SECURING LONDON'S WATER FUTURE

THE MAYOR'S WATER STRATEGY

OCTOBER 2011

MAYOR OF LONDON

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FOREWORD

In the middle of the 19th century, London was brought back from the brink of environmental catastrophe by Joseph Bazalgette through the construction of the London combined sewer network. 150 years later we still rely on this network to drain the city.

Bazalgette had hoped to future-proof his sewage system to cope with the waste of a city twice as populous as the metropolis of 2.5 million Londoners he knew in his day. London is now a city of nearly 8 million people and many of our Victorian-era solutions, including Bazalgette's remarkable subterranean achievement, are now struggling to deal with the demands we place on them. The growth of the city and changes in the way we live our lives are placing stresses on our water infrastructure that they were not designed to deal with. These will be further compounded by our changing climate.

I believe a world-class city needs a world-class infrastructure. We therefore need to reduce some of the pressures on our current water system to ensure it can continue to serve us well into the future.

My ambition is to put 'the village' back into the city. By this, I mean we can improve the quality of life for Londoners by ensuring that we focus our efforts on delivering a cleaner and greener city with stronger and safer communities through our work to make our city more sustainable with a high quality of life.

This means attracting investment and stimulating growth. Thousands of jobs could be created by improving the water and energy efficiency of our homes and businesses, and through opportunities such as the construction of the ambitious Thames Tideway Tunnel – a super-sewer for the 21st Century.

Underpinning this strategy is the fact that in the South East of England we are currently removing more water from the environment for our consumption than it can sustain. In the face of a growing population and increasing demand for resources, it makes sense to use the water we have more wisely and to plan for a future where there may be less water available. This both safeguards our environment and enhances our water security for the prosperity of London for decades to come.

In addition, at a time when utility bills are rising, making adjustments that save money also makes sense. Wasting less hot water has multiple benefits: it saves money on energy costs, and for those with a water meter, on water bills too.

We can also be more creative about how we manage rain water in London. We should undo the hydrophobic policies of the 1960s – which saw natural rivers and waterways encased in concrete – and find ways to work in harmony with water in our landscape to ease the consequences of heavy rainfall and beautify our city at the same time. These strategies will help us to stand on the shoulders of Bazalgette and future-proof London for the challenges ahead.

Boris Johnson
Mayor of London

PREFACE

A strategic framework for enhancing quality of life in London and protecting the environment

The Water Strategy is part of a series of strategies that together set out actions and policies to make London the best big city in the world. How? By improving the quality of life of Londoners and making the city more sustainable.

The future of the planet lies in cities. In the 1950s just 29 per cent of people lived in towns and cities. By the close of the 20th century that figure had increased to 47 per cent, and by 2050 it will hit 70 per cent. There are clearly benefits to city living. People live longer, have access to better education, extensive public transport, greater healthcare provision, more social, cultural and economic opportunities and a lower carbon footprint. The Mayor is working to ensure that London not only retains its world city status but remains among the best places on the planet to live, whatever your age or background. He also wants to ensure that the city is liveable and its development is sustainable for future generations.

The Mayor's ambition is to put 'the village' back into the city. What this means is improving the quality of life for Londoners by ensuring that we focus our efforts on delivering a cleaner and greener city with stronger and safer communities through our work to make London more sustainable.

The Mayor's environment strategies and programmes are built on three policy pillars. These are retrofitting London, greening London, and cleaner air for London. These pillars aim to improve the quality of life for Londoners and visitors, and to make the capital more attractive. The Mayor's programmes that underpin these pillars are delivering targeted improvements and benefits that Londoners can see and experience around them. They also aim to make public services more efficient and less of a burden on tax payers, whilst delivering wider environmental benefits such as conserving water, saving energy or reducing waste.

The three 'pillars' and example programmes:

Retrofitting London
Retrofitting London's existing buildings is not only crucial to tackling London's CO_2 emissions, it also reduces energy and water use, delivers new jobs and skills, as well as saving London businesses and homes money on energy bills. Almost 80 per cent of the 14,000 low carbon jobs that could be created per year from delivering the Mayor's CO_2 target and two thirds of the £721 million of annual low carbon economic activity would come from retrofitting.

Our homes and workplaces are responsible for nearly 80 per cent of the city's emissions. Fundamentally 80 per cent of these buildings will still be in use by 2050. The RE:NEW programme which installs a range of energy and water efficiency measures in homes,

enables Londoners to save money on their energy bills while making their homes more energy efficient. The RE:NEW demonstrations in 2010, have shown that households could save over £150 annually through retrofitting actions.

Greening London
The Victorians bestowed on us a city softened by trees and green spaces. Greening London builds on this legacy and aims to improve the look and feel of our city, making it more attractive whilst reducing the impact of noise and air pollution. Greening London also makes the city more resilient to flooding and extreme weather events, and can contribute to a healthy mind and body. The Mayor through his RE:LEAF programme and the London Green Grid has an ambition to increase tree cover by five per cent by 2025, therefore achieving one tree for every Londoner and creating a better network of interlinked, multi-functional and high quality open and green spaces.

Cleaner air for London
Air pollution is a serious health issue and the Mayor is determined to reduce its impact. Actions being taken to improve air quality include introducing the first ever age limit for black cabs, tougher standards for the Low Emission Zone, new cleaner hybrid and hydrogen buses and fitting older buses with equipment including filters to curb pollution. The new bus for London, which will be launched in 2012, will use the latest green technology making it 40 per cent more efficient than a conventional double decker. The Mayor is working to introduce more electric vehicles onto London's streets. In May this year, he launched Source London, the UK's first citywide electric vehicle charging network and membership scheme and we are also now investing record amounts to deliver a cycling revolution in London. Additional steps are being taken to tackle pollution levels at some of the busiest roads in central London. This includes utilising dust suppressant technology that prevents PM10 from re-circulating, installing green infrastructure to trap pollutants and a no engine idling campaign to reduce engines running unnecessarily when stationary. Eco-marshalls are also being deployed to help both monitor and reduce the impact of taxis on air quality.

London continues to attract people and businesses and therefore continues to grow. The London Plan forecasts the city's population could increase from 7.6 to 8.8 million by 2031. These strategies show that making London a sustainable city and protecting the environment does not mean we all have to be eco-warriors or make sacrifices to our standard of living. We can work to lessen our impact on the city while at the same time improving the environment and our quality of life.

In a post-Olympic London, we can also grasp the opportunity to make the capital a digital leader, an intelligent city. By harnessing the power of data, we can run our city more efficiently, understand environmental trade-offs, and communicate better with Londoners, enabling them to make better informed and sustainable choices in how they live and work. This is already happening through the explosion of social media and digital applications that encourage behaviour change based on the choices an individual makes. Data visualisation is also allowing us to understand complex data sets, telling us the results of the millions of decisions we make, on us, on our neighbourhoods, on our city and beyond.

Transitioning our city to a sustainable low carbon economy will also bring economic opportunities for London in terms of jobs and investment. Despite the economic downturn, the value of London's low carbon and environment sector is now worth over £23 billion, growing by over four per cent a year. As London and the rest of the world continue to reduce their greenhouse gas emissions over the coming decades, the economic opportunities from that activity will be huge. London must make sure it grabs this opportunity and continues to be a world leader.

Kulveer S Ranger
Mayor's Director of Environment

EXECUTIVE SUMMARY

Chapter 1 – Introduction

We can no longer afford to take our water for granted. We have to change the way we perceive, use and reuse our water to ensure that we have enough when we really need it. However, responding to this challenge will mean that we can save money, hand an improved water infrastructure over to our children and reduce our impact on the environment.

Most people in London expect to turn on the tap and get water without having to think about where it comes from. Equally, people want to be able to pull out the plug and let water run away without having to worry about what happens to it afterwards. However, changes are going on around us that mean that Londoners will have to pay more attention to where water comes from and goes to.

London is a growing city, reliant on water supplies from outside London to meet it needs and dependent on a water infrastructure that is, for the most part, over 100 years old. The management of water in London is also complex: four water companies provide London with water and only one manages London's sewage. The water companies are overseen by two regulators, which both require management plans, but neither plan has to be consistent with the other. This means the short term plans may not deliver the long term aims of the water companies.

The strategy is intended to complement the plans and strategies of other organisations, including the national water strategy, by presenting a London-specific view of water management. As a world city London needs to ensure that water, as an essential resource for communities and the economy, is managed in the best interests of London despite the growing pressures. That is why the Mayor has decided to produce a Water Strategy for London. It draws on the other plans and strategies, but also seeks to influence their future development. Its goal is improved water management – both in terms of the water we want (such a drinking water) and the water we don't want (such as sewage and floodwater in the wrong place).

Arrangement of the document

This chapter gives a general explanation of the context within which this strategy is being prepared. The next two chapters are concerned with the supply of water for use in homes and businesses. Chapter 2 explains where our water comes from, and the challenges to balancing supply and demand, now and in the future, whilst chapter 3 focuses on our use of water and how we might use the water that we have more effectively. After that, attention shifts to how to manage the water that we no longer need. Chapter 4 explains how water services are paid for. Chapter 5 is concerned with rainwater and other surface water whilst chapter 6 is concerned with wastewater collection, treatment and disposal. Chapters 3 to 6 begin with a vision for how the issue should be addressed, followed by policies and/or actions on what action the Mayor and partners should take to achieve the vision.

Chapter 2 – Pressure on water resources

We have to recognise that our current demand for water is unsustainable, and that as the number of Londoners increases and summer rainfall decreases, meeting this level of demand in the future whilst safeguarding the environment will create significant challenges.

The majority of London's water supplies come from the River Thames and River Lee, with about 70 per cent of all the water taken from the Thames upstream of Teddington Weir. It is then stored in reservoirs around the capital. The remainder is abstracted from the aquifer underneath London.

To meet our demand for water, some water companies are currently abstracting more water from the environment than it can sustain. In a dry year, our demands exceed what the environment can supply and we are reliant on reservoirs to meet our needs. However, during a hard drought, these may not be sufficient, so London now has a desalination plant as an emergency measure.

Londoners use more water than the national average (167 litres per person per day in 2009-10 compared to 146 litres per person per day), largely because we live in small households, which are less water efficient. Many Londoners have little incentive to save water - only one in four homes has a water meter. We also lose enough water in leakage from our water mains network to fill more than 238 Olympic-sized swimming pools every day.

London's demand for water will increase in the future as London's population grows and the trend of people living in smaller households continues. Furthermore, higher seasonal rainfall and hotter summers will mean that the availability of water will decrease when we need it most. There are also questions about whether we will be able to capture and store the additional water that wetter winters will bring. This means London's already tenuous supply-demand balance will become increasingly unsustainable – we therefore need to act to balance supply and demand.

Water companies are required to produce Water Resource Management Plans (WRMPs), which set out how water companies will balance their supply of water with customer demands over a 25-year period. These plans are revised every five years. In parallel water companies are required to produce business plans that set out how they will fund the first five years of their WRMP. Currently there is no requirement for the WRMP and the business plan to be consistent in enabling the same long term goals, despite the intention for WRMPs to drive the business plan. This means that there is no guarantee that the short-term plans will set the direction for the long-term aims of the WRMP, and the long-term needs of Londoners. The complexity of the water planning system including the highly technical modelling that feeds the figures in the plans, make it very difficult for non-technical stakeholders to have an input.

The implementation of the Water Framework Directive is expected to lead to the Environment Agency substantially reducing the amount of water that water companies can abstract from rivers in the South East. It is anticipated that these could have a profound impact on the balancing supply and demand in the future. The next round of WRMPs will have to take account of these reductions to supply.

Chapter 3 – Managing water use

Vision : The Mayor believes that Londoners should have a secure supply of water that is affordable, safeguards the environment, and a water infrastructure fit for a world-class city.

In order to achieve and sustain this vision, two sets of action are required. Firstly, the water industry needs to work better in the interests of its stakeholders, so that water company short-term business plans enable the long-term aspirations of their resource plans, and customers have greater clarity and say over what investments their bills are paying for.

Action 1

The Mayor will lobby Defra to ensure that there is greater coherency between the planning, funding and delivery of water company business and resource plans.

Action 2
The Mayor will lobby Defra, Environment Agency and Ofwat to develop a simple, transparent mechanism for comparing the costs and benefits of supply and demand measures in water company plans that fully accounts for the short- and long-term social, environmental and economic costs.

Secondly, The Mayor believes that in the face of growing demand and declining supplies, it makes sense to use the water that we have more wisely. The Mayor will work with partners to implement a 'six-point plan' of integrated actions to help Londoners and London's businesses save water and money.

Point 1. Improve the water efficiency of London's existing buildings through retrofitting simple cost-effective measures. This saves Londoners money and offsets the demand for water from new development.

Action 3
The Mayor will work with London's water companies and other partners to further integrate water efficiency into London retrofit programmes.

Point 2. Ensure all new development is super water efficient. This reduces residents' bills (all new development is metered), the need for new water resources and the impact on the environment.

Action 4
The Mayor will lobby government to ensure that improving the water efficiency of homes is promoted and supported in the Water White Paper and the Green Deal.

Action 5
The Mayor will work with London's water companies and developers to monitor the water usage in new homes to see if the actual water efficiency matches the predicted water efficiency.

Action 6
In the next review of the London Plan, the Mayor will draft a new policy requiring all new workplaces to achieve an improved water efficiency standard such as AECB's 'best practice' levels or WRAP's 'highly efficient practice'[1].

Point 3. Raise Londoners' awareness of the financial benefits of increased water efficiency – many Londoners would be able to save money by being more water efficient and even having a water meter.

Action 7
The Mayor will lobby government and Ofwat to improve water company customer engagement, for example, through providing more informative water bills.

Action 8
The Mayor will work with London's water companies to raise awareness of Watersure, optant metering and assessed charges through Citizens Advice Bureaux, Voluntary Action Centres, doctors' surgeries and social housing providers.

Point 4. Increase the number of homes that have a water meter. Paying for the volume of water consumed is the fairest way to pay for water, yet less than a quarter of London's 3.2 million homes have a meter. Having a meter helps consumers be aware of how much they are using and provides information to help control their bills.

Action 9
The Mayor will work with London's water companies, Environment Agency and Ofwat to

support the already planned introduction of water metering throughout London, with the aim of metering all houses and blocks of flats by 2020 and all individual flats by 2025.

Action 10
The Mayor will lobby government to investigate the opportunities and benefits of combining the 'smart' energy metering programme with enhanced water metering.

Point 5. Change the way Londoners pay for their water. The current system does not encourage or reward water efficiency, nor sufficiently protect those who cannot afford to pay.

Action 11
The Mayor will lobby government and Ofwat to enable tariffs that incentivise and reward water efficiency, whilst protecting vulnerable customers.

