unfair usage patterns.

Most fundamentally, where water is at all scarce, charges need to be based on volume used. But the structure of charges should also better reflect the real marginal values of water, as they change over time, particular at peak scarcity, and between locations. Such charges send signals for reducing water usage when water is scarcest.

These issues are explored in Chapter 8.

Water supply regulation: Processes for identifying least cost and innovative solutions for water companies to match demand and supply

The increasing costs of new water supply infrastructure, and the particularly high costs of capital intensive reserve supply to respond to infrequent peak scarcity events, means that a simple, somewhat 'predict and provide', regulatory process for deciding water monopolies' new supply investments is an expensive approach.

Regulation needs to encourage processes which generate a range of competing, innovative options on both the demand and supply side, and select solutions on a level playing field.

As well as 'traditional' capital-intensive new water supply infrastructure, there are other options, with lower capital costs and high but infrequently incurred operating costs, which may be better ways to address peak scarcity events. These include targeted demand-side response measures and trading of water between company areas (effectively sharing reserves across larger geographic areas).

These issues are explored in Chapter 9.

Information revelation: Arrangements which reveal more info, in particular through trading

The increasing values of water, their complex variation over time and between locations, and the increasing range of relevant options for matching supply and demand, means that decisions based on poor information have an increasing environmental and economic cost.

As a result of uncertain property rights, fixed and averaged pricing and monopoly supply the water sector is currently characterised by very poor information in a range of areas. These include ecological impacts of water scarcity, water values (opportunity costs to the environment and alternative users), demand elasticities,

economic (as opposed to accounting) costs of supplying water, potential innovations and the cross-subsidies between water customers.

Regulation needs to enable processes that reveal and transmit richer information on an ongoing basis to inform the above. Trading, competition and contestability processes have key roles to play. Regulated monopolies tend not to know very much about aspects of their own cost structures, their customers' preferences or the full range of possible future options, because their existence and current shape will likely not depend on having and using such knowledge.[43]

This theme runs through the next chapters.

Strategy and process for implementation

The reforms to regulation set out in this report need to be made as soon as possible, so that the processes are in place for minimising the economic costs of dealing with over-abstraction. But the government will still need a strategy and process for identifying and implementing investments to reduce damaging over-abstraction. Investment costs will still be substantial, and the government will need to make choices about how far and fast they proceed. The process will need to incentivise abstractors to identify those investments which secure maximum environmental gains for minimum costs.

These issues are explored in Chapter 10.

43 Yarrow et al (2008)

7
Reforming regulation of abstraction

Reforming the water abstraction licensing arrangements aims to help the process of tackling over-abstraction by minimising the scale of new restrictions needed on abstraction.

As discussed earlier, currently licensed abstraction levels exceed environmental limits at many locations and times, causing environmental damage. A strategy is therefore needed to reduce this legacy of over-licensing – this is explored in Chapter 10.

This chapter deals with how to reform the general regulation of abstractions so that the process of reducing over-abstraction is less costly than it would otherwise be.

Problems with current abstraction regulatory arrangements

The current arrangements for regulating abstractions have grown up over decades when water was (considered) less valuable, so simple and broad brush approaches were acceptable. Current regulatory arrangements are now insufficiently sophisticated in reflecting the temporal and geographic complexity in water's values for the environment and for people. This leads to environmental damage. The Environment Agency takes a highly discretionary approach to regulation, to try to protect the environment, but which delivers unclear water property rights, allocative inefficiency and higher economic costs to abstractors.

Lack of responsiveness to environmental risks

80% of abstraction licences have no conditions that limit abstraction as environmental conditions deteriorate. The remaining 20% of, more recently issued, licences do include a hands-off flow condition, which specifies, for example, a river flow level below which abstraction must cease. However, even a hands-off flow condition, with just a single cut-off point, may be insufficiently responsive for many aquatic environments. Aquatic ecosystems are in general more vulnerable to abstraction under conditions of low flows. As river levels fall licences allow an increasing *percentage* of its flow to be abstracted (until any hands-off flow condition abruptly kicks in). While the abstraction of, for example, 40% of high flows may pose little risk to a freshwater ecosystem, the abstraction of 40% of low flows might pose risks.

The volumes of water that can be abstracted, in many systems, should ideally therefore fall as river levels fall, responding better to environmental needs.

Ineffective structure of charges for abstraction

Water companies can often make choices over which water sources to use among a number of alternatives (though this is far from always the case, as a result of insufficient interconnection between areas, or in the driest periods). But there are few incentives for water companies (and other abstractors where they have a choice) to choose less environmentally risky water sources. Companies are incentivised to make such choices – on the 'merit order' between different sources – on the basis of financial costs, but not also on environmental costs and risks. So a water company may use low financial cost but environmentally sensitive sources of water when less environmentally sensitive (but somewhat higher cost) alternatives are available (see discussion of the River Dart in Box 9).

Charges for abstraction are levied by the Environment Agency simply as a fixed sum per annum based on the maximum abstraction limit of a licence. Being non-volumetric, the marginal cost to an abstractor of drawing an extra litre of water is zero. Furthermore charges do not vary according to the environmental scarcity of water between locations nor at different times, so there is no incentive to take account of differing relative environmental costs. Indeed, if current charges are compared between different regions, on the face of it, they look perverse. For example, it costs more to abstract water in Northumbria than in the Thames region, despite water in Northumbria being significantly more abundant.[44]

Incentives need to be improved, for example through a charges structure with higher volumetric charges for more environmentally risky abstraction and lower charges elsewhere.

Lack of clear property rights

The Environment Agency retains a very high degree of administrative discretion in decisions affecting abstraction licences, including in relation to trades between abstractors (including 'taxing' those trades, as discussed earlier), changes to use and the process of tackling over-abstraction. Such discretion creates regulatory uncertainty – abstractors are unsure of the property rights that their licences confer. This prevents abstractors from effectively planning, investing, innovating and trading.

Abstraction licences need to become more effective property rights, enabling people to get the most value from available water.

Lack of trading and price revelation

Lack of clear property rights, and other barriers disincentivise trading, whether of abstraction licences themselves or the water itself. See Box 8 on the potential for water trading and barriers to it.

Lack of trading prevents a water market beginning to reveal information about the values which users place on water availability (at particular locations and times). Such pricing information would inform a range of choices, including about where and when to source water, invest in, trade and use water supply, as well as where, when and how much effort to put into water efficiency measures and demand-side response. Without signals for the values of water, there is little incentive for holders of water rights to consider the best use for them. Abstractors may, for example, simply hoard water, even though it would have substantial value

44 Yarrow et al (2008)

to others. The available water for people will therefore be inefficiently allocated, with costs to society including increased costs of protecting the environment.

Barriers to the development of water trading need to be addressed.

Lack of clarity about institutional functions

The Environment Agency is responsible for the abstraction licensing regime. This involves the Agency in undertaking a number of distinct functions. It has a function (as an 'environmental regulator') to establish abstraction limits where it acts on behalf of the natural environment. It also has distinct functions where it acts on behalf of all water users, for example working as a 'system operator' to manage the licensing system in order to maximise the benefits from available water in-the-round – both for the environment and for people.

At present it is far from clear that the Environment Agency discharges each of these two functions in an appropriately distinct way. This may to lead to a lack of focus and confused approaches. For example, as discussed earlier, there appears to be a lack of urgency about even identifying what needs to be done to secure environmentally sustainable abstraction levels. (In 2010, WWF felt the need to start legal proceedings against the government in relation to sustainable abstraction, applying for judicial review of the government's plans to meet the Water Framework Directive.) Conversely, the Environment Agency tends to take a highly restrictive approach to trades between abstractors, even where such trades would be welfare-enhancing, reallocating water from lower to higher value uses at no additional environmental costs. It may be that under the current institutional arrangement there is a clear focus *neither* on the objective of ending environmental damage *nor* on the objective of maximising the economic value from available water.

Institutional arrangements need to support all of the government's objectives in relation to water abstraction.

Box 8: Trading water

Water trading may involve the trading of abstraction licences or water itself. Generally, trading may occur between abstractors within a catchment or between water companies through interconnection between their pipe networks.

Water trading has become a key feature of water management in a number of jurisdictions around the world. For example, in California and Australia large volumes of trading occur, particularly farmers selling water rights to urban water supply companies in dry years. During 2007-08, Australian water traded was valued at A$1.7 billion, with 97% of it traded in Murray-Darling Basin states in the South East of the country.[45]

Trading of water enables and incentivises water to be used where it has the greatest benefits ('allocative efficiency'). In an effective trading market, where water had a market value, those abstractors who gained greater value from selling rather than using their water, would have the incentive to sell to someone who valued the water more than its market price. Such a market would, in particular, encourage users to use water more efficiently, where the cost of doing so was less than the market value of the water saved.

Abstraction licence trading

There is little water licence trading in England and Wales. Between 2003 and September 2010 there were only 51 trades, out of 20,000 abstraction licences. Most of the trades were between spray irrigators, and the majority occurred in the Anglian region.