Point 6. Continue to tackle leakage. A quarter of our water is lost in leakage – this is water we pay for but never receive. A one per cent drop in leakage would provide enough water for 47,120 people.

Action 12
The Mayor will encourage Ofwat to develop the evidence base for Sustainable Economic Level of Leakage and benchmark performance on managing leakage, including the costs and benefits of fixing leaks that takes account of costs for London.

Action 13
The Mayor will lobby Ofwat to review the deadline for leakage reporting.

The Mayor is also keen for Londoners to save money and reduce their carbon footprint by reducing their bottled water consumption (tap water is 500 times cheaper than bottled water).

Action 14
The Mayor will encourage water companies and other partners to promote London's drinking water. This will include facilitating ways of working with London boroughs, our stakeholders and private sector organisations on potential funding models, or schemes, that provide efficient easily accessible and free drinking water to Londoners on the move, at no cost to the tax payer.

Action 15
The Mayor of London will lead by example by completing the Water Disclosure Project Questionnaire for the Greater London Authority to examine global water dependencies. The Mayor will integrate risks associated with global water use into the Mayor's Green Procurement Code to encourage companies to consider their water risks.

Chapter 4 – Paying for water services

Vision. The Mayor's vision is that we will help Londoners increase their water efficiency and save money by having a charging system that is fair to all, incentivises and rewards water efficiency, protects the vulnerable in society.

As discussed in chapters 2 and 3, demand for water is increasing in London and there is the need to move to higher levels of water metering to manage it. Universal water metering is the fairest way to pay for water usage.

Despite living in a seriously water stressed part of the UK, Londoners pay less for their water services than many other areas of the UK. Because the majority of people pay a fixed charge for their water and sewerage services, many Londoners have little understanding of how their bills will be affected by being metered. Water meters on their own do not

necessarily reduce and maintain a lower level of water consumption. Meters combined with tariffs that incentivise and reward water efficiency can reduce water consumption by a further five per cent.

Some unmetered households that use a lot of water have effectively been 'protected' from paying for the amount of water they use and if metered are likely to pay more for their water services. Some of these households are already paying more than three per cent of their income for water services and may be considered to have water affordability problems. The move to universal metering may drive more households to have water affordability problems.

The Mayor supports the introduction of universal metering in London but notes that tariffs alone will not provide a 'magic bullet' to alleviating water affordability problems, or offset the impact of universal metering. The Mayor believes that an integrated approach is required that combines universal metering, tariffs, smarter billing, retrofitting and a social protection system to reduce wastage, achieve water neutrality and support London's neediest families. The Mayor will work with the water industry to achieve this.

Action 16

The Mayor will lobby Defra to amend the working definition of water affordability to include disposable income after living costs, and for London to have its own water affordability assessment

Action 17

The Mayor will, through the London Water Group, work with the water companies to manage water affordability In London by:

a determining whether a current definition of water affordability is applicable to London
b identifying groups of Londoners that are, or could become, vulnerable to water affordability issues
c identifying the needs of these groups
d examining how the existing initiatives including the RE:NEW programme, could be integrated and better targeted to tackle water affordability
e lobbing government to secure funding for a water affordability pilot in London.

Chapter 5 – Managing rainwater

Vision. The Mayor's vision is that we adopt a more creative approach to managing flood risk from rainfall in London, taking opportunities to slow the progress of water from 'rain to drain' and using rainwater for non-potable uses to reduce demand for treated mains water.

This chapter is concerned with managing rainwater. Rainwater is either lost through evaporation, seeps into the ground to replenish groundwater levels, flows over the ground and returns to streams and rivers, or enters the drainage systems. In outer London, the surface water drains carry rainwater from pavements, road surfaces and rooftops into local rivers and streams. In central and inner London, rainwater is mixed with sewage in the combined sewer and flows to the sewage treatment works.

Rainfall intensity in London appears to be increasing. An analysis of rainfall records from a weather station in east London shows that before 1960, only one day experienced rainfall exceeding 40mm, compared to ten days after this period. A day with 45mm rainfall had a 30 year return period before 1960, and now has less than a one in six year return period of occurrence.

The increase of heavy rainfall days and the increase in hard surfaces from new or re-development means the existing surface water

drains can no longer cope with the rise in runoff. In turn, this can lead to a greater risk of flooding as surface water drains are overwhelmed.

Because so much of London's surface is concrete and tarmac, and therefore impermeable to rainfall, we are very reliant upon our drainage system to keep us dry. However, the responsibility for drainage currently rests with many agencies, including water and sewerage companies, the London boroughs, Transport for London, the Highways Agency and private landowners. This fragmented ownership, together with the realisation that surface water flood risk is probably the greatest short-term climate risk to London, led the Mayor to convene the key stakeholders to work together to understand and manage the risk.

Action 18

The Mayor will work with partners through the Drain London Forum to manage surface water flood risk and ensure a consistent approach across London. This will include:

a identifying flood risk hotspots and working with partners to determine who is best placed to manage these

b developing a Community Flood Plan Programme to support communities that wish to increase their resilience to flooding

c developing at least three demonstration projects to show how urban greening measures can help to manage surface water flood risk.

Chapter 6 – Disposal of wastewater

Vision. The Mayor believes that wastewater should be seen as a resource and not a by-product that is best kept out of mind. Opportunities should be sought to not just reduce the greenhouse gas emissions from wastewater, but to use it as a source of low-carbon energy.

In the mid 1800s, Sir Joseph Bazalgette designed and initiated the building of London's combined sewers. Still in use today, they remove wastewater and rainwater in the same pipe from properties in central and inner London. In order to avoid the flooding of streets and properties with raw sewage during intense rainfall events, Bazalgette designed a series of overflow outlets from the combined sewers into the tidal River Thames and its tidal tributaries (together referred to as the Thames Tideway). There are now 57 such outlets, known as combined sewer overflows (CSOs), which allow diluted storm sewage (excess sewage and rainwater) to spill untreated into the Thames Tideway after intense rainstorms.

Discharges occur at some CSOs between 50 to 60 times each year. Widespread heavy rainfall can lead to over a million tonnes of untreated sewage and rainwater legally discharging directly into the rivers. Despite much improvement in the Thames this is clearly unacceptable in the 21st century and contravenes the Urban Waste Water Directive that requires all wastewater to be treated before it is discharged.

To address these discharges, the government has asked Thames Water to develop a storage and transfer tunnel project, known as the Thames Tideway Tunnels. This involves two tunnels to collect the discharges and take the wastewater for treatment at Beckton STW in east London. Construction of the first tunnel, known as the Lee Tunnel, from Abbey Mills Pumping Station to Beckton STW commenced in 2010 and will be completed in 2014. From November 2011 Thames Water will be undertaking a second phase of consultation on the second tunnel, known as the Thames Tunnel. This is expected to lead to a planning application in 2012 and construction between 2013-2020. The preferred route will involve around 20 construction sites to act as tunnel

boring sites and CSO connection sites. Beckton STW is also being increased in size to deal with the additional treatment demands.

Action 19

The Mayor will work with Thames Water and other partners to support the construction of the Thames and Lee Tunnels, as a means of greatly reducing storm discharges from the combined sewer system and improving the quality of the water in the River Thames. The Mayor will ensure cost effectiveness and reduced disruption at all individual locations by continuing to lobby Thames Water on local issues.

In areas of London served by the separate sewer, if the foul drainage is misconnected into the rainwater drainage, this results in untreated sewage getting into London's rivers and streams. If the rainwater drainage system is misconnected into the foul water system, then this results in a greater volume of dilute effluent being sent unnecessarily to the sewage treatment works. Identifying and treating misconnections is currently a complex and slow process and undermines parallel efforts to improve the quality of London's waterways.

Wastewater can be a source of greenhouse gases, further intensifying climate change, but sewage sludge can also provide an alternative source of energy, reducing our dependence upon fossil fuels.

Action 20

The Mayor will work with Thames Water and other partners to identify ways in which the management of sewage can provide renewable energy and reduce emissions of greenhouse gases.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

1.1.1 Most people in London expect to turn on the tap and get water without having to think about where it comes from. Equally, people want to be able to pull out the plug and let water run away without having to worry about what happens to it afterwards. However, changes are going on around us that mean that Londoners will benefit from using water more carefully.

1.1.2 London is a dynamic, growing city and, like other cities, is facing the effects of a changing climate along with growing demands on resources. Together these pressures will aggravate the stress on existing systems by creating:

- greater demands for water from the mains and, therefore, from the natural environment;
- increased flows to, and discharges from, the sewage treatment works;
- greater risks of surface flooding as rainwater runs off new houses, driveways and roads; and
- increased risks of storms and tidal surges.

1.1.3 All in all, this means that we will have to plan much more carefully how we provide and use our water.

1.1.4 The Mayor has chosen to produce this strategy because he believes that water is an essential resource for London and that Londoners' interests are not being best served by the current arrangements. This strategy is intended to complement the plans and strategies of other organisations, by presenting a London-specific view of water management. It draws on the policies, strategies and plans of others but also seeks to influence their future development. Its purpose is to promote improved water management – both in terms of the water we want (such as drinking water) and the water we don't want (such as sewage and floodwater in the wrong place). This strategy considers all aspects of water management and how they interact.

1.2 Arrangement of this document

1.2.1 This chapter gives a general explanation of the context within which this strategy is being prepared. The next two chapters are concerned with the supply of water for use in homes and businesses. Chapter 2 explains where our water comes from, and the balance between supply and demand, whilst chapter 3 focuses on our use of water and how we might use the water that we have more effectively. After that, attention shifts to how to manage the water that we no longer need. Chapter 4 explains how water services are paid for. Each chapter begins with a policy setting out a water management hierarchy, and includes specific actions. Chapter 5 is concerned with rainwater and other surface water whilst chapter 6 is concerned with wastewater collection, treatment and disposal.

1.3 Integrated water management

1.3.1 Future Water, the government's Water Strategy for England[2], puts forward a vision for water policy and management in which, by 2030 at the latest, we have:

- improved the quality of our water environment and the ecology which it supports, and continued to provide high levels of drinking water quality from our taps;
- sustainably managed risks from flooding and coastal erosion, with greater understanding and more effective management of surface water;
- ensured a sustainable use of water resources, and implemented fair,

Figure 1.1 Water company service areas

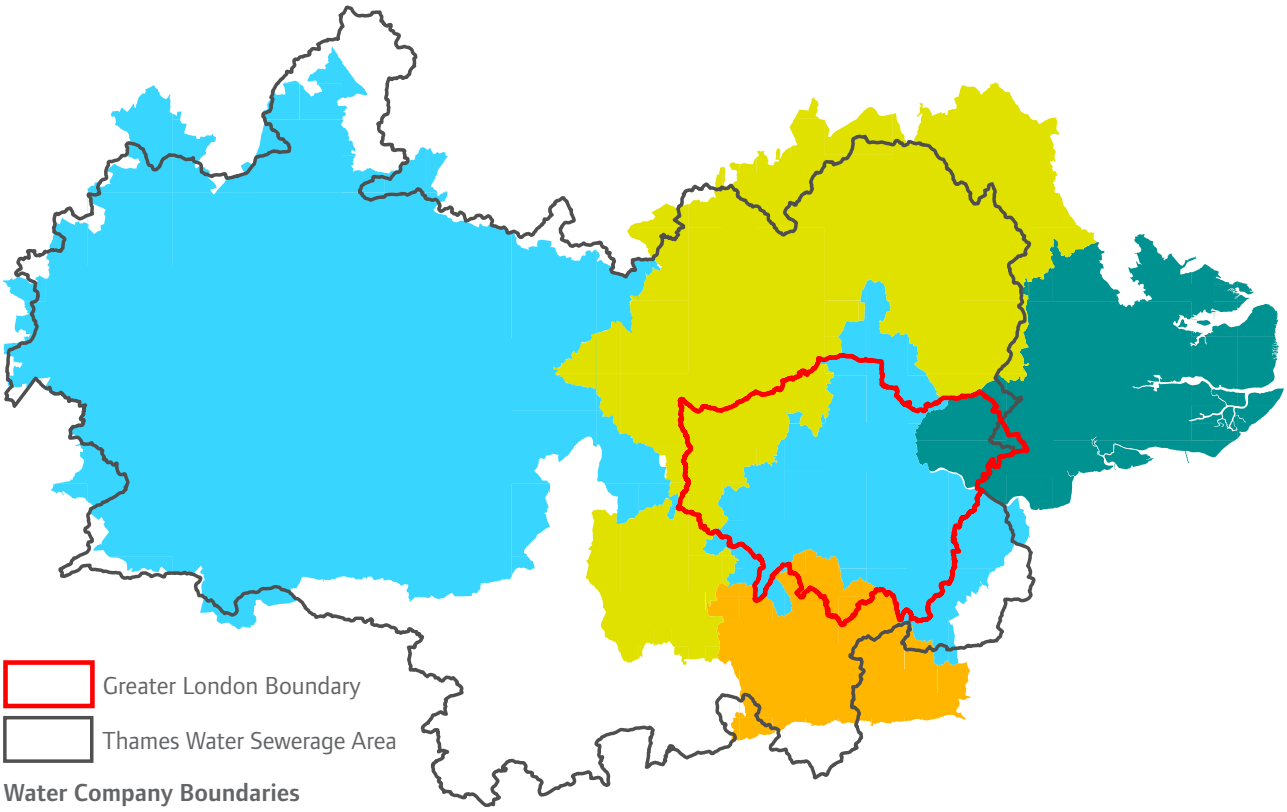


Table 1.1 Water companies operating in London

Company	Service
Thames Water	Water supply and sewerage
Veolia Water Central	Water supply only*
Essex & Suffolk Water (part of Northumbrian Water)	Water supply only*
Sutton & East Surrey Water	Water supply only*

*Thames Water provides sewerage services in these areas

affordable and cost-reflective water charges;

- cut greenhouse gas emissions; and
- embedded continuous adaptation to climate change and other pressures across the water industry and water users.

1.3.2 The integration of water management as a whole is central to the success of this strategy. The government has recognised the importance of taking an integrated approach to water management in various recent initiatives, such as the Water Act 2003 and Future Water, along with other strategies mentioned elsewhere in this document. The Global Water Partnership (a partnership between governments, water suppliers and others) defines integrated water resources management as a 'process which promotes the co-ordinated development

and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems.'

1.3.3 The government is expected to publish the Water White Paper, later this year. This will respond to the recent reviews of the water industry (Cave and Walker reviews) and set out reforms for the water industry. Government has also committed to focusing on the challenges facing the water industry such as climate change and population growth.