45 Severn Trent Water (2010).

There are regulatory process barriers to the trading of abstraction licences in England and Wales, in particular the 'taxing' of trades by the Environment Agency (see Chapter 4). Other barriers relate to hydroecology (in some areas), regulatory uncertainty and uncertain property rights (as also discussed in Chapter 4), and the lack of a visible trading market and market prices. Ofwat and the Environment Agency examined the barriers to abstraction licence trading in 2008[46] and identified some measures in 2009,[47] which have yet to be fully implemented.

Agriculture is currently the key source of potential trades, and on average constitutes only 1% of abstraction in England and Wales. However, agricultural abstraction is a much higher proportion in certain areas and at certain times of year (often when water is scarcest). For example, agriculture constitutes up to 30% of abstraction in East Anglia in summer. Therefore there may be some scope for trading water between farmers and other abstractors in summer. Such trading could be supported by some farmers' ability to build water storage on their land. More effective trading, and establishing market prices, might thus make a contribution to matching peak water supply and demand.

There will nevertheless be limits to the scope for trading of abstraction licences in many areas.

Trading water between water companies

In addition, water companies, with their water transport networks, have significant potential to trade water with each other.

Figure 7 showed how the marginal cost of matching future supply and demand varied hugely across England and Wales – indicating large potential gains from trading. There are already a number of 'bulk water supplies' traded between water companies, but the level of bulk water supplies has remained low and relatively stable at around 5% of total supplies over the last 15 years, despite increasing demand and supply pressures. A number of the bulk supplies date back very many years. Some, perversely, move water from high cost areas to low cost areas.

Ofwat undertook an analysis to estimate whether there was the potential to make savings, compared to companies' existing Water Resource Management Plans, through building new interconnectors between company regions and trading of water across company boundaries.[48] Ofwat estimated that new interconnectors to transport water from low cost areas to high cost areas could save around £1 billion (NPV) compared to existing plans. A new interconnector could, for example, negate the need for new supply infrastructure investment, such as a reservoir or desalination plant to be built on one or both sides of a company boundary. Severn Trent Water has done analysis to indicate that it could trade water into neighbouring companies' areas, in order to more cheaply supply some of the latter companies' future water supply needs.[49] Many new interconnections would only be needed in peak periods, so that the operational (pumping and carbon) costs would be relatively small. Interconnectors effectively expand the reserves available to both newly connected companies.

If the use of interconnectors increased, it could develop into at least a partial, 'peak reserve water grid' – where water flowed much more between company areas at peak times, when water was most valuable and therefore worth paying to transport furthest.

The Environment Agency has attempted to pursue a collaborative approach to agreeing greater movement of water between company areas, under the Water Resources South East (WRSE) process. The process identified potential for greater sharing of water, but found it hard to make better headway, because of poor information from companies, and in all likelihood because companies did not have the incentives to fully engage with such a process.

There are a number of regulatory and cultural barriers to increased trading between water companies, including: [50]

46 Synovate (2008), *Exploring views on the potential for more active water rights trading,* Report prepared for Ofwat and the Environment Agency.

47 Ofwat and Environment Agency (2009), *Review of barriers to water rights trading – Final Report.*

48 Ofwat (2010b), *A study on potential benefits of upstream markets in the water sector in England and Wales.*

49 Severn Trent Water (2009), *A framework to implement a water trading model.*

50 Severn Trent Water (2010).

- companies' preference to own and control their own water supply resources, driven in part by their desire to augment their Regulatory Capital Value;
- lack of detailed information available about the true costs of using neighbouring companies' transport networks;
- complexity of negotiation of contracts, with considerable scope for incumbent water companies to discriminate against competition from neighbouring water companies, using both price and non-price means;
- barriers in legislation, including the 'Costs Principle' in the Water Act 2003 which severely limits water supply entrants' margins; and
- disincentives in price control regulation, because bulk supplies add to companies' operating costs.

Ofwat last year made a number of suggestions for ways to better enable competitive trading across companies' boundaries, including new regulatory incentives for trading and improved regulatory guidance on bulk supply pricing.[51]

Options for reform

The overall direction for reform must be to develop a more sophisticated abstraction licensing regime responsive to environmental variability in time and place, maximising environmental protection for a given restriction or cost, conferring effective property rights to abstractors, and able to adapt over time to increased scientific understanding, climate change and other trends.

The next sections consider the following three areas for reform:

- quantity limits and conditions on abstraction licences;
- charges for abstraction; and
- institutional arrangements for abstraction regulation.

Quantity limits and conditions on abstraction licences

Quantity limits on the amount of water which can be abstracted are clearly a critical regulatory tool. But the focus needs to move away from the level of the maximum limits on (daily) abstraction, and towards quantity limits which are responsive to environmental conditions.

Hands-off flow conditions are an important tool, in cases where abstraction needs to cease at a river flow level which risks serious environmental damage. Establishing these, where appropriate, in the 80% of abstraction licences where they are absent is a key part of achieving more responsive abstraction licensing.

But, for many locations, simply mandating a hands off flow condition will neither be sufficient to protect the environment, nor provide the right balance between protecting the environment and meeting people's needs for water. This is because:

- to properly protect ecosystems, in many locations progressively less water needs to be abstracted as river levels fall (and there may be multiple thresholds for ecosystem damage);
- in some locations, very high costs of infrastructure to meet very infrequent peak demand periods in dry years may outweigh the environmental cost of incurring some rare environmental damage (which if very rare, ecosystems may more readily recover from); and

51 Ofwat (2010c), *Valuing water – how upstream markets could deliver for consumers and the environment.*

- scientific understanding of the ecosystem impacts of low flows at each location may be insufficient at present to establish a hands-off flow condition which appropriately balances environmental protection and the economic value of water to people.

These points suggest the following approach to achieving more responsive abstraction licensing:

- In appropriate licences, allowed quantities of abstraction could be graduated in pre-specified 'tiers' tied to particular river flow levels.[52] Alternatively each abstractor on a river could be entitled to a particular 'share' of overall flows. As river levels fall, so does the amount of water that can be abstracted. Where river levels become very low, permissible abstraction can fall to zero – equivalent to a hands-off flow condition. Similar approaches have been applied to manage abstraction in rivers in Spain and Mexico, for example. In theory the 'graduated tiers' and 'shares' approaches can be the equivalent, but in practice, it is likely to be complex and burdensome to calculate shares on a variable flow river.[53]
- For each hands-off flow condition, it needs to be considered whether or not there should be (rare) circumstances where the condition could be violated, for example, if the ecosystem costs were substantially outweighed by the costs of building new water supply for very rare peak scarcity events. (It is already Environment Agency practice to allow relaxation of conditions in certain circumstances.) Circumstances for such allowed violation should be carefully pre-defined, with minimum discretionary decision-making by the regulator, so that property rights are as clear as possible.
- Environmentally-responsive licenses will not be established fully-formed in one step. The first step is to establish licence conditions which crudely – but much more closely than many current licences – reflect environmental conditions. (Getting to the first step is clearly a huge challenge in terms of the costs of reducing current substantial over-licensing, and could take 15 years or more to achieve – see Chapter 10). Subsequently licences may be refined and made more sophisticated as scientific understanding increases, new information is revealed about water's values, and as external factors alter, such as rainfall patterns. But the first step must establish firm property rights for abstractors, to enable them to plan, invest and trade. So subsequent refinements should be undertaken only through market operations by the regulator, i.e. they purchase further reductions in a market.

More sophisticated licence conditions (for example graduated tiers) which are both responsive to environmental conditions and confer more certain property rights will have a number of benefits. They better protect the environment, while at the same time enabling abstractors to plan, trade and invest in confidence about the rights they hold. For example, as a river began to get drier, tiered abstraction limits would kick in in a predictable way, so abstractors could plan for this by putting in arrangements to trade water with other abstractors, or investing in water transport or storage. These processes would in turn reveal more information about the local values of water.

52 'Return flows' - the volume of water discharged back into the river after abstraction, its location of discharge, and also its quality, are relevant to specifying abstraction quantity licence limits.

53 Shares are suitable for parts of Australia, the US and China, where the issue is calculating shares of water collected each year by a large dam.

Charges for abstraction

Another approach to making abstraction more responsive to environment conditions involves the structure charges for abstraction. It is likely to be easier in the short-term to make adjustments to the structure of abstraction charges, than to secure new licensed abstraction quantity limits.

Developing structured abstraction licence charges could send powerful signals about which abstraction sources are generally most environmentally sensitive, as well as about the particular periods when water is becoming acutely scarce and the environment is at risk of damage. Such a structure of abstraction charges could inform abstractors' operational decisions about which sources to use at a given time (where such choice existed) as well as, theoretically, decisions about new investments, e.g. new interconnection.

With more expensive abstraction at times and locations of scarcity, balanced by cheaper charges at other times and places, it would be possible to disincentivise companies from using cheap but environmentally sensitive sources so often. Box 9 describes some early, but successful, modelling of this approach on the River Dart.

Clearly a prerequisite for developing structured abstraction charges is charging for abstraction by volume actually used, rather than the current approach of charging by maximum allowed abstraction. This is feasible, as abstractions are measured.

The existing overall level of abstraction charges is set simply to cover the Environment Agency's administrative costs plus the capped EIUC levy to fund RSA compensation. This is not necessarily the right level, but changing it raises issues about effective tax levels, and it is beyond the scope of this report to propose the right level. This report instead focuses on the structure of abstraction charges. It seems likely that much could be achieved simply by restructuring within the existing level of charges. Total abstraction charges paid by all England and Wales water companies is of the order of 10% of companies' total direct water operating costs of around £950 million per annum.[54] On average, abstraction charges therefore already represent a significant operational cost for water companies, and, if better structured, could deliver powerful incentives in relation to operational decisions, delivering environmental benefits in the short-term at low cost. However there will be limits to what can be achieved through the restructuring of existing abstraction charge levels to alter capital investment decisions. One way to extend the reach of the above charging approach to capital investment decisions would be to enhance the use of 'shadow environmental charges' in investment appraisals. Estimates of the environmental costs or benefits of a new water supply proposal are included in the investment appraisal.

Box 9: Modelling of proposed reforms to abstraction licensing[55]

WWF recently undertook analysis, as part of the *Itchen Initiative,* to explore the potential of more environmentally responsive abstraction licence conditions and structured abstraction charges, similar to ideas discussed in this chapter.[56] Modelling was undertaken on the Itchen and Dart rivers. While this modelling work was only preliminary, it indicated that reductions in environmentally damaging abstraction may be achievable through either or both of these mechanisms, at low cost.

Modelling graduated tiers on the Itchen

WWF tested the performance of a 'graduated tier' abstraction limits at Southern Water's Otterbourne abstraction source on the River Itchen.

54 Ofwat (2010d), *Financial Performance and expenditure of the water companies in England and Wales 2009-10.*

55 Le Quesne et al (2011).

56 Le Quesne et al (2011)

The model tied the volume of water that could be abstracted from the source to the water available from that source, consistent with environmental protection. As the flow in the river fell, the permitted abstraction quantity fell (down to a hands-off flow level), and vice versa allowing higher rates of abstraction (than the current maximum abstraction limit) at higher river flow levels. The model made use of measured historic Itchen river flows.

The results showed that graduated tier licence conditions delivered fewer days with low flow levels that risked harming macro-invertebrates and limiting salmon migration, and higher total availability of abstraction than the alternative scheme proposed by the Environment Agency following it's 'Review of Consents' at the Itchen, in all but the driest scenarios.

WWF concluded, from these results, that the graduated tier licensing approach had merit for delivering both environmental and abstraction availability goals. By allowing *increased* abstraction from vulnerable sources, at the times when they are least vulnerable (high flows), such a graduated tier approach may create opportunities in some areas to 'rest' other sources for use at times when vulnerable sources are under pressure, or to make greater use of environmentally-benign winter storage schemes.

Whether the graduated tier approach was able to deliver acceptable abstraction yields in dry and drought periods remained to be proved. Even if such an approach did not eliminate all environmental damage, but instead limited it to the most infrequent, driest periods, at low cost, then it is worth further serious investigation by the Environment Agency.

Modelling structured abstraction charges on the Dart

WWF tested the potential effects of structured abstraction charges on South West Water's abstraction on the River Dart.

The surface water abstraction by South West Water from the River Dart at Littlehempston has been identified as a potentially damaging abstraction for some time. The area supplied from the Littlehempston abstraction can also be serviced by a number of alternative sources. At times of low flows, the principal alternative to the use of water from the Dart is water released from Roadford reservoir and pumped from the Tamar catchment. In current practice, sources are prioritised on the basis of least cost at periods of higher water availability, and on the basis of maximising yield as scarcity increases. As water abstracted from the Dart is cheap, this is used in priority to the Roadford source (i.e. it is higher in the 'merit order' than Roadford). WWF modelled scenarios for restructuring abstraction charges so that the Dart river abstraction was expensive, compared to Roadford, at low river flows (when the Dart river environment was at risk) and cheaper at high flows.

The model was tested using the drought of 1995/1996. The cost of protecting low flows using water pumped from Roadford would have been in the region of £75,000 (including carbon costs),[57] with a very small reduction in storage at the Roadford reservoir over a two-year cycle . WWF compared this with the alternative of replacing the 27 Ml per day source at a capital cost of up to £100 million.

The total annual charge paid by South West Water to the Environment Agency for the abstraction at Littlehempston in 2010/11 was around £120,000. This is much higher than the estimated £75,000, suggesting that it would be sufficient simply to restructure, rather than raise, charges to impact merit order and better protect the Dart at low flow.

The principal drawback of this approach is that it may not provide protection in the case of the most severe droughts, when all available sources of water may be required. Nevertheless an approach which has the potential to limit environmental damage to rare dry years is worthy of further serious investigation. Many natural environments will be able to recover from very rare damage events (and the costs of expensive infrastructure can be assessed against the environmental benefit of eliminating the rarest drought events).[58]

This approach requires, by definition, a choice of available sources to meet supply. The extent to which this is the case will vary between supply zones, depending on how well interconnected zones are.

57 Additional pumping and carbon costs would only be incurred in dry years.

58 The implications of both graduated abstraction tiers and structured abstraction charges are likely to be different in rain-fed rivers, such as the Dart, and groundwater systems. In the former, flow levels are highly variable, and so times under which abstraction needs to be more constrained are likely to be shorter and confined to certain times of year. By contrast, in groundwater systems water levels may decline for longer periods of time.

Institutional arrangements for abstraction regulation

The Environment Agency is responsible for administering the abstractions licensing regime. Box 10 outlines its range of distinct functions.

Box 10: Distinct functions relating to abstractions regulation

The Environment Agency has at least four distinct actual or theoretical functions in relation to abstraction:

- *Environmental regulator* in relation to water availability, understanding the ecological impacts of abstraction and using these to inform environmental limits on abstraction. In this function the Agency should be acting on behalf of the environment.
- *System operator*, managing and coordinating the abstraction licensing regime, including establishing, monitoring and enforcing licence conditions and charges. In this function, the Agency should act on behalf of all users of water, including all abstractors and the environment, with the aim of maximising the overall economic, social and environmental benefits of water availability.
- *Market operator*, operating a market where abstractors may trade they licences or licensed water itself. In this function the Agency should again act on behalf of all abstractors.
- A *market participant*, acting in the market to change the allocation of abstraction property rights, informed by evolving understanding of ecological impacts from the *environmental regulation* function. In practice, the Environment Agency currently discharges activities related to this function mainly through negotiation of compensation under the Restoring Sustainable Abstraction programme. In this function, the Agency should be acting on behalf of the environment.

Given the problems that this report has highlighted, having a clearer, more distinct focus on each of these different functions within the Environment Agency is likely to be important in helping to achieve sustainable levels of abstraction and maximising the economic benefits from available water. In particular, current environmental damage from over-abstraction and increasing pressures from population and climate change require a focused and effective strong institutional *environmental regulation function* focused solely on the needs of the environment. Its key skills need to be in relevant science and ecology, and its focus should be on monitoring and improving understanding of the links between over-abstraction and environmental damage in local areas. At the same time, the increasing values of water and the huge potential costs of securing sustainable abstraction mean that the way the system of water rights is managed has substantial and increasing economic implications. An institutional *system and market operation function* focused on maximising the economic and social benefits from available water is critical, focusing on translating environmental limits into more sophisticated abstraction licence conditions and charges, developing firmer property rights and enabling water trading. Its needs key skills in relation to economics, system and market operation.

As discussed earlier in this chapter, in the Environment Agency there appears currently neither sufficient focus on the needs of the environment, nor on the maximising the economic benefits from available water, with some existing approaches suggesting confusion between objectives. There is a case for institutional reform. This should involve greater separation between the environmental

regulation function and system/market operation, so that there is an appropriate focus on each separate function, appropriate distance between functions pursuing different objectives, and specialisation in terms of skills.

This reform could be achieved through greater functional separation within the Environment Agency, or by moving one of the functions – most likely the system and market operator function – to another institution. That could be a new agency, or an existing one. One candidate is Ofwat. Adding to Ofwat's existing role as water economic regulator and competition authority would not be without risks. But Ofcom provides a model for a sectoral regulator combining a competition and economic regulation role with a system and market operation role – in Ofcom's case in relation to spectrum. Spectrum is in many ways analogous to water abstraction in that it is a scarce and valuable resource, where property rights need to be assigned and their exercise subject to coordination and enforcement, to maximise the value to society of available spectrum. Ofcom pursues this in the ways it allocates spectrum, issues spectrum licences, manages secondary trading and sets charges for the use of spectrum.

Of course, spectrum differs from water, in particular in its environmental implications. This why is water needs a strong, separate and more focused water environmental regulator function within the Environment Agency, to understand and represent the needs of the environment. Ofwat is not an appropriate institution to make environmental assessments.[59]

Recommendations

The abstraction licensing toolbox should be broadened. A range of licence conditions should be deployed to achieve abstraction licences that are more responsive to environmental scarcity, while maximising available abstraction. As well as more hands-off flow conditions (which curtail abstraction at low river flows), the scope for use of graduated quantity limits should be examined.

Abstraction charges should be reformed so that (a) charges vary by volume actually abstracted and (b) the structure of abstraction charges should better reflect locations and times of environmental risk.