1.4 Governance of water

1.4.1 The roles of the various organisations involved in the governance of water are, in summary:

Water companies

Four water companies serve London (see Table 1.1 and Figure 1.1)

Regulators

These include:

Environment Agency, has a statutory duty to manage water resources. It does this by regulating the volume of water that water companies and other abstractors can take from the water environment. It also reviews water company Water Resource Management Plans to make sure that there is enough water for people, with an improved water environment. The Environment Agency is also responsible for water quality in the principal rivers, streams, canals and lakes and sets the standards for any discharges into them. It is also responsible for managing flood risk and minimising the impact of floods.

Water Services Regulation Authority (Ofwat), which is the economic regulator of the water industry. The primary duties of Ofwat are to ensure customers continue to receive safe, reliable, efficient and affordable water and sewerage services that promote positive social, economic and environmental impacts today, tomorrow and over the long term. Their goals are:

- Ensuring a fair deal for customers
- Keeping companies accountable
- Making monopolies improve
- Harnessing market forces
- Contributing to sustainable development
- Delivering better regulation.

Drinking Water Inspectorate, which is responsible for maintaining drinking water quality. It checks that water companies comply with their duty to supply wholesome water and other regulations. These checks entail audits of water companies' samples and tests as well as site visits, and the results are reported annually by the Chief Drinking Water Inspector. The Inspectorate also investigates complaints and incidents related to drinking water quality.

The Department for Environment, Food and Rural Affairs (Defra) has overall policy responsibility for water including water resources; water quality (including drinking water); water conservation; flood and coastal defence; inland waterways; and the water industry. It sets the regime within which the water companies and the regulatory bodies operate. It is the sponsoring department for the Environment Agency, Ofwat and the Drinking Water Inspectorate. The Department is also responsible for signing off the River Basin Management Plans.

Consumer Council for Water (CCWater) represents consumer interests in England and Wales. CCWater is a non-departmental public body, independent of regulators. Its general functions are, to:

- acquire and review as well as to publish information about consumer matters
- advise and inform public authorities on the views of consumers
- provide information to consumers
- monitor and challenge regulators and water companies.

Waterwise is a non-governmental organisation focused on decreasing water consumption in the UK and building the evidence base for large-scale water efficiency. They are the leading authority on water efficiency in the UK.

European Union, which has adopted numerous water-related Directives. In particular the Water Framework Directive[3] is designed to protect and improve the environmental condition of all waters. It applies to surface waters (including lakes, streams and rivers), groundwater, estuaries and coastal waters (out to one nautical mile). Its overall objective is consistent water management across Europe in order to:

- reduce pollution, prevent deterioration and improve the condition of aquatic ecosystems including wetlands
- promote the sustainable use of water
- help reduce the effects of floods and droughts.

The Floods Directive required Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015.

1.5 Links with other plans and strategies

Water industry plans

1.5.1 It is now a statutory duty for water companies of England and Wales to prepare, consult, publish and maintain a Water Resources Management Plan under new sections of the Water Industry Act 1991, brought in by the Water Act 2003. These plans detail how companies intend to meet their customers' need for water over the next 25 years while protecting and enhancing the environment. They are reviewed annually and revised every five years. In addition to Water Resource Management Plans, water companies also have drought plans which set out the range and sequence of actions companies would plan to take under various drought conditions. More on these plans can be found in chapter 2. Every five years, the water companies also prepare business plans for approval by Ofwat.

River Basin Management Plans

1.5.2 Under the EU Water Framework Directive (WFD) all inland, estuarial and coastal waters must aim to achieve 'good ecological status' by 2015, but only one of London's 47 water bodies has achieved this status. All river catchments (rivers, streams, lakes and the land that drains into them) are assigned to administrative River Basin Districts. Also water-dependent Protected Areas are designated under other EU Directives such as the Habitats Directive. The River Basin Management Plans published December 2009, by the Environment Agency, set out the environmental objectives and programmes of measures to meet the WFD requirements for all water bodies within River Basin Districts.

Mayoral strategies

1.5.3 The Mayor is responsible for strategic planning in London. Among his wide range of powers and duties, the Mayor must prepare a Spatial Development Strategy for London, known as the *London Plan*. This Plan:

- sets out an integrated social, economic and environmental framework for the future development of London, looking forward 15–20 years;
- integrates the physical and geographic dimensions of the Mayor's other strategies, and includes broad locations for change and provides a framework for land use management and development, which is strongly linked to improvements in infrastructure, especially transport;
- provides the London-wide context within which the London boroughs must set their local planning policies;
- sets the policy framework for the Mayor's involvement in major planning decisions in London;
- sets out proposals for implementation and funding;
- is London's response to European guidance on spatial planning and is a link to European Structural Funds.

1.5.4 The London Plan was published in summer 2011. The London boroughs' development plans must be in 'general conformity' with the London Plan.

1.5.5 The Mayor is required under the Greater London Authority Act 1999, as amended by the 2007 Act, to prepare a Climate Change Mitigation and Energy Strategy and a Climate Change Adaptation Strategy for London. Work in preparing the Adaptation Strategy has identified the increased risks faced by London of floods, droughts and high temperatures. These predicted effects emphasise the need to manage water resources wisely as the amount of water available decreases with increasing demand. The overlap on droughts and flooding is managed by the Water Strategy covering surface water and drainage related flooding, with the Adaptation Strategy covering tidal and fluvial flooding. A first draft of the Climate Change Adaptation Strategy was published in August 2008[4], and a public consultation draft was published in February 2010[5].

1.5.6 Other strategies prepared by the Mayor, which have an influence on water, include:

The Mayor's Municipal and Business Waste Strategies will be published later in 2011. Issues such as litter, fly tipping and the dumping of used cooking oil down drains can lead to serious problems such as blocked drains and flooding. In future there may be opportunities for combining the treatment of liquid sewage wastes with organic waste from households and businesses, to generate low carbon energy.

The *London Housing Strategy*[6] was published in February 2010. It includes objectives for more sustainable homes including reduced energy and water consumption and adapting to climate change.

The *Climate Change Mitigation and Energy Strategy* is expected to be published during October 2011, following a public consultation in Autumn 2010. The strategy sets a target of reducing London's carbon dioxide emissions by 60 per cent by 2025. The treatment and supply of fresh water and the treatment of sewage are users of energy and sources of greenhouse gas emissions. In addition, heating water in the home accounts for 18 per cent of London's carbon dioxide emissions from homes.

The *Transport Strategy*[7], published in 2010, sets out the Mayor's priorities and programmes for transport. A key issue is the impact of water mains replacement

and repairs on traffic congestion and the maintenance of the road drainage system to manage flood risk.

The *Economic Development Strategy*[8] was published in 2010. The Mayor's ambitions are for London to be the world capital of business, and to have the most competitive business environment in the world; to be one of the world's leading low carbon capitals, for all Londoners to share in London's economic success and for London to maximise the benefits of the 2012 Olympic and Paralympic games.

The *Biodiversity Strategy for London*[9] was published in 2002. It recognises the importance of the Thames and other waterways for biodiversity, and promotes the restoration of degraded tributary rivers.

1.6 Investing in infrastructure

1.6.1 In 1985, the then Greater London Council said in a report *London's Decaying Infrastructure: The Way Ahead*[10] that 'by many standards London now [1985] compares badly with other major European cities in terms of the quality of life for its residents and workers, and its attraction as a location for investment and growth… there is no doubt that the decline of much of London's infrastructure (particularly in Inner London) reinforces these problems.' It went on to say: In 1985, 'most of London's central sewer system [was] more than 70 years old, and almost half the water mains [were] over 75 years; a substantial proportion [was] over 100 years old'. Local authorities, House of Lord's Committees and the government had all expressed concern about the failure rates of water mains and sewer piping. The estimates of the level of necessary maintenance and renewal differed widely. The government's financing limits were reducing capital spending programmes.

1.6.2 There has been major investment, for example in the London Ring Main, for water supply. However, in many ways, 25 years after this report, the statistics have just moved on with half the water mains now over 100 years old. It is only relatively recently that Thames Water has been able to begin a major programme to replace the Victorian mains. To date, Thames Water has replaced over 1,300 miles of old and leaky water mains in London. Current consumers are bearing the cost of past underinvestment in maintenance.

1.6.3 The combined sewerage network, built under the direction of Sir Joseph Bazalgette, in the 1860s, is still carrying out its original dual function; namely to convey London's sewage to the major sewage treatment works and act as a surface water drainage system. A series of overflows take the sewage and surface water into the River Thames during heavy rainfall. However, an increase in sewage in the system, plus an increase in surface water from a larger and less permeable area, means that lower levels of rainfall can trigger overflows into the River Thames. So whilst standards in sewage treatment in general have improved greatly, the direct pollution of the River Thames from these overflows is no longer acceptable in the 21st century. Dismantling the 19th century combined sewer and replacing it with two separate ones would be prohibitively expensive. Instead there are other options to make the combined sewer system more sustainable (chapter 6).

1.7 Towards sustainable development

1.7.1 One of the primary reasons for preparing this Water Strategy is to move towards

greater sustainability in London. The government has charged the Environment Agency, and more recently Ofwat and the Consumer Council for Water, with a duty to promote sustainable development. One part of this is about achieving more with less. In doing so, it is wider than just the infrastructure and the provision of water services; it is also about people's attitudes and behaviours. As the demand for water rises across the whole of the south east of England, London can no longer rely solely on drawing in ever more water from the surrounding counties as its population grows. London has large scale potential to reduce water use across the city and improve its infrastructure for generations today and in the future - saving Londoners money on their energy bills. London must start to use the water that it already has more effectively.

1.7.2 There is a perception that 'efficient water use' is synonymous with 'a poorer service'. This is a myth. For instance, a toilet flush volume of four and a half litres can provide the same performance as a flush volume of seven litres. Dual-flush toilets are common in many countries but there are still relatively few in the UK. Similarly lacking is the use of reclaimed water (such as rainwater or grey water) for non-potable needs to improve water efficiency and to lessen the load on the drainage infrastructure and reduce flood risk.

1.7.3 Clear objectives and targets should support each step towards sustainable development. The Mayor wants to ensure that over the years to 2031, London excels among global cities - expanding opportunities for all its people and enterprises, achieving the highest environmental standards and quality of life and leading the world in its approach to tackling the urban challenges of the 21st century. The following three key objectives and principles for water management in London are therefore proposed as the basis for translating this vision into specific actions in the later chapters of this strategy.

Objectives

To use the water London already has more effectively and efficiently.

1.7.4 The majority of London's water supplies come from the rivers Thames and Lee upstream of the tidal reaches: these freshwater catchments are a critical part of London's water supply chain. As the demand for water rises across the whole Thames basin, it make sense to focus on reducing water use within London to avoid demanding more water from outside sources that will come under increasing pressure. Londoners have the potential to use water more effectively and efficiently, reducing leakage, reducing demand for water and simultaneously reducing carbon emissions.

To minimise the release of untreated wastewater and diffuse pollution into the water environment.

1.7.5 Untreated wastewater can find its way into London's rivers and watercourses via the drainage system. The design of the combined sewer system and sewage treatment works allow this under storm conditions in order to prevent flooding. Incorrectly connected drains adds to the pollution of rivers and canals. Rainwater runoff in an increasingly paved London carries yet more pollutants – so called 'diffuse' pollution because it has no singe source – into ponds, lakes and streams. All

these have serious consequences for health, biodiversity, tourism and the overall quality of life.

To manage, and where possible reduce, the threat of flooding to people and their property.

1.7.6 As the climate changes, London needs to maintain and improve its resilience against all sources of flooding. Surface water flood risk probably represents the greatest short term climate risk to London, but groundwater and sewer flood risks are often overlooked. These problems are also likely to get worse as a result of climate change. We need to focus on identifying where the risks are greatest and prioritising our efforts there, but recognising that we cannot protect everyone all the time, and therefore we must help Londoners recognise and own some of these risks.

To reduce the greenhouse gas emissions produced from supplying water and treating wastewater.

1.7.7 As previously noted, the supply of water and treatment of wastewater is a significant contribution towards London's greenhouse gas emissions. Tackling these sources will be important to achieving the 60 per cent carbon reduction target. Furthermore, rather than being a source of greenhouse gases, sewage waste could actually become a source of low-carbon energy.

Principles

- *Delivering practical changes locally.* There is significant potential across London to improve our water efficiency. At a time of growing demand and decreasing supply, it makes more sense to use the water we have wisely.
- *Maintaining a long-term perspective on the value of water and London's water infrastructure.* Placing a value on water that represents the true economic, social and environmental costs of its supply and treatment, helps to enable decisions that are sustainable for current and future generations.
- *Promoting consumer awareness, helping consumers to avoid unnecessary consumption and developing a fair system for paying for water.* There are many opportunities to educate Londoners about where their water comes from, how we can use the water that we already have more effectively and efficiently, and how we can all benefit from doing so. Without this, we will depend on developing new water resources outside of London and putting greater pressure on existing supplies.
- Working together. Working together avoids duplication, minimises conflicts and achieve better results.

1.8 Implementation and monitoring

1.8.1 The majority of the actions proposed or referred to in this strategy are being, or will be, implemented by organisations other than the Mayor of London. The role of the Mayor is to set out his vision of how Londoners can be better served, and to work with the organisations responsible for providing or regulating the services to achieve the optimum outcome.

1.8.2 This strategy does not propose any additional monitoring arrangements. The returns submitted by every water company to Ofwat in June each year, known as the *June Returns*, provide a mass of data which is then made available on the Ofwat web site. This, for example, is the source of the information provided in Table 2.6 Water supply statistics for London. It's possible that these monitoring arrangements may change in the future. The Environment Agency also requires water companies to provide annual reviews

of their water resources management plans for environmental monitoring purposes. The Environment Agency publishes a wide range of information on, for example, water resources and river pollution incidents.

1.9 Review of the Water Strategy

1.9.1 As stated previously, there is no requirement for the Mayor to produce this strategy, but he has chosen to do so because he feels that Londoners' interests could be better served. The Mayor will monitor the implementation of the policies and actions in the strategy. The Mayor will reflect on how the publication of the forthcoming Water White Paper[11] in the winter of 2011 and any subsequent revision of government policy, may affect the strategy. In addition, when the Localism Bill (2011) becomes law, a new London Environment Strategy will replace this strategy and amalgamate it with the other statutory strategies and plans concerning the environment that the Mayor is required to publish under the GLA Act 1999.

CHAPTER TWO

PRESSURE ON WATER RESOURCES

2.1 Introduction

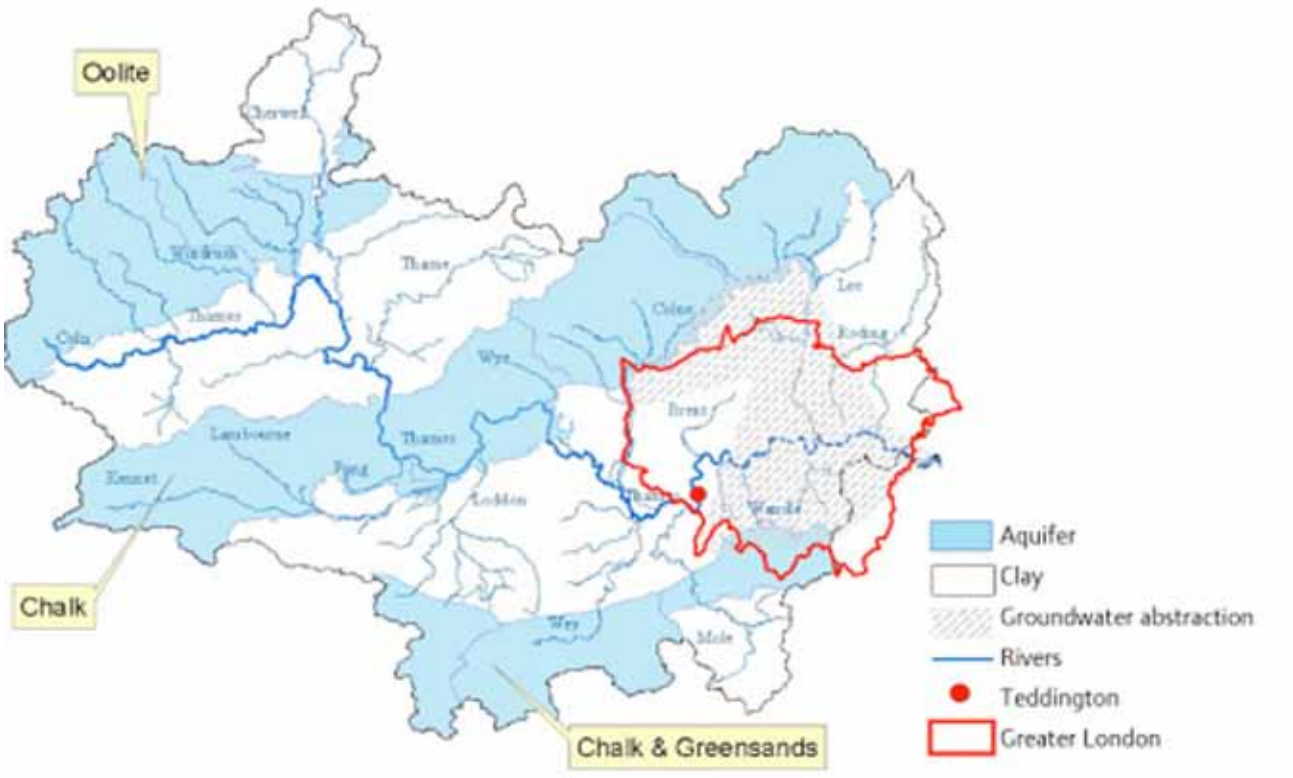
2.1.1 Water is essential. We drink it. We use it in our homes and gardens, in commerce and industry. Over the years Londoners have become accustomed to having as much high quality water as they want, when they want it.

2.2 Where we get our water

2.2.1 The Thames Basin is the largest river basin in the South East of England. As such, it offers a more dependable supply of water during droughts than other catchments in the South East of England because it is able to collect more water. In particular, London benefits from its location on the lower stretch of the River Thames. By the time the River Thames reaches London, the flow has gained from many smaller rivers and streams and as well as from groundwater. The Chalk, Greensand and Oolite aquifers of the Thames catchment, shown in Figure 2.1, are important sources of water for the communities in those areas but they also provide the 'baseflow' into the tributaries of the River Thames. They help sustain river flows during dry summer months. London water sources are shown in more detail in Figure 2.3.

London's annual rainfall is surprisingly low when compared to other capital cities (see Table 2.1) and the rest of England and Wales. Combined with the large population, this means that the amount of water available per person is less than in many hotter and drier Mediterranean and African countries. However, the rainfall is fairly uniform throughout the year and evaporation is modest. London also benefits from the contribution of rainfall in the River Thames catchment as a whole to

Figure 2.1 Regional water sources



Teddington Weir is the point at which the freshwater River Thames flows into the tidal River Thames.
Source: Environment Agency

both the flow in the Thames and recharging the aquifers.

2.2.2 Of the rain that falls in the Thames catchment, two thirds is either lost to evaporation or used by growing plants (transpiration). Of the water that is then 'available', 55 per cent is abstracted for use, one of the highest amounts in the country[12]. All the available water cannot be taken because some must be left to protect the natural environment including fish, river and riverside plants and water birds. Of all the water abstracted, 82 per cent is for public supply and out of that half is supplied to households and a quarter to non-households (the remainder being lost through leakage). This sequence is shown diagrammatically in Figure 2.2.

2.2.3 The majority of London's water supplies come from the rivers Thames and Lee, with about 70 per cent of all the water taken from the freshwater River Thames upstream of Teddington Weir. It is then stored in reservoirs around the capital. The remainder is mostly abstracted from the 'confined chalk', which is concealed below the clay of the London basin, shown by the grey shaded area on Figure 2.1. The various sources are shown in more detail in Figure 2.3.

Table 2.1 Average city rainfall comparisons

City	Rainfall (mm/year)
London	590
Jerusalem	597
Istanbul	629
Mexico city	662
Edinburgh	664
Thames Region	690
Newcastle	700
Dublin	740
Rome	791
Manchester	809
England and Wales	897
Sydney	1226

Source: City rainfall data compiled by Waterwise from relevant country MET office websites.

Figure 2.2 What happens to rainfall in the Thames catchment

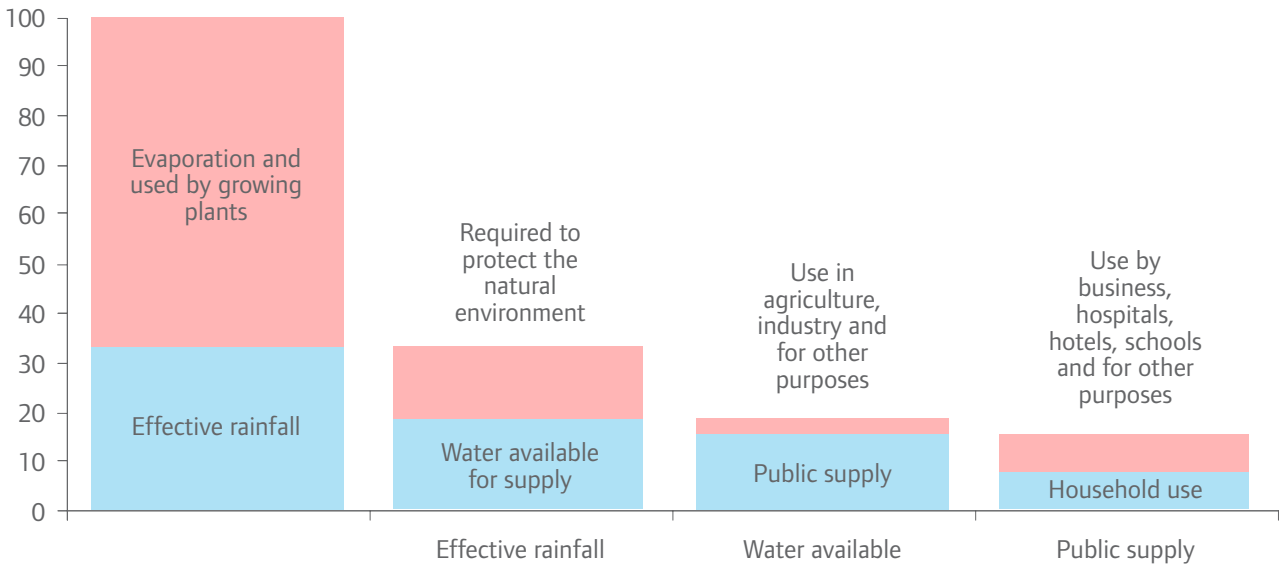
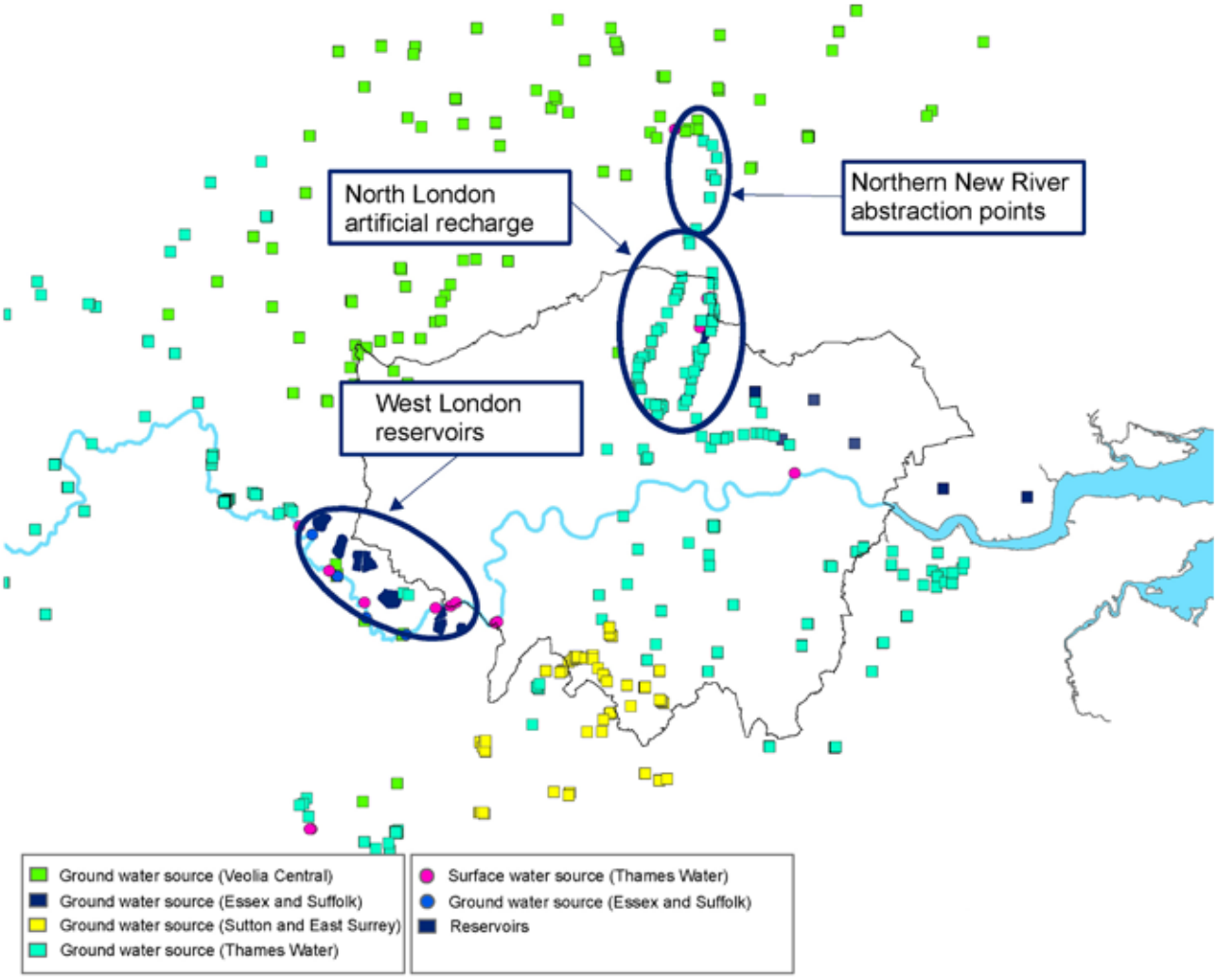


Figure 2.3 London water sources, Environment Agency 2011



2.2.4 In 2007, the Environment Agency published a map[13] of England showing areas where household demand for water is a high proportion of the available rainfall, both now and in the future. This map of 'water stress', shown in Figure 2.4, highlights that the whole of the South East of England is 'Seriously' water stressed, meaning that the demand for water is already having a negative impact on the environment.

2.3 Our growing demands

London's population has steadily grown from a low point in the mid 1980s to 7.62 million people today and is expected to keep growing to reach about 8.82 million by 2031 (see Figure 2.5). The number of households is expected to grow faster than the overall population as the average household size is falling, due mainly to later marriage, fewer children, more divorce and longer lives. The current number of London households (3.20 million in mid-2007) is likely to grow to 3.83

Figure 2.4 Water Stress map of England (Environment Agency)

1 Anglian Water
2 Bournemouth and West Hampshire Water
3 Bristol Water
4 Cambridge Water
5 Essex & 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
18 Veolia Central Water (formally Three Valleys Water)
19 United Utilities
20 Wessex Water
21 Yorkshire Water
22 Anglian Water