The Environment Agency should be reformed, with its distinct functions in relation to abstraction regulation separated. A strong, focused water environmental regulation function, acting on behalf of the environment, should be separated from abstraction 'system and market operation' functions that manage the abstraction licensing system in order to maximise the overall benefit to society of water. The latter functions could be located separately from the Environment Agency, for example in Ofwat.

59 It should be noted that such reforms do not imply centralisation of functions that are currently carried out in local or regional offices.

8
Reforming water supply tariffs

Water supply tariff arrangements need to be reformed in order to help the process of tackling damaging over-abstraction, by incentivising reduced peak demand and thus reducing expenditure on new supply infrastructure.

Chapter 7 discussed how better structured charges for abstraction could send signals to abstractors about when and where water is most environmentally valuable. Analogous arguments may be made in relation to customer charges or 'tariffs' for water supply reflecting the marginal values or costs of supply.

Problems with current water supply tariff arrangements

Current water tariffs are a legacy of a time when water was less environmentally valuable and developing new supply sources and infrastructure was generally cheaper. In such circumstances, a simple approach to charging for water – a flat rate – was acceptable.

Such an approach is now neither sufficient to reflect the increasing general marginal value of water nor the temporal variations in water's value, in particular scarcity peaks. It leads both to higher levels of environmental damage and to unnecessarily high spending on new supply infrastructure.

Unmetered household water supplies

The UK remains one of the few remaining western European countries where a significant proportion of households do not pay for water on the basis of their use, Ireland and Norway being the only others. In 2010, just 35% homes in England and Wales paid for water on the basis of volume used. This means that around two-thirds of households pay zero marginal cost for water consumption.

Current water company plans suggest that the England and Wales household metering rate will rise to around 50% by 2015.[60] Metering is being brought forward only slowly in most areas, in part because cost-benefit appraisals rank it lower than other options for matching future demand and supply. This is driven by:

- a relative lack of evidence for meters' benefits in terms of average demand reduction;
- even less evidence of meters' impact on *peak* demand reduction, which is most important in determining costs of matching supply and demand (and thus the costs of rectifying over-abstraction). For example, it may be that some peak usage for garden watering is more price elastic than average water usage;
- viewing metering itself as a direct demand-side alternative to supply-side options such as new reservoirs. Instead meters should be viewed as an essen-

60 Ofwat (2009), *Future water and sewerage charges 2010-15:Final determinations.*

tial tool to enable a range of demand-side measures, such as structured tariffs, customer engagement with water efficiency measures.

Water companies vary substantially in their current and planned rates of metering. But these variations do not necessarily reflect differences between regions. By 2015, Southern Water's plans are to have 92% households with a meter, whereas neighbouring Portsmouth Water will have only 24%.[61]

Even where metered, tariffs are averaged over time

Of the 10 million or so water meters already in place, the large majority are 'dumb' meters that clock up water consumption as water flows past the mechanism. These meters have to be manually inspected in order to collect data, and so are generally read only once or twice a year. Such meters do not lend themselves to structured water tariffs, such as tariffs that vary by time of year or between times of differing water scarcity. Almost all metered household customers therefore have a tariff that is the same all year round. (There are a few experiments ongoing, such as on seasonal tariffs.)

The consequence of such temporally averaged tariffs, as discussed earlier, is to fail to signal to water consumers when greater water efficiency and reduced demand would save most in terms of environmental damage and/or costs of supply. A particular consequence is a significant cross-subsidy to those undertaking the most garden watering in a dry year summer peak, often better-off households (see Box 7).

Increasingly, some water companies are installing Automated Meter Read (AMR) water meters, one basic type of 'smart' meter, which transmits consumption data via radio frequency. The meters themselves are equipped with memory to record time series data (e.g. daily consumption) for a period, and this data can be transmitted to a central hub, or to a passing vehicle. Such AMR 'smart' meters are less costly to read (helping to offset capital costs). Even more importantly, unlike dumb meters, they can provide the data necessary to deploy more structured water tariffs that, for example, vary over time, and they can provide customers with greater feedback on water use and more control of their bill.

However some water companies are continuing to install 'dumb' meters. South East Water is planning to install a significant number of dumb meters.[62, 63] It is not clear exactly what factors were included by the company and Ofwat leading to this decision, but it does seem extraordinary to be investing in dumb, rather than smart, meters now, with an expected lifetime of 20 years.

Geographically averaged tariffs

In addition to tariffs averaged over time, tariffs tend to be averaged geographically. Often all metered household customers within a company region have essentially the same tariff. But this is not always the case, and sometimes geographic averaging only happens over part of a region for historical reasons. Whatever the pattern of geographic charges, they do not relate to the relative scarcity or costs of water as these vary geographically.

As noted earlier, there are substantial variations in supply costs and scarcity, within as well as between company areas. Given this, there could be benefits in

61 Ofwat (2009)

62 In 2009, South East Water submitted proposals to install smart meters but it is understood that Ofwat excluded the additional capital cost of these from South East Water's allowed prices on the basis that such meters were not cost effective for customers.

63 Le Quesne et al (2011)

tariffs varying geographically so that, for example, there were greater incentives to use water efficiently where it is scarcest and most expensive.

At the same time, it needs to be recognised that current geographic averaging reflects a form of established 'Universal Supplier Obligation', with cross-subsidies between customers across particular defined regions. (This is analogous to Royal Mail's USO to provide certain postal services at a single price nationally.) However, geographic USOs are not a necessary bar to structured tariffs and their associated potential benefits. This is because what is important in signalling more efficient levels of water demand are *marginal* prices not total bills.

Options for reform

Temporally varying tariffs

The key objective for reform is to encourage water tariffs that vary over time to signal scarcity and incentivise reduced demand, particularly at peak times. This would reduce the need for the most expensive peak supply infrastructure and help secure sustainable abstraction at lower cost.

This reform is about the *structure* of tariffs, not about increasing total charges to customers. If charges are increased during a dry period, they should be equivalently reduced during periods of relative plenty.

The degree to which charges should vary between peak and other times may depend on a range of factors, including the costs of providing peak supply infrastructure, the costs of any environmental damage caused by peak demand, and consumers' price elasticity of demand. Customers should not in general face a peak marginal price that is greater than the combined financial and environmental cost of their marginal water use. Trials, and their evaluation, will be needed to help hone the precise shape of new structured tariffs.

As well as the efficiency arguments for temporally varying tariffs, there is a key argument about fairness. Such a tariff helps address the current unfair subsidy to those who disproportionately increase their demand at times of peak scarcity. As discussed earlier, a single hour using a garden sprinkler in a dry summer could be costing £25, which is paid for by all customers.. It seems unfair for poorer households living in flats to be subsidising those watering large gardens in a dry summer. Peak tariffs would incentivise reduction in these costs, and allocate the remainder more fairly to those driving the costs.

Tariffs which better reflect the actual costs of water use put power into the hands of customers: they are able to reduce their water bill from current levels by adjusting their water use in peak periods.

But could temporally varying tariffs risk hitting vulnerable households – large families, or those with medical conditions requiring high water use? With any change in the distribution of charges, individual customers' bills may rise or fall, and there would be no incentive effects if this could not happen. But there is no reason to believe that vulnerable households would generally risk being worse off as a result of peak tariffs. Indeed, there are reasons to believe that they would in general be better off. Such tariffs should place no additional cost on households with all year round high water use. Provided a household's seasonal variation in water usage is proportionately no more than average, the extra they paid in peak periods, would be offset by the reduction in charges in other periods. In fact,

such tariffs should recover disproportionate peak demand costs more fairly and reduce the need for expensive peak supply infrastructure, generally benefitting vulnerable customers. They would no longer be subsidising households with large gardens. To the extent that it is deemed that vulnerable households needed further support, it should be through targeted social support arrangements, such as the Water Sure scheme, which ensures that target metered vulnerable households pay no more than the average metered water bill in their region.

Box 11 discusses some of the evidence for the impact of water tariffs on consumption.

Box 11: Evidence water tariffs' impact

It is unfortunate that there is relatively little hard evidence in England and Wales for the impact of water tariffs on consumption behaviour. There is some evidence that 'dumb' meter installation may cut average water usage by 10-15%, with leakage detection being a significant part of this saving. Trials of some structured tariffs are ongoing, including 'rising block' tariffs and tariffs which vary by season.

Evidence from abroad suggests that structured tariffs have been able to reduce water consumption. Evidence from a number of US states, which have introduced rising block tariffs in relation to scarcity, shows that raising prices of water does reduce demand. 'Modest' increases in price have been shown to reduce demand by 5-15% on average, with a greater response to price signals during the summer months.[64]

One study[65] examined individual consumption and billing data for 7 million Colorado households over a two-year drought period. In 2002, Colorado water bills changed from a flat unit rate ($2 per 1,000 gallons), to a rising block tariff. In 2003, this was personalised for each customer by restricting consumption in the first block to that customers' average consumption for the previous winter. By 2004, the price of the third block was $7 per 1,000 gallons. Households on rising block tariffs typically used 5% less water than when on a flat rate. Price elasticity was -0.60 (in other words, for every 10% increase in price, demand reduced by 6%). High users of water were more responsive to price signals with an elasticity of -0.75, compared to -0.34 for low users. Households were much more responsive to price during the drought period, in part due to high awareness but also due to higher prices.