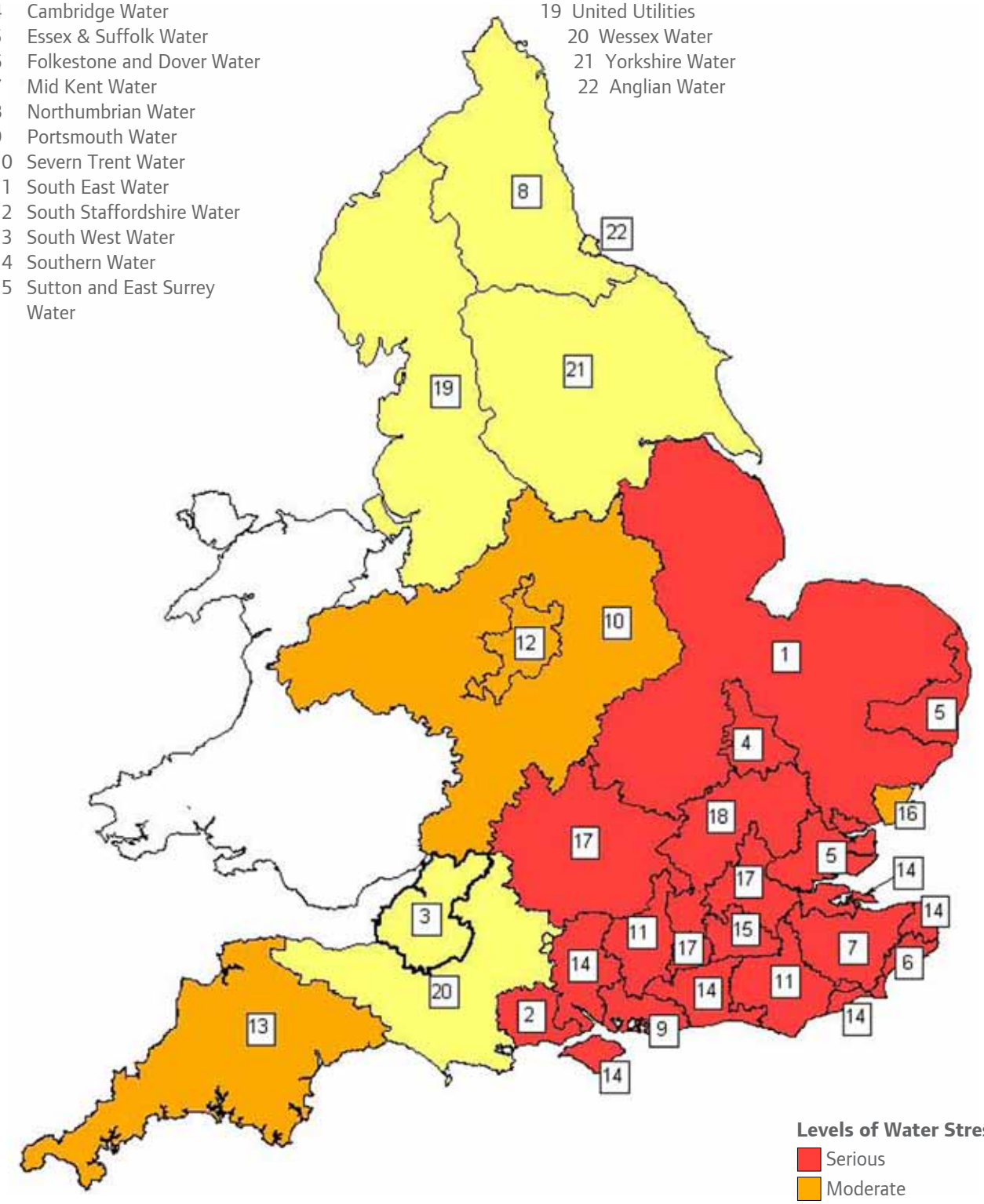
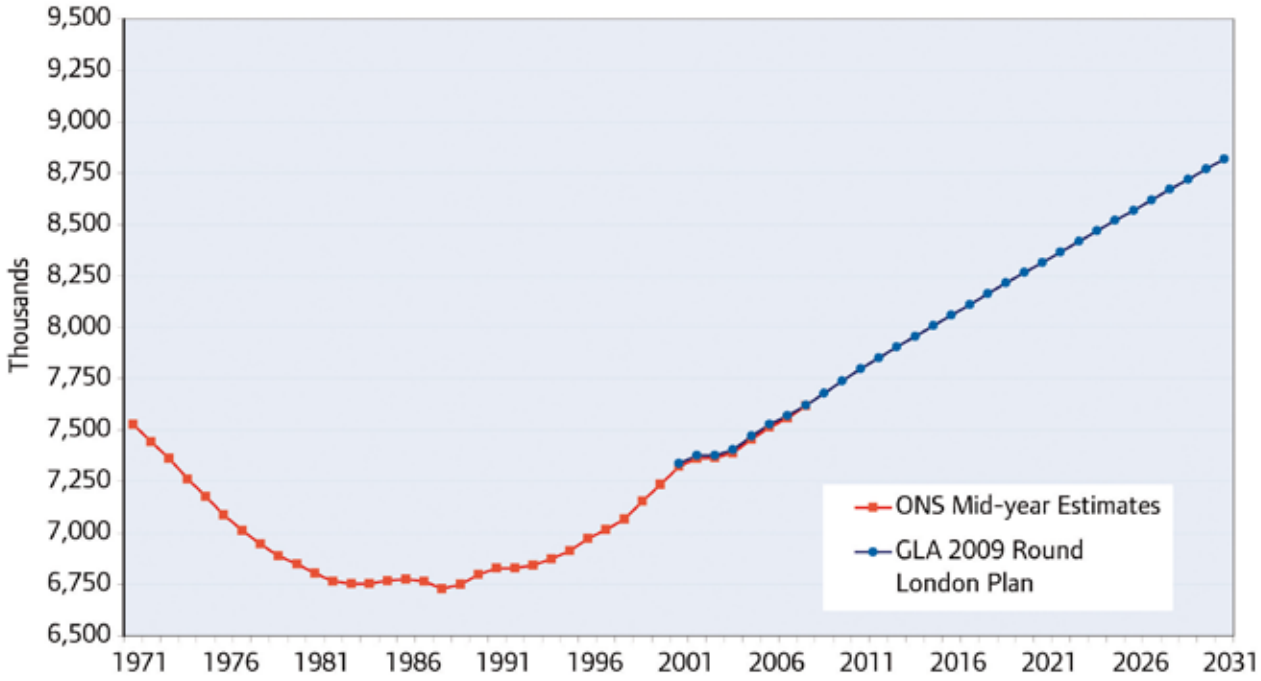


Fig 2.5 London's population projection 1971-2031[14]



Source: Greater London Authority DMAG.

million by 2026. In order to accommodate this growth, the current London Plan sets a target of building a minimum of 32,210 net additional new homes per year. The growth in London's population means more water will have to be supplied, more sewage treated and sludge disposed of, and construction of more homes for this growing population will mean more surface water runoff.

2.3.1 Water use rose more or less continuously during the 20th century. The fall in industrial demand for water has been more than outpaced by the rise of household use. During 2009/10 each Londoner used an average of 167 litres of water a day compared to the national average of 146 litres per person per day (Figure 2.6). This headline figure conceals many variations because households:

- have different appliances and fittings (see Table 2.2)
- have a different number of occupants at different stages of life (see Table 2.3)
- have different attitudes to water use
- have a range of lifestyles that reflect in their water use.

The variation in demand from people with water meters compared to people without water meters can be stark. In Sutton and East Surrey Water's Sutton Water Resource Zone, the average per person consumption per day is around 40 litres greater for households without meters compared to households with meters.

2.3.2 Water demand is not just about a growing population. The number of occupants in a household also influences individual water use. Table 2.3 shows how household water use differs depending on the number of

Figure 2.6 Domestic Water Use in London

Table 2.2 National average domestic water use

Household water use	Fitting or appliance	Range of household water use				
		Litres/person/day			Percentage used	
		Low	High	Median	Low	High
Toilet use	Toilet use	35	45	39	22%	31%
Personal washing	Bath	21	35	51	32%	34%
	Shower	6	20			
	Hand basin	10	15			
Drinking water	Drinking water	2	2	2	1%	2%
Clothes washing	Washing machine	14	25	22	12%	13%
	Sink	0.6	1.3			
Dish washing	Dishwasher	1	5	12	7%	8%
	Kitchen sink	7	10			
Car washing	Car washing	0.9	1.2	1	1%	1%
Garden watering	Sprinkler	0.3	4	9	3%	7%
	Other means	4	10			
Miscellaneous*	Miscellaneous	13	32	20	11%	16%
Median water use, and high and low percentage variation				**156**	**89%**	**112%**

Source: Environment Agency

* The miscellaneous category includes filling swimming pools and ponds, as well as cooking, cleaning and watering houseplants[15].

people. It shows that, in the context of water use, larger households use less water per capita. This conflicts with the trend towards smaller size households in London.

2.3.3 Generally households with a meter use less water than those without (see chapter 3). Fewer than one in four households in London has a water meter. This lags behind much of the rest of the developed world where metering is the norm. For instance Australia, Austria, Denmark, Finland, France, Germany, Japan and Switzerland already have 100 per cent metering of single-family houses[16]. As a result, companies providing water to Londoners have limited data on how much households are using in different areas, and what factors influence that use. Their ability to influence the household use of water, and indeed their ability to measure and manage their use, is low. It is also in contrast to gas and electricity, where householders have always paid for their consumption by the volume used.

2.4 Water companies' responsibilities

2.4.1 To avoid running out of water, enforcing drought restrictions too frequently, or damaging the environment by abstracting too much water (for example, by reducing river flows to a level where fish cannot survive), it is essential to balance supply and demand. During most years, including most summers and dry periods, there is sufficient water in the River Thames and River Lee together with groundwater to meet London's needs. However, during prolonged periods of low rainfall, supplies are limited and drought actions may be required. Typically it takes two winters of below average rainfall to necessitate drought actions. Winter rainfall is particularly important because it is during the winter that groundwater stores are filled so that they can support river flows and abstraction in the next spring and summer. Water companies have both Water Resource Management Plans (WRMPs) for the long-term and Drought Plans to manage supplies in times of shortage.

2.4.2 WRMPs set out how each water company intends to balance supply and demand, and how it intends to provide sufficient water to meet demand and protect the environment over the next 25 years. Water companies update their plans every five years, in line with the price review process (see chapter 4). Since 2007, these plans have been a statutory requirement under the Water Act 2003. To date, three of the four companies supplying London with water have had their WRMPs approved by the Secretary of State. Thames Water has been involved in a public inquiry into their WRMP and they aim to publish a draft final plan in January 2012. It is worth noting that whilst there is a statutory requirement to produce a WRMP, there is no statutory requirement to implement it.

2.4.3 The Water Act 2003 also requires all water companies to have sound Drought Plans in place so that they can continue to supply water to their customers when sources are depleted. Table 2.4 highlights the different actions that water companies can take to conserve water resources during a drought.

2.4.4 In their Drought Plans and their WRMPs, the water companies specify the expected frequency of using drought measures. The industry commonly refers to this as a company's 'levels of service'. A supply-demand deficit arises if a company has insufficient water available to meet its customers' reasonable needs in a dry year.

Table 2.3 Water consumption in households of different sizes

Number of occupants	Individual water consumption (litres/person/day)	Reduction per person compared to a single person household
Single occupancy household	207	0%
2 people	172	17%
3 people	148	29%
4 people	135	35%
5 people	131	37%
6 people	127	39%

Source: Thames Water

Table 2.4 Drought actions available to water companies

Customer measures	Engineering measures
Promote campaigns and water awareness. Introduce temporary water use restrictions e.g. hosepipe and sprinkler bans. Seek restrictions on non-essential uses Seek rota cuts (e.g. restricting water supplies to certain days or times or to a much lower pressure) or standpipes (i.e. pipes in the street from which people have to collect water).	Use alternative or unused sources. Increase efforts to reduce leakage. Introduce bulk transfers (e.g. large transfers of water between water companies). Improve the distribution network. Lower groundwater pumps. Seek additional sources of water. Modify discharge regimes (e.g. suspend or modify an obligation to discharge 'compensation water' into a canal, river or stream).

Note: See water companies' Drought Plans for details on how and when companies would apply these measures.

Table 2.5 Companies' levels of service – water supply restrictions

Water Company	Hosepipe ban	Drought order/permit	Rota cuts/standpipes
Thames	Once in 20 years	Once in 20 years	Never
Veolia Water Central	Once in 10 years	Once in 20 years	Unacceptable
Essex & Suffolk	Once in 20 years	Once in 50 years	Never
Sutton and East Surrey	Once in 10 years	Once in 20 years	Once in 100 years

A dry year demand is the utmost demand a company can meet without having to introduce restrictions at any time in the year, but there is no set definition of what constitutes a 'dry year'. Table 2.5 details the levels of service commitments for the four water companies serving London set out in their five-year business plans.

2.4.5 Studies carried out by Thames Water with its customers suggest that they do not regard a reduction in the frequency of hosepipe bans as a priority.

2.4.6 Under current legislation[17], a water company can temporarily ban or restrict the use of hosepipes for watering private gardens or

washing private motor vehicles if, in its view, there is or could be a serious shortage of water for it to distribute to its customers. When hosepipe bans were last introduced in the summer of 2007, there were complaints (including many letters to the Mayor) that public gardens were still being watered and paving washed down. The government, in the Flood and Water Management Act 2010 widened the range of non-essential uses of water that can be controlled by water companies. These now include cleaning paths, patios or other artificial outdoor surfaces using a hosepipe. This increases the ability of water companies to manage demand in times of water shortage, particularly in the early stages of a drought or where supplies of water available for distribution deteriorate rapidly.

2.4.7 Water companies divide their supply area into 'water resource zones' (WRZ) which are defined on the basis of good water supply connectivity. Customers in each zone experience the same risk of water restrictions. There are six zones covering London, which also supply water outside London. The current dry year annual average situation for these zones is:

Sutton and East Surrey Water.

- East Surrey WRZ: Critical peak deficit until 2011/12. No dry year annual average deficit
- Sutton WRZ: No deficit

Essex & Suffolk Water

- Essex WRZ: Deficit until 2013/14

Thames Water

- London WRZ: No deficit (due to desalination plant)

Veolia Water Central

- Southern WRZ: No deficit
- Central WRZ: No deficit

2.4.8 The opening of Thames Water's desalination plant at Beckton has enabled Thames Water to forecast a score of 100 for its security of supply index for its London resource zone. A former deficit of 160 Ml/d, equivalent to the demand of about a million people a day[18], has been largely met by the desalinisation plant. In practice, the desalination plant is costly to run and would only be used in emergency.

2.4.9 The security of supply index is an indicator of the extent to which the company is able to guarantee provision of its planned levels of service. A company showing a supply-demand deficit (or in other words having a security of supply index of less than 100) means that its customers face a higher risk of water restrictions than that stated in the company's level of services (see Table 2.5). Yet a deficit does not imply that restrictions are inevitable in a dry year, as it is more of an indicator of 'theoretical risk'. However, there will be a greater risk of restrictions being imposed than if there were no deficit.

2.4.10 Table 2.6 summarises the companies' water supply statistics. The figures in brackets show the London proportion of the company-wide totals. The distribution loss is the volume of water lost by a company through leaks in its mains network. These losses together with the leaks on the customers' supply pipes add up to the company's total leakage. While only 71 per cent of Thames Water's domestic customers live in London, 75 per cent of Thames Water's distribution losses occurred in London. Alternatively, Thames Water supplies 79 per cent of London's water but accounts for 86 per cent of all distribution losses.

2.4.11 The Mayor has established a partnership known as the London Water Group, to

Table 2.6 Water supply statistics for London (2009/10)

	Thames	Veolia Water	Essex & Suffolk	Sutton & East Surrey	Total
Estimated population served (000) (London percent of company total)	6,166 (71.1%)	1,019 (32.5%)	537 (29.6%)	293 (44.9%)	8,015
Overall water supplied (million litres per day including leakage) (London percent of company total)	1,875 (72.9%)	277 (33.5%)	136 (29.8%)	68 (43.3%)	2,356
Proportion of London's water distributed by company	79.6%	11.8%	5.8%	2.9%	100%
Household water consumption (litres/person/day)	167	169	160	165	167
Proportion of households with water meters in London	22.6%	35.4%	44.7%	30.9%	26.0%
Distribution loss (million litres per day) Percentage loss (London percent of company total)	362 19.3% (74.8%)	34 12.3% (37.1%)	14 10.6% (31.8%)	7 9.9% (44.8%)	418 17.7%
Total leakage (million litres per day) Percentage loss (London percent of company total)	504 26.9% (74.9%)	52 18.9% (36.0%)	21 15.7% (32.9%)	11 16.0% (45.0%)	589 25.0%
Leakage per property (litres per day)	196	135	93	93	177
Security of supply index Apr 2010	100	100	85	100	
Security of supply index Apr 2011	100	100	82	97	

Security of supply index is a measure of each company's ability to supply customers in dry years without imposing demand restrictions such as hosepipe bans. 100 is the highest index score. The index relates to the whole company.
Source: Water companies' June Returns to Ofwat
The figures in brackets show the London proportion the company-wide totals.

bring together representatives of the four water companies serving London, the water industry regulators (Environment Agency and Ofwat), local government (London Councils), consumer interests (Consumer Council for Water), Waterwise, Transport for London and other stakeholders. Its purpose is to inform the development of this strategy, investigate London-specific research and coordinate activities between the various organisations.

2.5 Water efficiency

2.5.1 Ofwat has introduced a mandatory water efficiency target from 2010 to 2015. The Base Service Water Efficiency (BSWE)[19] target requires water companies to work with customers to save one litre of water per household per day per year. In London, this represents 0.59 per cent of an average household demand. In addition to the BSWE there is an enhanced water efficiency level

(Sustainable Economic level of Water Efficiency), which is optional.

2.6 The effects of drier, hotter summers and wetter winters

2.6.1 In the longer term, water resources will also be affected by drier summers and a greater potential for droughts. The UK Climate Impacts Programme (UKCIP) has reported that the UK has warmed by nearly one degree since 1914, whilst we have witnessed seven of the ten warmest years on record since the beginning of 1990. A separate analysis of London's climate record has identified that summer temperatures in London have risen at an average rate of 0.73ºC per decade over the last thirty years[20].

2.6.2 In June 2009, the UKCIP published projections outlining how the UK's climate would change over the coming century. These project that we are very likely to face warmer, wetter winters and hotter, drier summers. The scenarios, know as UKCP09, project climate changes according to three greenhouse gas emissions scenarios. The 'medium emissions' scenario projects that by the middle of the century London is likely to experience:

- an average 18 per cent decrease in summer rainfall (see Figure 2.8) (but it is unlikely to be more than a 39 per cent decrease)
- an average 15 per cent increase in winter rainfall (but it is unlikely to greater than a 39 per cent increase) often becoming heavier. The annual amount of rainfall does not change
- summer mean temperatures may rise on average by 2.7 degrees and winter temperatures by 2.2 degrees
- summer cloud cover may decrease by up to ten per cent.

2.6.3 These changes to the seasonality of rainfall, increases in temperature and decreases in summer cloud cover will have a dramatic effect on the availability of, and demand for water:

- Heavier rainfall can run off the ground rapidly, limiting time that is needed for water to penetrate into the ground and top up our groundwater
- Drier summers will mean that waterways will have low flows and be more sensitive to any pollution
- Increased frequency of extreme weather including droughts could affect the choice of supply and demand management measures towards those that are more climate resilient
- Warmer winters will lengthen the growing season, increasing the demand for water from vegetation (whilst also reducing the 'winter recharge period' for our aquifers)
- Hotter summers will increase the amount of water lost by evaporation
- Increased subsidence and heave from fluctuating soil moisture will lead to more broken water mains, though warmer winters may reduce the number of breaks due to frozen ground or frozen pipes
- Heavier rainfall may overcome surface water drainage networks, causing flooding.

2.6.4 Water companies will be expected to use the new projections to assess the impacts of climate change, including wetter winters and drier summers on their WRMPs. Thames Water is reviewing the UKCP09 projections to undertake a sensitivity analysis of its proposals in its WRMP. They may use the analysis as evidence to ask Ofwat for further funding to increase the number of water meters it wants to fit over the next three years.

Figure 2.7 Projected changes in monthly temperature for London. Medium emissions scenario (50 per cent probability level)

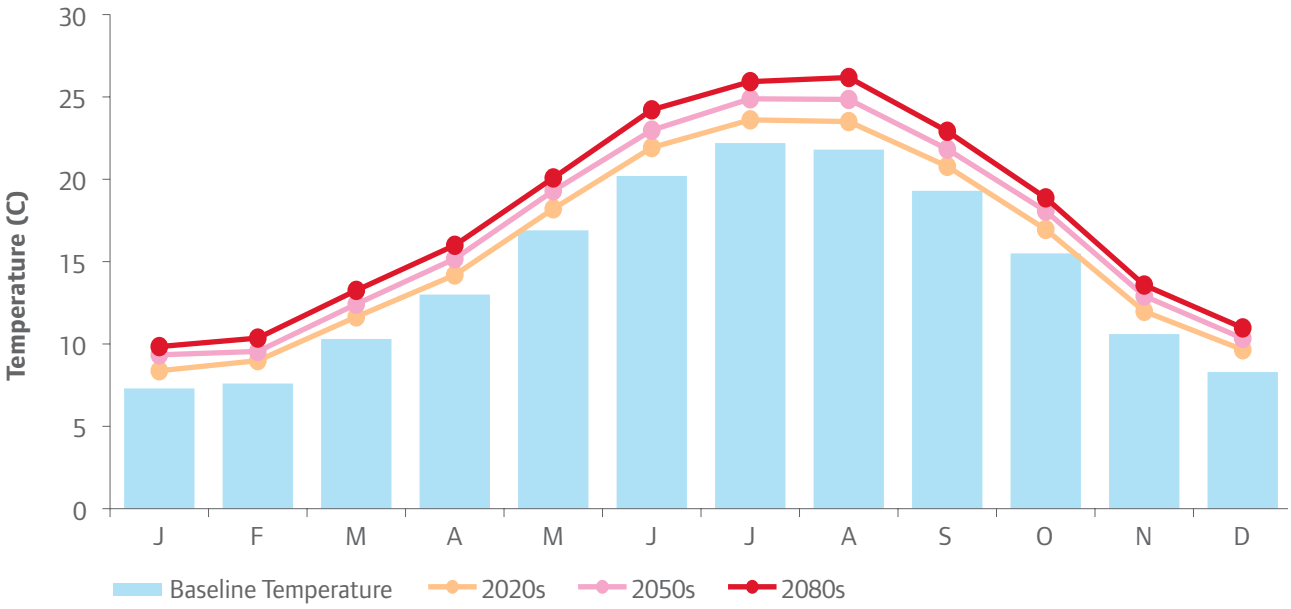
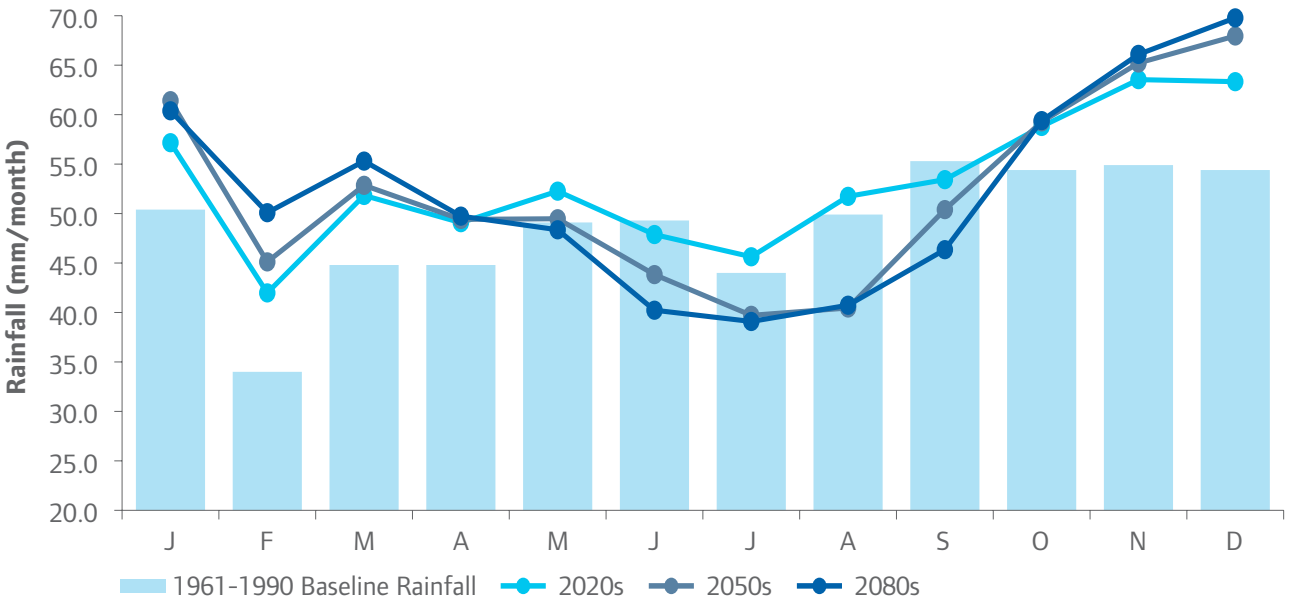


Figure 2.8 Projected changes in monthly precipitation for London. Medium emissions scenario (50 per cent probability level)



2.7 Climate Change Act 2008

2.7.1 The Climate Change Act 2008 addresses the issue of adaptation to the full range of climate change risks. It introduces a power for the Secretary of State to require public bodies and statutory undertakers, including water companies and the Greater London Authority, to carry out their own risk assessments and make plans to address those risks. In addition, the government must report at least every five years on the risks to the UK of climate change, and publish a programme setting out how these impacts will be addressed.

2.8 Increasing supply

2.8.1 The Environment Agency's *Water for the Future – Managing water resources in the South East of England*[21] concluded that by 2035 demand for water in the South East of England would significantly outweigh supply unless we reduce the amount of water we use or find new resources. It notes 'we can build new resources, but we need to ask ourselves how long we can go on doing this and how resilient and flexible to climate change these options will be looking forward 100 - 200 years. We need to try harder to reduce the amount of water we use by changing our behaviour, reducing waste and making better use of new technologies'.

2.8.2 The water company WRMPs identify seven main options to increasing supply:

a Increasing abstraction
b Desalination
c Increasing reservoir capacity
d Wastewater treatment
e Raw water transfers
f Groundwater recharge
g International import of water.

Increasing abstraction

2.8.3 Water companies must have an abstraction licence to take water from rivers or aquifers. The Environment Agency decides whether existing abstractions are causing unacceptable harm to the environment, such as reducing a river's flow to an extent that the fish stock cannot survive, or how much more abstraction can take place. In doing so, it prepares Catchment Abstraction Management Strategies (CAMS) that assess the status of local sources.

2.8.4 The three main CAMS covering London are the Thames Corridor CAMS, the London CAMS, and the Roding, Beam and Ingrebourne CAMS[22]. The first of these studies shows that the Thames upstream of the weir at Teddington is over-abstracted. The volume of water taken out of the lower Thames can account for as much as 50 per cent of the natural flows in a normal summer, rising as high as 80 per cent in droughts. Taking any more water could increase the salinity downstream of Teddington Weir, and that would affect which species of fish can thrive in the upper estuary.

2.8.5 The other two CAMS show that there are very few opportunities in London, and indeed across much of the Thames Region, to take any more groundwater or surface water in summer months. In many of the Thames's freshwater tributaries, low river flows can affect habitat and water quality and thereby reduce biodiversity. The EU Water Framework Directive requires nations to undertake actions to improve the ecological potential of their water bodies. As noted previously, one of the main impacts on rivers in the South East is low summer flows, accentuated by abstractions. The Environment Agency is currently using UKCP09 to assess how climate change may affect future summer river flows and whether to impose 'sustainability reductions' on water companies and other water abstractors to protect these watercourses and comply with the EU Directive. These reductions are expected to be significant in the South East and are likely to dramatically affect the next round of water company resource planning.

Desalination

2.8.6 Thames Water opened its Beckton desalination plant in July 2010 to address the deficit in its London resource zone. The plant takes water from the Thames at low tide (when it is least salty) and uses a technology called reverse osmosis to produce drinking water. The plant will only operate when

demand cannot be met from conventional water sources[23]. At full operation, the plant could supply 150 million litres of water a day; enough water to supply 400,000 homes.

2.8.7 Desalination is a very energy intensive process. At full operation, the desalination plant requires enough energy to power 8,000 homes. A biodiesel electricity plant has been built to offset the carbon emissions of the desalination plant. The power plant is designed to run '24/7' and the output will normally be used to power the standard sewage treatment processes at Beckton, with a small amount going to the desalination plant to keep it in a state of 'preparedness'. The power plant will, over time, balance the power requirement of the desalination plant but it will not be able to meet the peak power demand of 18 megawatts on the occasions that it is in full operation.

A new reservoir

2.8.8 Some major new resource developments, for example a reservoir, can take in excess of 20 years from conception through to operation. Thames Water believes that it will need a major new source of water to meet the forecast demand by 2026. The preferred option in its revised draft WRMP, which was examined at a public enquiry, is a new storage reservoir in the Upper Thames area, outside of London. It would be filled by pumping water from the Thames at times of high river flows[24]. The revised draft WRMP proposed a 100 Mm^3 reservoir, but the outcome of the public enquiry was that the company should revise the appraisal of its options and plan for less surplus. A 'draft final' plan is due to be published in January 2012 and it is expected this will include a smaller resource of some kind.

2.8.9 Research by the Tyndall Centre[25] found that increased reservoir storage capacity has the potential to compensate for increasingly intermittent flows, but that even construction of the maximum feasible storage capacity will not be sufficient to adapt to the changing climate and growing population unless per capita demand is reduced.

2.8.10 A group opposed to the reservoir has proposed alternatives, including water transfer from the River Severn to the River Thames and effluent reuse. Thames Water is expected to investigate these options more closely in the new plan.

Waste water effluent reuse

2.8.11 It is clear from what has been said previously that there is little scope for developing new sources of river water or groundwater in and around London. However, reclaiming wastewater from sewage treatment works (referred to as 'effluent reuse') is a significant potential new resource that Thames Water and other companies are currently investigating. It would be a dependable source but it may have an 'image' problem. Ensuring drinking water integrity, understanding customer attitude, and minimising the increased energy consumption are the key associated issues.