These Colorado tariffs focused on high average users, rather than simply high peak users as discussed in this report. This focus may be appropriate to Colorado's water scarcity patterns. But Colorado's experience nevertheless shows that structuring water tariffs can affect demand, and that high use in dry periods was particularly susceptible to price incentives.

Geographically varying tariffs

Different Water Resource Zones[66] within a company region are likely to experience different levels of (peak) scarcity, at different times. Therefore, in proposing temporal variation of water tariffs to reflect scarcity, we need to include consideration of geographic variation of tariffs.[67]

The levels of any peak and off-peak tariffs should reflect water costs and scarcity, and thus should often vary between Water Resource Zones within a single water company region. This raises the issue that water charges are typically averaged across whole water company regions. But such geographic cross-subsidies may be preserved alongside temporally-varying tariffs. Specifically, if one Water Resource Zone has much higher costs in a dry summer than a neighbouring zone, then it is possible the ratio between peak and off-peak charges may differ

64 ME Renwick and RD Green (2000), *Do Residential Water Demand Side Management Policies Measure Up?: An Analysis of Eight California Water Agencies*, Journal of Environmental Economics and Management, 40.

65 DS Kenney, C Goemans, R Klein, J Lowrey and K Reidy (2008), *Residential Water Demand Management: Lessons from Aurora, Colorado*, Journal of the American Water Resources Association, Vol. 44, No. 1.

66 Water Resource Zones are (generally) subsets of water company regions. There are defined as areas across which water may readily be transported.

67 As discussed earlier, there could be efficiency benefits in marginal water charges varying by location according to relative geographic costs and scarcity. But the main benefits of geographic variation would seem likely to arise in peak scarcity periods. At times when water is plentiful, the benefit of geographically varying tariffs would be low. Consideration of geographic variation in this report therefore focuses only on the geographic consequences of temporally varying tariffs.

between the two zones, while still preserving the same *average* charges across the whole company region.

Rising block tariffs

'Rising block tariffs' are another form of structured tariff, currently being trialled. They comprise a unit cost of water that rises – in blocks – as household consumption rises. Their purpose is to reduce water demand by focusing disincentives on those households with relatively large consumption. Given the earlier discussion of the importance of variable and of peak scarcity, rising block tariffs appear a less well-targeted solution to the issues highlighted in this report.

Establishing rising block tariffs also requires potentially difficult decisions about the consumption levels for each price block. Such decisions have implications for vulnerable households, such as some large families and those with medical conditions requiring high water use. As already discussed, such issues do not generally arise as a result of temporally varying tariffs.

Regulation of water tariffs

What is needed to drive development of water supply tariff innovation and greater use of structured tariffs? Ofwat has a key role to play, as it provides guidance to water companies on their tariff arrangements and has powers to sign off companies' proposed tariffs.

Ofwat should encourage, through guidance, water companies to make the structure of (AMR metered) tariffs reflective of water's costs and values at different times. Doing so should be seen as part of Ofwat's statutory duty to protect the interests of customers, many of whom unwittingly subsidise peak summer water use by the few, and face generally higher supply costs as a result of current inefficient water charging structures.

AMR metering roll-out

Structured water tariffs need water meters smart enough to support them. There is a good case for Defra to set out minimum 'smart' standards for new water meters, as it makes little sense to be installing further 'dumb' meters which do not support many of the benefits outlined in this report.

Water companies and Ofwat should include in investment appraisals for metering expansion estimated benefits from the ability to develop structured (in particular, peak) tariffs (although it will be hard to accurately quantify such benefits).

There is a question of whether the government needs to go further to promote metering, and in particular to set a target for water meter penetration. It seems reasonable that areas with sufficient water scarcity should have near full 'smart' metering, and this implies going well beyond the 50% level after 2015. However universal metering is not likely to be necessary in the foreseeable future, as there are some areas of the country where water is plentiful and unnecessary metering investment has costs. The 2009 Walker review into household water metering and charging recommended that the government revise its current approach to metering to deliver 80% metering in England and Wales by 2020.[68] The government has taken a directive role in driving smart meter roll-out in the energy sector, with a

68 Walker (2009).

timetable of full roll-out by 2019. One argument for that approach is that government coordination enables more cost-effective processes for roll-out, for example street by street installation. Yet Southern Water has been able to take forward such an approach to meter roll-out in its region under existing arrangements, in part because it suffers high levels of water scarcity.

Compulsory water metering is a more politically sensitive issue than energy smart metering, and a quantified national target for water metering may not anyway be the right approach anyway. It would be hard to set at the right level to avoid unnecessary costs, may carry unnecessary political difficulties and would not itself address how to achieve metering roll-out.

Instead, the government should look to ensure that water companies' metering investment decisions reflect all the benefits of increased 'smart' metering. Defra guidance should set out a government view that 'smart' metering and associated structured tariffs have substantial benefits for customers and for the environment, which should be fully taken into account in Water Resource Management Plans, investment appraisals and 2014 price review decisions. The government could also set out a presumption that expanded metering will be a significant part of any substantial new demand/supply investment by a water company.

Water efficiency target

There will be limits to the degree that household customers change demand in reaction to price signals, and there is a case for some additional measures to encourage water demand reductions and water efficiency.

The 2007 climate change review by Nicholas Stern recommended that, in addition to carbon pricing to incentivise carbon emissions reduction, there also needed to be other policies to drive behaviour change particular among householders. Energy companies now have targets to help improve their customers' energy efficiency, for example through the CERT scheme supporting energy efficiency installations. An analogous approach is justified in water. Ofwat set a minimum water efficiency target on all water companies, to reduce average customer water consumption by one litre a day over a five year period.

This target is not particularly challenging, nor, as a flat across-the-board reduction, does it target demand reduction effort where it would have the most impact. Such a target should require more to be achieved in those areas where water is scarcer, including areas where environmental damage is greatest and where future costs of matching supply and demand are highest.[69] This is returned to in the context of regulatory incentives on water companies in Chapter 9.

Recommendations

Defra should set out minimum standards for new water meters, to ensure they are sufficiently smart to support structured tariffs (at least Automated Meter Read standard).

Defra guidance should set out the government's view that 'smart' metering and associated structured tariffs have substantial benefits for customers and for the environment. These benefits should be fully taken into account in Water Resource Management Plans, investment appraisals and 2014 price review decisions, and there should be a presumption that such metering

69 Ofwat (2008a) Press notice announcing new water efficiency targets.

will be part of any substantial new demand/supply investment by a water company.

Water companies should develop structured water tariffs that vary over time to signal scarcity and incentivise reduced demand, particularly at peak times. Such tariffs have the potential to reduce the need for the most expensive peak supply infrastructure, to secure environmental benefits and to improve fairness in water charges.

Ofwat should use its sign-off powers over water tariffs to require water companies to make the structure of 'smart' metered tariffs reflective of water's values at different times. As part of this, Ofwat should require companies to make transparent estimates of cross-subsidies between relevant customer categories for the costs of demand and scarcity peaks.

9
Reforming water supply regulation

The purpose of reforming water supply regulatory arrangements is to help the process of tackling over-abstraction by reducing the costs of matching water demand and supply.

Water supply companies form the largest group of abstractors, and how they are regulated and behave is critically important in addressing the problems outlined in this report.

Problems with current water supply regulatory arrangements

Some aspects of current water supply regulatory arrangements are a legacy from a period when the options were simpler for developing new water supply sources and infrastructure, and were generally cheaper. A simple regulatory approach focused on scrutinising different capital supply projects put forward by the monopoly water company was acceptable.

Such a process is now insufficient to identify and select the best ways to bear down on the costs of matching water supply and demand. The regulatory framework needs to deal with greater complexity of options and information, including options for dealing with the peak versus average demand shortfalls, comparing demand- and supply-side options, operational expenditure versus capital expenditure solutions, new sources versus greater interconnection and promoting innovation. Failure to select the most cost-effective solutions for matching demand and supply now, and in the face of future water scarcity challenges, will make it harder and slower to reduce damaging over-abstraction.

Water supply has historically been developed with demand treated – to a large extent – exogenously. In the regulatory process, demand was predicted and new supply investments agreed up to a certain level of expected peak demand (after which, if necessary, demand would be curtailed with drought orders). Such a process is unlike most markets for scarce resources, where levels of demand and supply are mediated by price mechanisms.

More recently, the Water Resource Management Plan (WRMP) arrangements are an attempt to address the problem lack of market price mediation, by mandating a process for identifying and appraising a range of options – on both the demand- and supply-side – for matching future water demand and supply over 25 years. But the WRMP arrangements, and associated price review processes, are limited in their effectiveness in a number of ways, including:

- water companies having incentives to bias investment appraisals in favour of traditional capital-intensive supply-side approaches; and

- monopoly water companies being virtually the sole originators of demand/supply options, and under little or no competitive pressure to innovate or discover new information.

Bias in favour of capital-intensive supply side solutions

Monopoly water companies have their prices regulated by Ofwat. The process for establishing prices incentivises companies to try to maximise their Regulatory Capital Value (RCV) on which Ofwat allows them to earn a regulated return. Companies grow their RCV by securing Ofwat agreement to new capital investment. Ofwat's approach to price regulation also incentivises companies to become more efficient by minimising operational expenditure, a further incentive for companies to choose capital over operational expenditure.