2.8.12 Thames Water is investigating 'indirect reuse', which is where the reclaimed water would be returned to a watercourse and then abstracted into storage to blend with other water before treatment and supply. This provides an important buffer between the effluent discharge and the water-supply customer and mirrors what happens elsewhere in the catchment. However, the catchment areas of the London works are heavily urbanised with significant

proportions of industrial effluents. This is in marked contrast to the Langford Scheme in Essex where the effluent is derived from domestic customers.

Raw Water Transfers

2.8.13 'Raw' water is untreated water from a river, canal, reservoir or aquifer. Raw water transfers are therefore transfers of untreated water between water companies. Fig 2.9 depicts the major existing transfers in and to the east of London. None of the London's water companies' existing WRMPs propose new large-scale water transfers for water supply prior to 2035 (the current planning horizon). According to the Environment Agency, investigations into large-scale raw water transfers show that the financial and environmental cost moving water from the north of England, or Wales, to the south of England is higher than other options, meaning that such proposals are unlikely to be necessary to meet current forecast demand. However, there will be ongoing reassessments of the full range of options for future strategic water needs. The option of transferring water through the canal system has also been assessed by London's water companies to some extent. For example, Thames Water has considered, and is doing further work to assess raw water transfer via canal from the Midlands to Oxfordshire and from the River Severn via the Cotswolds Canal to the River Thames. The Water White Paper is expected to encourage water companies to investigate raw water trading in the next Asset Management Planning round.

Groundwater recharge

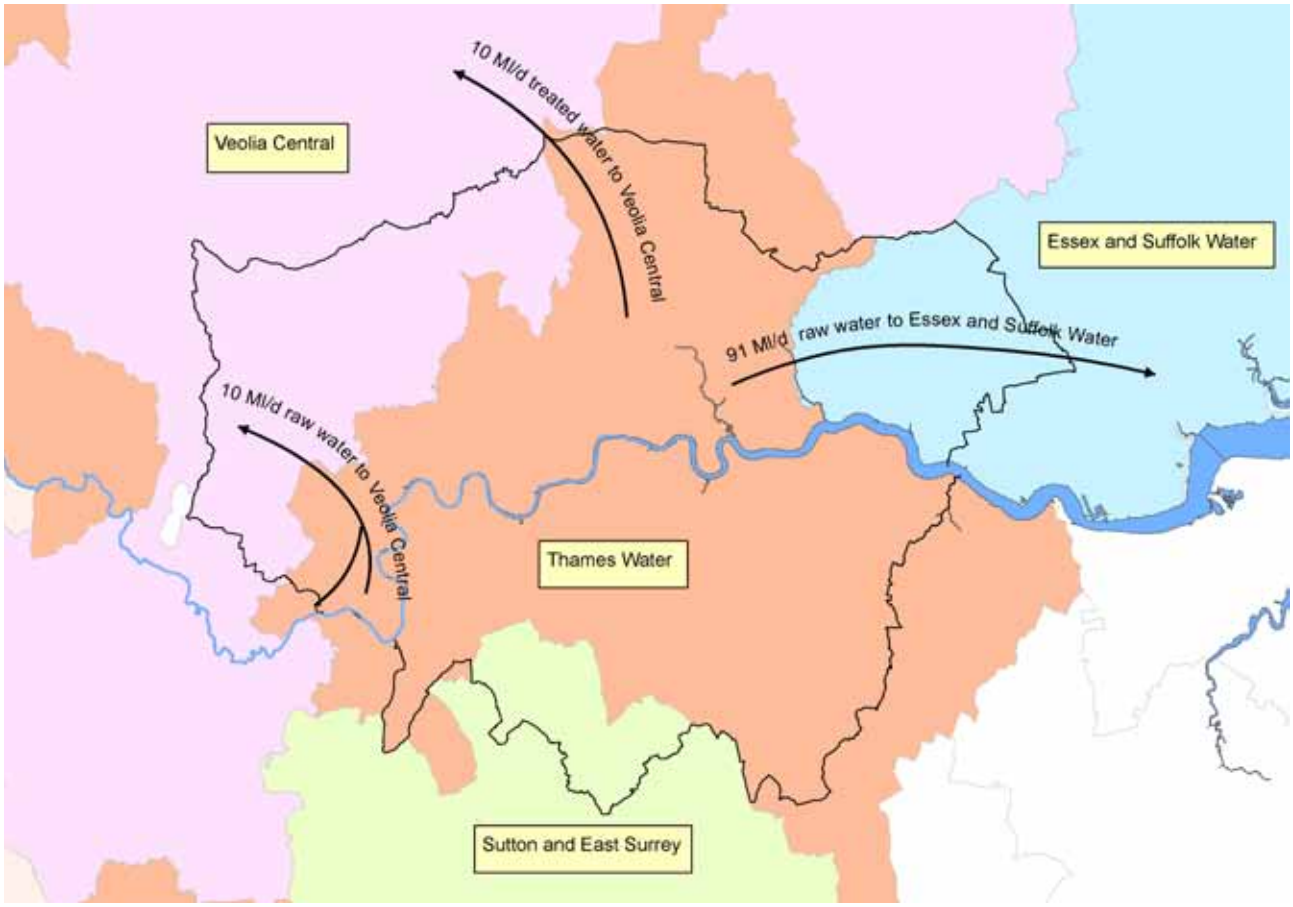
2.8.14 Groundwater recharge is, in effect, using the aquifer as a reservoir. Water is taken from rivers when flows are high and injected into the aquifer for use when water supplies are low. Groundwater recharge is only possible in areas where the geology prevents the injected water from seeping away. Recharge is energy intensive as water needs to be treated before it is stored in the aquifer and treated again when it is removed for use. Thames Water operates an aquifer recharge scheme in north London and is considering a second scheme in south London. Thames Water plan to take water out of the recharge scheme once in seven years.

International water imports

2.8.15 In the case of an extreme drought, a drastic supply measure is to import water from another country, for example as Barcelona was forced to do in 2008. Thames Water's WRMP identifies shipping water from Norway as an emergency measure.

In addition to all the supply side options there is the opportunity to reduce water demand. The Mayor is keen that the water industry puts a lot more emphasis on reducing water demand across London, which previously was given little attention compared to supply side. Chapter 3 covers the demand side options, which have significant potential to save water.

Figure 2.9 Existing water company bulk water movements for the Thames Gateway



Source: Environment Agency.

CHAPTER THREE

MANAGING WATER USE

Vision

The Mayor believes that Londoners should have a secure supply of water that is affordable, safeguards the environment, and a water infrastructure fit for a world-class city.

From vision to action

Achieving and sustaining this vision will only be possible if all the partners, from government to Londoners, collectively work together. This means :

- London's water companies must make the case for demand management measures in their plans and strategies, and ensure they deliver their metering, water efficiency and mains replacement programmes.
- Ofwat needs to revise how it compares demand and supply side measures and provides funding to water companies to implement demand management measures where justified.
- Defra needs to ensure that water efficiency is recognised and valued across all government departments.
- CLG must ensure that the proposed water efficiency standards for new development are introduced and enforced.
- London government (Mayor and boroughs) must work together to implement the RE:NEW programme at scale.
- Londoners must be helped to save water through home retrofit and advice programmes
- London's businesses should invest in water efficiency measures that have a quick payback.

The vision will be achieved through two sets of actions: Firstly, the water industry needs to work better in the interests of its stakeholders, so that the water company short-term business plans enable the long-term ambitions of their resource plans, and greater clarity is needed in the comparison of the costs and benefits of supply versus demand measures.

Action 1 The Mayor will lobby Defra to ensure that there is greater coherency between the planning, funding and delivery of water company business and resource plans.

Action 2 The Mayor will lobby Defra, Environment Agency and Ofwat to develop a simple, transparent mechanism for comparing the costs and benefits of supply and demand measures in water company plans that fully accounts for the short- and long-term social, environmental and economic costs.

Secondly, the Mayor will work with partners to implement an integrated 'six point plan' to enable and sustain increased water efficiency.

1 Improve the water efficiency of existing buildings.

Action 3 The Mayor will work with London's water companies and other partners to further integrate water efficiency into London retrofit programmes.

Action 4 The Mayor will lobby government to ensure that improving the water efficiency of homes is promoted and supported in the Water White Paper and the Green Deal.

2 Ensure all new development is super-water efficient.

Action 5 The Mayor will work with London's water companies and developers to monitor the water usage in new homes to see if the actual water efficiency matches the predicted water efficiency.

Action 6 In the next review of the London Plan, the Mayor will draft a new policy requiring all new workplaces to achieve an improved water efficiency standard such as AECB's 'best practice' levels or WRAP's 'highly efficient practice'[26].

3 Raise Londoners' awareness of the financial benefits of increased water efficiency

Action 7 The Mayor will lobby government and Ofwat to improve water company customer engagement, for example by providing more informative water bills.

Action 8 The Mayor will work with London's water companies to raise awareness of Watersure, optant metering and assessed charges through Citizens Advice Bureaux surgeries and social housing providers.

4 Increase the number of homes with a water meter

Action 9 The Mayor will work with London's water companies, Environment Agency and Ofwat to support the already planned introduction of water metering throughout London, with the aim of metering all houses and blocks of flats by 2020 and all individual flats by 2025.

Action 10 The Mayor will lobby government to investigate the opportunities and benefits of combining the 'smart' energy metering programme with enhanced water metering.

5 Change the way Londoners pay for their water

Action 11 The Mayor will lobby government and Ofwat to enable tariffs that incentivise and reward water efficiency, whilst protecting vulnerable customers.

6 Continue to tackle leakage

Action 12 The Mayor will encourage Ofwat to develop the evidence base for Sustainable Economic Level of Leakage and benchmark performance on managing leakage, including the costs and benefits of fixing leaks that takes account of costs for London.

Action 13 The Mayor will lobby Ofwat to review the deadline for leakage reporting.

The Mayor will encourage Londoners to save money and reduce the carbon footprint of their water consumption, by making tap water more easily available.

Action 14 The Mayor will encourage water companies and other partners to promote London's drinking water. This will include facilitating ways of working with London boroughs, our stakeholders and private sector organisations on potential funding models, or schemes, that provide efficient, easily accessible and free drinking water to Londoners on the move, at no cost to the tax payer.

The Mayor will encourage companies to consider their global water risks.

Action 15 The Mayor of London will lead by example by completing the Water Disclosure Project Questionnaire for the Greater London Authority to examine global water dependencies. The Mayor will integrate risks associated with global water use into the Mayor's Green Procurement Code to encourage companies to consider their water risks.

3.1 Introduction

3.1.1 It is all too easy to take secure water supplies for granted. Londoners rely on the water companies to provide sufficient clean water for their needs. In fact, each company has a duty to provide homes with a supply of water that is sufficient for household use.

3.1.2 The drought of 2006, with associated widespread hosepipe bans and real risk of more serious restrictions was a powerful reminder to us all that our water resources are not limitless. Yet, despite our limited water resources, we are not as careful with their use as we could be. In water-stressed areas, it makes sense to place a greater emphasis on managing water use.

3.1.3 Chapter 2 highlighted that the combined pressures of population change, climate change and the need to protect our environment will put increasing pressure on our water supply and demand balance.

3.1.4 The Mayor believes that the answer to this challenge is to ensure that the water industry and other stakeholders help current Londoners save water in their homes, public buildings and businesses to ease the demands on the environment and provide water for the new population. This approach is good for individual households and businesses as they save money and it is also good for London as a whole, as it defers the need to invest in new water resources and provides time to ensure that the water companies invest in those resources that are most sustainable over the long term.

3.2 Making the water industry work better for its stakeholders

3.2.1 Chapter 2 raised the issue that there is no statutory requirement for water companies to implement their WRMPs, and no mechanism to bring their WRMP and their business plans into alignment where they differ. This means that there is the potential for WRMPs and business plans to increasingly diverge, with the WRMPs proposing one course of action and the business plans funding another.

Action 1 The Mayor will lobby Defra to ensure that there is greater coherency between the planning, funding and delivery of water company business and resource plans.

3.2.2 A second issue is the complexity of comparing supply and demand measures. It is critical that water companies invest their customers' money in measures that are sustainable in the long and short-term and that customers understand where and why this investment has been made. There is no agreed, transparent mechanism for comparing supply and demand measures that fully captures the social and environmental consequences. This means that there is inconsistency between water companies in estimating the consequences and an unintended bias towards high-cost capital projects.

Action 2 The Mayor will lobby Defra, Environment Agency and Ofwat to develop a simple, transparent mechanism for comparing the costs and benefits of supply and demand measures in water company plans that fully accounts for the short- and long-term social, environmental and economic costs.

Enabling long-term water efficiency

3.2.3 The Mayor believes that in order to achieve and sustain long-term water efficiency as part of balancing supply and demand, that an integrated programme of reinforcing

measures is required. The Mayor will work with London's water companies and other partners to implement a 'six point plan' to deliver long-term water efficiency.

3.2.4 The Mayor's 'six point plan'.

1 Improve the water efficiency of existing buildings.
2 Ensure all new development is super-water efficient.
3 Raise Londoners' awareness of the financial benefits of increased water efficiency.
4 Increase the number of homes with a water meter.
5 Change the way Londoners pay for their water.
6 Continue to tackle leakage.

3.2.5 The Mayor has been working with water companies such as Thames Water to promote initiatives within this six point plan across London.

1. Improving the water efficiency of existing development

3.2.6 There are three strands of actions towards improving the water efficiency of existing development:

- Water conservation, where small changes in awareness and behaviour result in reduced water use. An example would be running a full, rather than a half-full dishwasher.
- Water efficiency, where water efficient fixtures and fittings are used to achieve the same end result, but use less water.
- Reclaimed water, using rainwater and wastewater for non-potable uses.

Water conservation

3.2.7 All Londoners can save water without needing to make any investment. Simple choices, such as only running dishwashers and washing machines when full, not brushing teeth or washing up under a running tap, or occasionally showering instead of having a bath can add up to significant financial and water savings. Spending just one minute less in the shower each day can save a four person household up to £40 a year in gas bills and a further £60 in metered water bills[27].