A capital bias will tend to favour options for matching demand and supply which involve investing in new infrastructure within a company's area, for example reservoirs, desalination plants, pipe interconnection within a company's area, but also, potentially, water meters. A capital bias will therefore tend to disfavour options such as operational expenditure on demand reduction, leakage detection, purchasing water from a neighbouring water company, or installing water meters to the extent that these reduce demand (though Ofwat has introduced a 'revenue correction mechanism' to try to address the latter effect).

As discussed earlier, capital-intensive new supply infrastructure is often a very expensive approach to addressing infrequent water scarcity peaks. In any case, to select the most cost-effective approaches to matching demand and supply, there needs to be a level playing field.

Other, non-regulatory, factors may also contribute to a capital bias. Companies may be culturally more comfortable with their traditional role of building supply infrastructure (largely unchallenged by competitors), investors may have become used to the size of the RCV being shorthand for a company's value, and companies may prefer to have 'control' of their own supply rather than enter into contracts for bulk supplies with others. (Regulation may also be a factor driving the latter.)

Whatever its causes, the existence of a 'capital bias' is widely recognised. Box 12 sets out some examples of how the capital bias appears to have manifested itself in the processes by which investment options are appraised by water companies.

Box 12: Examples of the 'capital bias'

The following three examples illustrate how companies' cost-benefit assessments of demand/supply options appear to be biased towards new supply side infrastructure.[70]

- The benefits from supply-side investments are currently calculated at the point of abstraction, so they do not factor in the water losses and costs resulting from water treatment and distribution, including leakage. In contrast, the benefits from demand-side measures are naturally calculated at the point of consumption. Thus the playing field is not level, but tilted in favour of supply-side measures.
- Many companies (though not all) predetermine their 'economic level of leakage' and do not compare leakage reduction measures, on cost-benefit grounds, alongside other options for meeting the supply and demand balance. This may result in leakage not being reduced even when it is the cheapest option to address a supply-demand shortfall.

70 CR Fenn (2010), *Improvements to Current Methods for Water Supply-Demand Planning,* Discussion Paper for WWF's Itchen Initiative.

- Companies have focused on calculating 'capacity-based' unit costs for each proposed supply-side investment option. That is to say, the benefits of the investment are deemed to be the maximum volume of water that *could* be deployed as a result of the investment, irrespective of the likely frequency of its use. Investment appraisals should also calculate 'output-based' unit costs: the cost per litre of water actually expected to be delivered over 25 years, which may be very high for reserve supply to cover rare shortfalls in only the driest years (at least initially). (See Box 7 on the estimated capacity- versus output-based unit costs of the Thames desalination plant). Using capacity-based costs alone may understate the costs of some new supply infrastructure, and thus bias against measures able to deliver, for example, demand-side response in those rare periods, such as high dry period tariffs or interruptible contracts.

Lack of competition and contestability

The arrangements for deciding investments to match supply and demand, over the last 20 years, have been characterised by a bilateral administrative process between monopoly water companies, on the one hand, and Ofwat, on the other.

Companies project future demand and propose investments within their appointed areas (using draft Business Plans, now based on 25-year Water Resource Management Plans), while Ofwat, on the other hand, accepts or rejects proposals and attempts to drive down costs. There is very limited scope for competing demand/supply options to enter the process, as alternatives to the water companies' proposals. Ofwat is highly constrained in its ability to challenge companies' proposals, by an asymmetry of information (and by the general lack of information that characterises monopoly industries). It is hard for Ofwat to scrutinise companies' plans, let alone make counter-proposals for alternative demand/supply solutions. While the WRMP process has been an important step in requiring water companies to consider a range of options for matching demand and supply with wider scrutiny and consultation, such a process is no substitute for getting a range of competing market players involved.[71]

The England and Wales water sector does not need to be characterised purely by monopoly approaches to matching supply and demand. There is scope for both competing water producers and water retail service companies to offer alternatives, enabling more cost-effective approaches to emerge. For example:

- competing 'water retail service companies' could deliver (and aggregate) water efficiency and demand-side response measures, as an alternative to traditional new supply-side capacity. In Scotland, which has had competition in water retail supply for non-household customers since 2008, water efficiency services have substantially grown;[72]
- neighbouring water companies could compete to supply the water to each others' customers, transporting water across company boundaries where this was a cost-effective and environmentally sustainable approach; and
- neighbouring water companies could trade water directly with each other. Severn Trent Water has proposed development of this approach (see Box 8).

But there are a range of legislative and regulatory barriers to competition, to new entrants or neighbouring water companies, who wish to propose alternative, competing ways of matching demand and supply, including:

71 Similarly the Environment Agency's Restoring Sustainable Abstraction scheme is also a bilateral discussion between the Agency and abstractors (often water companies) about how to make good reductions in over-abstraction and the costs.

72 Business Stream (2010), *Business Stream scoops green accolade at UK CBI awards,* Business Stream Press Release 1 November 2010.

- the 'costs principle' enshrined in the Water Act 2003, which substantially restricts the margins available to an entrant to the water sector;
- the 'eligibility threshold', which currently prevents all but the largest commercial customers (using more than 50 Ml a year) from seeking alternative water suppliers;
- a single vertically-integrated water company licence enshrined in legislation; and
- regulatory arrangements which are insufficient to enable entrant and neighbouring water companies to effectively secure access to the incumbent's distribution network.

As result of a lack of competition and contestability, there are unique legislative and regulatory restrictions on mergers between the current 21 water monopoly companies.[73] These restrictions are driven by the needs of the monopoly price regulation process (which needs to be able to compare performance between sufficient numbers of companies). This perpetuates the existence of 21 separate water transport networks and adds to the difficulties in trading and sharing water between different areas.

Lack of innovation

Innovation is key to identifying cost-effective approaches to matching demand and supply. In his independent review for the government in 2009,[74] Professor Martin Cave found that levels of innovation in the water sector were low, with operational expenditure on research and development having fallen from £45 million a year in the early 1990s, to £18 million.

Water sector innovation does not need to be done by the monopoly water companies themselves, but these companies do need to engage with innovators, helping to demonstrate and develop their ideas, and providing a willing market for new approaches.

It is argued that regulatory arrangements tend to disincentivise innovation, for example through incentives to reduce operational expenditure, and through the five-year periodic price reviews which limit the period of returns from investment in innovation.

In any case, there are few, if any, regulatory incentives focused on promoting water sector innovation. Given the current absence of competition as a driver for innovation, and the argument put forward in this report that future challenges will require companies to explore new approaches, this absence of incentives may no longer be sustainable.

Options for reform

Reforms to water supply regulation need to enable the bringing forward of a range of options for matching demand and supply, including new innovations, and enable these to compete on a level playing field.

Market opening

A number of measures to open up elements of the water supply sector to competitive entry, were proposed in Ofwat's review of competition in 2008,[75] the independent Cave review in 2009[76] and Ofwat's further proposals in relation to upstream competition in 2010.[77] These proposals include:

73 The so-called water Special Merger Regime, gives Ofwat strong powers to block water mergers.

74 Cave (2009).

75 Ofwat (2008b) *Review of competition in England Wales water and sewerage industry: Part II*.

76 Cave (2009).

77 Ofwat (2010c).

- legal separation of all water companies' retail services functions to create a set of independent competing water service companies, better focused and incentivised on providing (non-household) customers with water efficiency and demand-side response services, effectively in competition with supply-side water companies;
- legislation to provide new supply licences which enable companies to provide selected water supply activities without needing to be vertically integrated, such as simply supplying water resources to a water company's treatment or distribution infrastructure;
- regulatory measures to enable competitors to have fair access to wholesale water supplies and to pipe networks;
- removal of the 'eligibility threshold' (in secondary legislation), enabling all non-household customers to choose their water supplier;
- removal from legislation of the 'costs principle', which currently unnecessarily restricts entrants' margins;[78]
- new regulatory incentives for trading water between companies, allowing companies to earn profit at the margin from the value they realise through trading, and thus encourage greater interconnection where efficient, and begin to reveal information about water's values (the regulator has powers to prevent excessive windfall profits); and
- regulatory separation of water companies' 'network system operation' functions, including giving them distinct regulatory incentives to encourage co-operation across company boundaries, thus helping facilitate development of new interconnections and fair access to networks.[79]

These – largely deregulatory – proposals should be taken forward.

Such steps to open markets and to vertically disaggregate the water monopoly businesses could enable an easing of restrictions on mergers. Mergers between neighbouring pipe network businesses could enable beneficial coordination and optimisation across wider geographic areas, particularly in the relatively dry South East where there is – perversely – greater geographic fragmentation of water transport networks than in other regions. Around half of the current 21 water monopoly companies are in the South East.

Markets need to be well designed, and market opening should proceed with appropriate caution to militate against unintended consequences. We cannot know ex ante precisely how much trading and market entry will occur, but developing even modest market activity would reveal hitherto unknown information to inform companies' and regulators' decisions.

Contestability within the periodic price review process

In addition to opening up to market competition, Ofwat's price review process should create opportunities for competing proposals for matching future supply and demand.

For example, a neighbouring water company may propose that they sell water into an area instead of the receiving company investing in its own supply; or a water retail service company may propose a programme of demand reduction installations. Such competing proposals should be solicited and rewarded as part of the periodic price review process; and the level of regulated companies'

78 Ofwat (2008b); Cave (2009).

79 Ofwat (2010c).

price cap should reflect only the most cost-effective set of competing solutions. Incentivising the tabling of a range of options could inject new information and innovation into the price review process.

Innovation

The principal driver of innovation across the economy is competition, so taking the steps outlined in the previous section is key to promoting innovation.

In addition, Ofwat should consider providing specific regulatory incentives for water companies, and others, to innovate. Any incentive should focus on rewarding innovation outputs, rather than inputs (such as R&D spend). It could be based on the Low Carbon Innovation Fund recently introduced by Ofgem to incentivise innovation in energy networks. This involves competitive bidding, and might require legislative change for such an approach to be applied in the water sector.

Balancing incentives for capital and operational expenditure options[80]

As part of its current review of regulation, Ofwat should identify ways to mitigate companies' bias towards capital-intensive supply-side solutions.

One approach could be for Ofwat to capitalise a fixed percentage of costs across both capital and operational expenditure in the Regulatory Capital Value, so that regulatory incentives are equalised between capital and operational expenditure solutions.[81] A similar approach has been used by Ofgem in its fifth electricity distribution price control.[82] This mechanism could be applied across all water company activities, or only certain categories of operational expenditure – for example, expenditure to match supply and demand. This would remove disincentives to operational expenditure based solutions, such as buying water across a company border or demand reduction activities (while generally maintaining incentives for efficiencies in operational expenditure).

Ofwat should also consider approaches to addressing cultural drivers to the capital bias. Ofwat could put in place – for a period – regulatory incentives that deliberately countervail expected cultural biases.

One such approach would be to develop Ofwat's water efficiency targets, already discussed in Chapter 8. Targets for demand reduction could be a useful way to countervail companies' bias towards supply-side capital investment. But the current targets are currently too crude and weak, requiring a flat one litre per customer reduction in average demand. A stronger, revised target would need to focus effort on those areas where water was scarcest, where supply-side solutions were most expensive and, if feasible, dry year demand.

Another approach would be for Ofwat to require a minimum proportion of companies' programmes for matching demand and supply to consist of demand-side measures and interconnection. This could also be a way of promoting smart metering, as discussed in Chapter 8. Such incentives would be appropriate for a time-limited period only, in order to help shift cultures.

Recommendations

The government should legislate to enable an opening-up of the water supply market to competition, with neighbouring water companies, new separated water service companies and new entrants able to compete to supply customers, encouraging alternative and innovative ways for matching supply and demand.

80 Le Quesne et al (2011)

81 Severn Trent Water (2010).

82 Ofgem (2009), *Electricity Distribution Price Control Review Final Proposals*.

In particular, legislation should implement the recommendations of the Cave review, and include mandatory legal separation of water companies' retail services businesses; new operating licences which enable companies to provide selected water supply activities; removal of the 'eligibility threshold' currently preventing most non-household customers from choosing their supplier; and regulatory separation of water companies' 'network system operation' functions.

Alongside such market-opening, and subject to a sufficient degree of regulatory vertical disaggregation of water companies' businesses, restrictions under the special merger regime for water companies should be eased to enable mergers between companies' water retail services businesses, and between pipe network businesses.

Ofwat's periodic price review process should solicit and incentivise competing proposals for matching future supply and demand, with the level of regulated companies' price cap reflecting only the most cost-effective set of competing solutions.

Ofwat should consider specific new regulatory incentives for innovation outputs.

Ofwat should identify ways to mitigate companies' bias towards capital-intensive supply-side solutions, for example, by capitalising a fixed percentage of costs across both capital and operational expenditure in the Regulatory Capital Value; developing scarcity-based demand reduction targets; or requiring a minimum proportion of companies' programmes for matching demand and supply to consist of demand-side measures and interconnection, for a time-limited period.

10
Strategy for addressing current over-abstraction

The previous chapters set out ways to reform regulatory arrangements in order to make dealing with the problem of damaging over-abstraction cheaper, and therefore more likely to happen sooner. But there will still need to be a strategy and process for actually delivering sustainable abstraction levels.

This will still require substantial investment over a period of time. It is important that the strategy for ending damaging over-abstraction incentivises least cost approaches and does not become a charter for water companies to build unnecessary capital infrastructure, to add to their Regulatory Capital Value at customers' expense.

That is why the reforms outlined already are important; and also why the process for ending damaging over-abstraction, outlined in this chapter (at high level), needs careful design with appropriate incentives built-in.

Process for addressing over-abstraction

As already discussed, the key barrier to making better progress on eliminating damaging over-abstraction is essentially cost. New demand and supply side measures will need to be funded to replace lost abstraction. Abstractors may be entitled to compensation in respect of their existing rights.[83] The key issue is for the design of the process to address over-abstraction to place incentives on water companies and other abstractors to minimise those costs. The following are likely to be key elements of such a process.

Setting a clear goal

The government must set a clear goal, or commitment, in relation to tackling damaging over-abstraction. Essentially this should set out a deadline for achieving sustainable abstraction across all catchments. The timetable should be informed by the requirements of the Water Framework Directive and affordability estimates. It might, for example, be set for fifteen years time, giving abstractors considerable time to plan and invest.

It would be unlikely to make sense, nor be realistic, to commit to eliminating any chance of over-abstraction in all areas (however expensive) and in all periods (however dry). But there should be a commitment that, from the future deadline (or earlier), any abstraction that significantly damaged the environment would carry a charge to reflect the full costs of that damage.

Such a timed commitment would, for the first time, provide a clear direction and destination to inform abstractors', and Ofwat's, decision-making. There may

83 There are some legal uncertainties in relation compensation, for example, the degree to which new conditions on usage of existing abstraction licence rights require compensation (as opposed to reductions in volume of licensed abstractions). And the 2003 Water Act makes a provision that certain licences causing 'serious damage' may not have a right to compensation on revocation after 2012. But regardless of the legal issues about allocation of the costs from restricting abstraction, those costs will remain, and constitute the key barrier to making progress. (In the case of water companies, water customers will bear the costs virtually regardless of the legal issues.)

be a case for legislating in relation to the commitment, to maximise regulatory certainty.

This approach would be different from Defra's previous proposals, consulted on in 2009, for time-limiting all abstraction licences. Instead of blighting the abstractions market with uncertainty about the Environment Agency's future discretionary decisions, such an approach aims to empower catchments to develop themselves a plan for delivering a sustainable catchment.

To support this, the Environment Agency should be tasked with rapidly translating the commitment into catchment-level goals, starting with the most at risk catchments. Catchment goals should not specify reductions in particular abstraction licences, nor specific changes to licence conditions, (as happens under the current Restoring Sustainable Abstraction (RSA) scheme). Instead they should establish the overall *outcome* sought. Focusing on outcomes at the whole catchment level would give water companies and other abstractors the flexibility to work out the best catchment-level plan for achieving sustainable abstraction outcomes.

The Environment Agency should help catchments develop their plans. This will include developing and making available the more sophisticated licensing tools outlined earlier in this report, including graduated licensed volume limits and structured, volumetric abstraction charges. Given the importance of variability in water scarcity, in most cases the key changes to abstraction rights will not be reductions in maximum licensed volumes.

In developing and accepting catchment plans, the focus should not be on securing perfection. The key will be to establish firm new property rights, in the right ballpark for minimum protection of the environment based on existing knowledge. This would be a great improvement on the current unsustainable position in some catchments. Over time, more scientific and market information will be revealed, and rainfall patterns may change. The regulator would be able to adjust abstraction property rights by participating in the market and buying back or selling new rights. Sustainable abstraction is not an end-point but an ongoing process.

By establishing property rights, which at least crudely reflected environmental limits and which would in future be adjusted only through market operations, this would enable abstractors to plan, invest and trade. These processes would reveal new information about water's values and the costs of sourcing water which would inform future regulation, development of water supply and improve the efficient allocation of available water.

Funding

Moving to sustainable catchments will require substantial investment. The current RSA scheme has been limited by its dependence on funding raised through the EIUC levy on abstractions licences, which is restricted by the Treasury. As discussed earlier, the Treasury's restrictions are understandable given the inadequate incentives within current arrangements to minimise compensation costs.

Pressing the Treasury for additional funding is not the most important avenue for securing the necessary funding. The majority of new restrictions on abstraction are likely to fall on water companies. Funding for water companies should come through the standard route for all other water company investments: their revenues, as capped through Ofwat's price review process.

Once government has set out a clear goal, potentially in legislation, for achieving sustainable abstraction, Ofwat is best placed to scrutinise water companies' proposals for achieving it, under its duty to protect the interests of customers. There are basically two key price review periods for achieving sustainable abstraction ahead of the deadline for the Water Framework Directive, 2015-2020 and 2020-2025.

Funding to compensate other abstractors will need to continue to be raised from a levy on (non-water company) abstraction licences.

Incentives

Ofwat is expert in deploying incentive regulation of monopoly water companies. It would be able to apply this expertise to incentivising least cost approaches and investments by water companies in response to abstraction restrictions. (While Ofwat only regulates water companies, a similar incentivised approach should be applied to other abstractors by the relevant regulator.)

For Ofwat's incentive regulation processes to have impact, companies need to have an incentive to engage with Ofwat. One incentive is being able to secure revenues for new capital investment, adding to the Regulatory Capital Value. But this does not provide Ofwat with a particularly strong lever, since water companies might decide to do nothing unless they were provided with a sufficiently attractive margin which was not in the interests of customers. And, as discussed earlier, this particular incentive encourages water companies to seek the most capital-intensive, and not always the least cost, approaches.

It is important therefore that water companies have other incentives. Firstly, there must be the credible risk that, if water companies do not take action to achieve sustainable abstraction by the government's deadline, they will suffer sufficient consequences. Consequences could include enforcement action and / or high abstraction charges that reflect the full environmental cost of environmental damage. (To make the risks associated with an, initially distant, deadline more credible, charges on damaging abstractions could be gradually increased over time, as proposed in the Cave review.[84]) Secondly, there should be the incentive that, if water companies propose approaches and investments which Ofwat considers contribute to the government's goal of securing sustainable abstraction while being in customers' interests (least cost), then Ofwat will allow the water companies to recover the costs in their revenues.

Another incentive on water companies and other abstractors is the benefit they would gain following achievement of sustainable abstraction in their catchments. Once a catchment has met the Environment Agency's basic goal for sustainable abstraction (discussed above), then regulatory uncertainty would be largely removed. Abstractors would have confidence in their water property rights, be able to plan, invest and trade water to realise its value. Early tradeability would be a key benefit from engaging in the process and securing sustainable licences.

As discussed earlier, Ofwat's periodic review process should be open, not just to the relevant water company, but also neighbouring water companies, water retail service companies and entrants to propose alternative, competing ways to match supply and demand in response to new restrictions on abstraction.

It might also be possible for Ofwat, as part of the periodic review process, to engineer some competition between water companies (for example, through

84 Cave (2009).

reverse auctions) for revenues to enable them to go further, faster towards sustainable abstraction than the average. As discussed making such earlier progress has potential benefits for water companies.

Recommendations

The government should set a clear timetable for achieving sustainable abstraction across all catchments, for example over the next fifteen years, with a commitment in legislation that any abstraction that subsequently significantly damaged the environment would be subject to enforcement or bear a charge to reflect the full costs of that damage.

The Environment Agency should translate the government's commitment into catchment-level goals, starting with the most at risk catchments first, setting out the overall catchment-level outcome sought and allowing water companies and other abstractors the flexibility to work out the best plan for achieving sustainable abstraction.

Implementing catchment plans should establish firm water property rights, within the limits of current information. Licences should be refined over time, as information improves and potentially as rainfall patterns change, only through the regulator participating in the market to buy back rights.

Moving to sustainable catchments will require substantial investment by water companies, which should be funded though their revenues and determined by Ofwat's periodic price review processes in 2015 and 2020. Once the government has set the timetable, so that water companies have incentives to engage, Ofwat has expertise in incentive regulation to secure the investments needed at lowest cost.

Ofwat should consider developing competition between water companies (for example, through reverse auctions) for additional allowed revenues to enable them to go further, faster towards sustainable abstraction.

11
Conclusion

There is a substantial problem of damaging over-abstraction in England and Wales. It has been estimated that achieving sustainable abstraction under current arrangements could cost between £3.7 billion and £27 billion. Progress is therefore currently very slow. At current rates it could take between 45 and 335 years to achieve.

The key to making better progress is to bear down on costs of achieving environmental improvements, and thus achieve more for a given rate of spending. Bearing down on costs requires reforms to both abstraction and water supply regulation.

Identifying the right reforms, requires an understanding of what drives the costs of supplying the water people need, while protecting the environment. Both water demand and water availability in the environment are highly geographically and temporally variable, and water scarcity is subject to marked peaks. This has become a more important characteristic as the overall value of water increases, as a result of increasing prosperity, increasing value placed on a healthy environment, population growth, increasing costs of new water supply sources and, potentially in future, climate change.

Regulation must enable and incentivise sufficient responsiveness to this variability in water scarcity, if the costs of matching supply and demand, and thus eliminating damaging over-abstraction, are to be contained. Greater complexity in terms of water's geographic and temporal values and the range of relevant options for matching supply and demand require processes for improving information and innovation.

This report makes recommendations for:

- regulation of water abstractions to make use of more sophisticated licence conditions and structured volumetric charges, to minimise environmental damage while maximising the availability of water for people, including through establishing more certain water property rights;
- institutional reform to ensure a clear focus on protecting the water environment, as well as a separate focus on managing available water to maximise the benefits for all users;
- greater use of structured tariffs for water customers (enabled by more 'smart' metering), in particular to send signals when (and where) water is at peak scarcity, to reduce the need for expensive new supply schemes which are used infrequently, and to allocate the cost of supply more fairly; and
- opening water supply and water trading markets, and addressing biases in

the regulation of water supply, in order to enable the identification of a wider range of innovative, competing options for matching demand and supply.

Such regulatory reforms would make addressing damaging over-abstraction cheaper, but far from costless. The government needs to set strategy and process for achieving sustainable abstraction. This report recommends that the government commit to a, perhaps, 15 year timetable, with sanctions for abstraction which continues to be damaging after that point, thus incentivising abstractors to engage in a process of identifying the catchment-level measures needed. The Ofwat price review processes in 2015 and 2020 should provide funding for water companies' efficient proposals for matching supply and demand under the necessary new abstraction restrictions, subject to Ofwat protecting the interests of customers, with contestability introduced into the process.

This report makes recommendations for a range of actors, including Defra, Ofwat and the Environment Agency. Overall, the government's water white paper, expected later in 2011, in the key opportunity to see this agenda progressed.

Risk of inaction

If recommendations such as these are not acted on:

- serious damage to river and wetland ecologies will continue and increase as the England and Wales population grows and rainfall patterns potentially shift;
- future water supply costs will be higher than they need to be;
- we will not have processes and information in place to respond sensibly if, or when, we are faced with a period of very severe water scarcity.

Whilst England and Wales are not Queensland nor Andalucia, and do not face the same severity of water scarcity events, there are lessons to be learnt from episodes in these latter regions. They were faced with water scarcity crises, and the responses, while effective, tuned out to be enormously more expensive than they needed to be.

South East Queensland faced a very severe multi-year drought in the early years of the last decade. The politically-led response to the crisis was to spend vast sums on rapidly deploying new infrastructure costing billions of dollars, including new supply sources and interconnection, while at the same time also implementing an intensive programme of demand reduction, including through pricing and education campaigns. Both arms of the strategy were so successful that South East Queensland now has far more supply infrastructure than it needs for its demand levels, and the state has an unnecessarily huge debt.

In Seville, after suffering severe water shortages during the 1992-95 drought period, construction of the Melonares dam was demanded by local and regional authorities. Proponents of the project projected substantial increases in domestic water demand in Seville by 2012 up to 190 hm^3/year. The dam was built between 2004 and 2009 at a cost of €110 million. But by 2010, gross demand had reached only 120 hm^3/year, despite significant population growth, as a result of significant investments in demand management, including water meters, a progressive tariff system, public information campaigns, and reduction in distribution losses.

Had these regions had better processes for revealing information about the options available and the effectiveness of a range of measures including pricing and demand reduction measures, they would have been able to respond to their crises in less costly ways.

Water is increasingly scarce. Rivers and natural environments are suffering damage as a result of over-abstraction of water in areas across England and Wales at particular times of year and in dry years. Pressures on water are likely to increase as a result of growing population and changed rainfall patterns.

The costs of addressing the problem of damaging over-abstraction under current arrangements are estimated to be huge, and it could take decades or even centuries to achieve sustainable abstraction at the current rate of progress. The absence of an effective strategy for achieving sustainable abstraction levels causes uncertainty for abstractors and increases water supply costs.

The key to making better progress is to bear down on costs. If the costs of matching water supply and demand can be minimised, the costs of eliminating damaging over-abstraction can be reduced. A key driver of costs is variability – both demand for water and water's availability in the environment are highly geographically and temporally variable. Peaks of water scarcity, often lasting for only a few weeks or months each decade or quarter century, are a significant driver of water supply infrastructure costs.

Current water regulatory arrangements are insufficiently sophisticated to enable efficient responses to such variability. Only a small minority of abstraction licences have conditions which curtail allowed abstraction when rivers are running low. Charges for abstraction licences do not vary according to the actual volumes abstracted, nor according to the environmental costs of abstraction. The UK remains one of the few remaining western European countries where most households do not pay for water on the basis of what they use. Where customers are metered, charges do not reflect the very different costs between wet and dry periods. Water companies tend to favour building traditional capital-intensive new supply-side infrastructure, over alternatives such as trading water between companies, or demand-side measures. There are few, if any, ways for competitors to propose alternative and innovative solutions to matching supply and demand.

Untapped Potential identifies reforms to regulatory arrangements for abstraction and water supply, to better protect rivers and natural environments at lower costs.

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