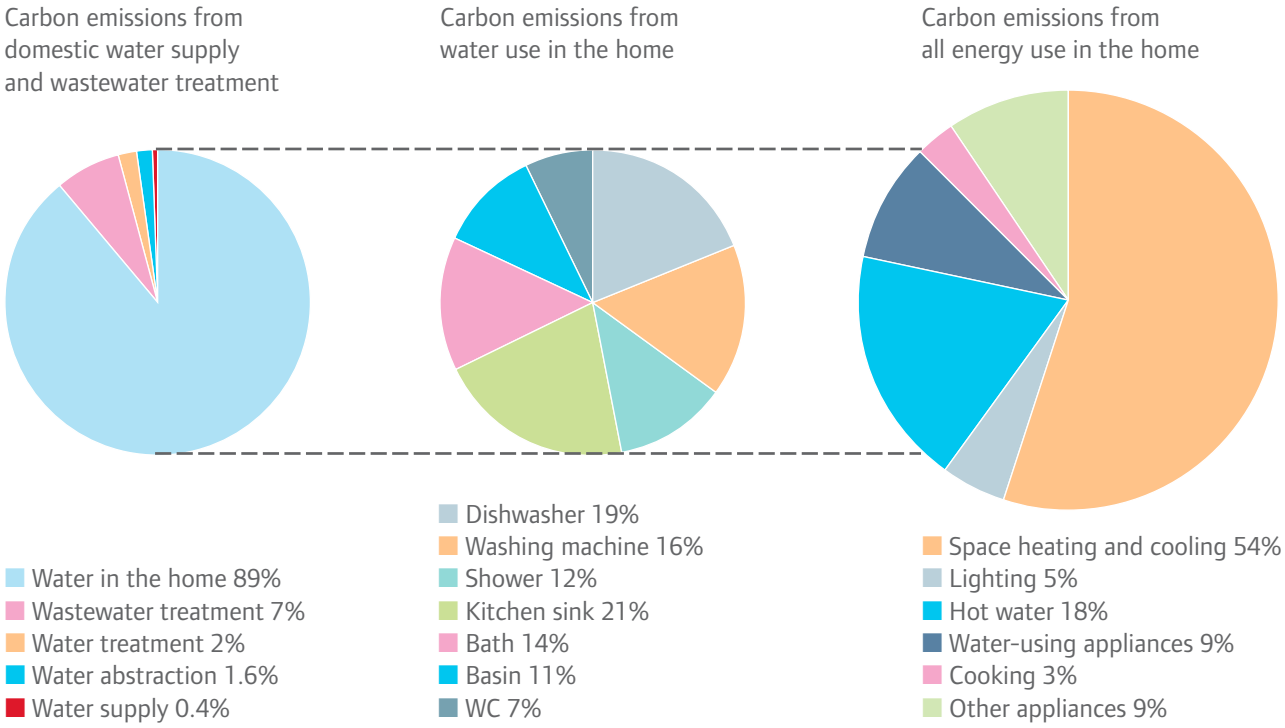
3.2.8 Londoners can and have saved large volumes of water – in response to the drought campaign during the summer of 2006, London's daily water consumption fell by about eight per cent (see fig 2.6). The significant savings made in response to hosepipe bans, and also by customers voluntarily reducing their water consumption, avoided the introduction of more severe restrictions.

Water efficiency

3.2.9 The greatest scope for improving water efficiency is in London's 3.2 million existing homes. As well as raising awareness of potential financial savings of conserving water, improving water efficiency in existing homes can be achieved through installing more efficient fittings and appliances. Adapting existing appliances can be inexpensive and relatively simple, such as fitting aerator showerheads and tap nozzles, or installing variable flush devices to existing toilets. With householders likely to move on average every 7-15 years[28] there are further opportunities to encourage refurbishment to be water efficient.

3.2.10 The Environment Agency report Water Efficiency in the South East of England, Retrofitting existing homes[29] shows that retrofitting existing homes has the potential to save water over the current Building Regulations requirements relatively quickly

Figure 3.1 Carbon emissions resulting from water supply, use and wastewater treatment



Sources: Environment Agency[31] (left chart) Energy Saving Trust (centre chart)

with existing and simple technology. Three Regions Climate Change Group report Your home in a changing climate[30] identifies and quantifies the options, costs and benefits for retrofitting existing homes to adapt to the impacts from a changing climate including water stress, flooding and overheating. The RE:NEW programme retrofitting package (box 3.1) will save over 98 litres of water a day (35,953 litres of water a year), saving the householder £61 on water bills (if metered) and £30 on energy bills.

3.2.11 Figure 3.1 illustrates the relationship between water use in the home (centre), overall carbon emissions associated with water supply and wastewater treatment (left), and the carbon emissions from all activities in the home (right). The left-hand pie chart shows that water use in the home accounts for 89 per cent of all the carbon emissions resulting from water use. Water abstraction, treatment and supply together with wastewater collection and treatment only accounts for just 11 per cent.

3.2.12 The right-hand pie chart shows that water use accounts for 27 per cent of carbon emissions from the home. This is made up of 18 per cent from the heating of water for baths, showers, hand washing and washing up. The other nine per cent is accounted for by water-using appliances including dishwashers and washing machines. Taking a shower rather than a bath – in other words, using less hot water – will therefore only have a relatively small effect on the carbon emissions from water supply but a much bigger effect on carbon emissions

Table 3.1 Reduced household water use, cost and carbon emissions through retrofits and behaviour changes

	Change to m^3 year	Change to water cost	Change to energy cost	Change to total cost	Change to Kg CO_2 year	Notes
Baseline: Standard London house with high flow mixer shower	0	0	0	0	0	Weekly: 5 showers and 2 baths per person. 10 litre toilet.
Scenario 1 Retrofit: Showerheads, Taps, Cistern insert	18% less	18% less	24% less	21% less	24% less	Showerhead 11 litres per minute for 7 minutes. tap aerators and Ecobeta toilet insert
Scenario 2 Behaviour changes: Replace bath/long shower with short shower	22% less	22% less	8% less	25% less	28% less	5 minute shower instead of daily bath or long shower
Scenario 3 Retrofit and behaviour changes combining Scenarios 1 and 2	44% less	44% less	47% less	55% less	47% less	Shower, toilet and tap retrofits. 5 minute showers

*Based on the average Thames Water bill for water and sewerage services in 2008/09.
Calculation based on Energy Saving Trust data

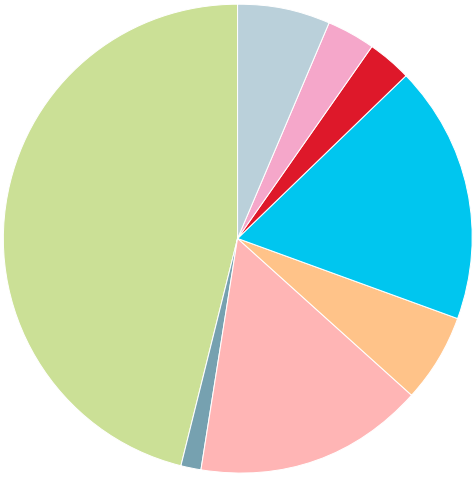
from the home. It is worth noting that that five per cent of UK carbon emissions comes from heating water in homes, which is more than domestic aviation!

3.2.13 Table 3.1 shows the potential savings in water usage, water and energy costs and carbon emissions that can be achieved through the introduction of various water saving devices and changes in behaviour.

Water efficiency in workplaces

3.2.14 In London, workplace (non-domestic) water use accounts for 29 per cent of total consumption. Figure 3.2 shows the breakdown of water use across workplace sectors. It can be seen that 'other services' (offices and public buildings), education and health (schools and hospitals) and hotels, bars and restaurants collectively

Figure 3.2 Workplace water use in London



represent nearly 80 per cent of workplace water demand. These are all land uses where high occupancy rates of buildings means that small and relatively cheap retrofit measures, such a dual flush toilets, waterless urinals, aerator taps and showerheads and water efficient white goods could save substantial volumes of water for relatively little cost and short payback time. The Office of Government Commerce set a best practice benchmark for water use in office establishments of 6.4 m3 per full time employee per year. Many offices operate at nearly double this.

3.2.15 The Mayor has initiated a range of programmes to improve the water and energy efficiency of London's homes and workplaces in London (see Box 3.1). Whilst the initial primary focus of these programmes was to improve energy efficiency, these programmes have now been expanded to integrate water efficiency and particularly hot water efficiency retrofits. When there is greater precision on water saving figures for non-domestic properties, the figures can be added to the water neutrality calculations (Figure 3.3).

Box 3.1 Retrofit programmes

RE:NEW. This programme improves the energy and water efficiency of London homes. RE:NEW is a partnership between the Mayor, London Councils the London boroughs and the Energy Saving Trust. The aim of the programme is to install water efficiency and energy efficiency devices in 200,000 homes by the end of 2012, and up to 1.2 million homes by 2015, at no up front cost to the householder. By 2030, every home in London should have been offered the opportunity for a free retrofit package.

RE:NEW is the first programme to combine energy and water retrofitting measures at a citywide scale. As noted above, nearly one-tenth of London's carbon emissions come from heating water for washing and cleaning. London cannot therefore achieve its 60 per cent carbon reduction target without improving water efficiency, particularly hot water efficiency.

The programme is delivered on an 'area' basis – working progressively, street by street, to fit efficiency measures in homes. This scale of retrofitting enables economies of scale in both the purchasing of the efficiency measures and minimises the per-household administrational costs.

Product	Lifetime of measure	Number of measures installed	Total kWh saved/ year	Total water saved (litres/ year)	Total carbon dioxide saved/ year	Water bill savings (£ saving/ year)	Energy bill savings (£ saving/ year)
Tap aerators (saving for whole house)	10	1	199.67	6570	42.35	11.12	8.84
Dual flush retrofit	10	1	0	17155	0	29	N/A
Showertimers	10	1	46	1278	14.1	2.16	2.04
Showerheads	10	1	440.36	10950	93.41	18.53	19.5
TOTAL	**N/A**		**686.03**	**35953**	**149.86**	**60.81**	**30.38**

The typical retrofit package of water efficiency measures that will be installed is two tap aerators, one toilet dual flush device (or a cistern displacement device if the toilet cannot be adapted to dual flush), one aerator showerhead and one showertimer. It is anticipated that each installed package, assuming average usage, will save over 98 litres of water a day (35,953 litres of water a year), saving the householder £61 on water bills (if metered) and £30 on energy bills.

All of London's water companies (Thames Water, Veolia Water Central, Sutton and East Surrey and Essex & Suffolk) have supported, or committed to supporting, RE:NEW, providing in excess of £2.1m worth of water efficiency measures.

RE:CONNECT. The Mayor's low carbon zones programme, is supporting ten London neighbourhoods to become exemplars of carbon saving and local environmental sustainability. Working in partnership with London boroughs, local community groups, utilities and charities, the programme is providing energy and water saving measures to households, businesses and community buildings in the ten zones. A range of water saving devices are being installed including low-flow shower heads, tap aerators, water butts and flow restrictors, saving water, energy and money.

RE:FIT. This programme enables the retrofitting of public sector buildings to improve their energy efficiency. The programme uses an innovative commercial model, where the costs of installed energy efficiency measures are paid back through the guaranteed energy savings of the measures.

The GLA group has completed a pilot of 42 of its buildings (including fire stations, police stations and TfL buildings), reducing emissions on average by 28 per cent and RE:FIT will now be extended to a further 58 GLA group buildings. Twenty other organisations, including boroughs, universities and hospital trusts have signed up to the programme. By 2025, RE:FIT aims to reduce London's CO2 emissions by approximately 400,000 tonnes per year and save in the order of one million m^3 of water per year[32].

Better Buildings Partnership

The Better Buildings Partnership (BBP) has brought together 14 of the largest and most influential commercial landlords in London, who collectively own a significant proportion of London's commercially rented floorspace. The BBP has developed a 'Green Lease Toolkit' which enables landlords and tenants to work together to improve the energy efficiency of buildings to the benefit of both parties. By 2025, the aim is for the BBP to have catalysed activity that will reduce emissions by 5,000 tonnes per year and save an additional 1.3million m3 of water per year.

Action 3 The Mayor will work with London's water companies and other partners to further integrate water efficiency into London retrofit programmes.

Action 4 The Mayor will lobby government to ensure that improving the water efficiency of homes is promoted and supported in the Water White Paper and the Green Deal.

3.2.16 Businesses that want to know more about how they can save water should contact their water supplier for advice. Thames Water, like many other water companies, offers free water audits to commercial customers and its Water Regulations Audit Programme offers

technical advice on water saving devices and measures (see below). Envirowise offers UK businesses free, independent advice and support on ways to increase profits, minimise waste (including water use) and reduce environmental impact[33]. Both Thames Water and Envirowise estimate that they can help businesses reduce water use by 30 per cent. The Enhanced Capital Allowance (ECA) scheme allows businesses to claim 100 per cent first year capital allowances on investments in technologies and products included in the ECA list of water efficient technologies[34].

3.2.17 Water companies are required to carry out water regulation audits of their non-domestic customers to ensure that all recent plumbing meets building regulations. Many water companies also offer a water efficiency audit in parallel, however the suspicion that the water regulations audit may lead to expensive replacements often prevents customers from taking advantage of the combined services. Thames Water estimates that in most cases the water efficiency savings outweigh the costs of changes that have to be made to comply with building regulations.

Reclaimed water

3.2.18 By 'reclaimed water', this strategy refers to the use of rainwater and grey water (water from baths, showers and handbasins) for non-potable uses, such as toilet flushing and outdoor water use. The public has a general understanding of water distribution based on a single supply of drinking-quality water. Changing their acceptance of a single supply system to two separate systems – one for drinking-quality water and another of lower quality water for non-potable uses – is a key to the success of reclaimed water.

3.2.19 There are no UK specific legal requirements defining an acceptable standard for grey water. However, rainwater correctly collected and stored can be used for toilet flushing, clothes washing and outdoor use without further treatment. Table 3.2 sets out possible acceptable water quality properties for different applications. The British Standards Institute is looking at developing a British standard for rainwater harvesting systems and UKRHA (UK Rainwater Harvesting Association) is currently working on a rainwater Code of Best Practice. Defra intend to produce appropriate standards for non-potable water. Adequate training and monitoring should be provided in order to minimise cross-connections and the risk of health related problems. For instance, a relatively simple way of avoiding cross-connections could be requiring different colour pipes for the drinking water and the non-potable water supply.

3.2.20 Reclaimed water uses include watering planted areas, washing paving, and for similar purposes within a development. This is instead of using water from the public supply.

Table 3.2 Rainwater and grey water sources and end use

Rainwater		Grey water	
Sources	**End use**	**Sources**	**End use**
Roof guttering	Toilet flushing	Wash basins	Toilet flushing
	Car washing	Baths	Car washing
	Plant watering	Showers	

3.2.21 Although grey water recycling systems can help to save water, some forms require energy to ensure appropriate cleanliness of water. An assessment should be undertook to ensure that such uses do not result in a significant increase in carbon dioxide emissions.

2. Ensuring all new development is super-water efficient

Homes

3.2.22 National planning policy states that all new social housing must be built to Code for Sustainable Homes Level 3 target of 105 litres per person per day (l/p/d) and from April 2011, all new private housing must be built to 125 l/p/d. The London Plan (Policy 5.15) states that all new homes in London should meet the 105 l/p/d standard, whilst the Mayor's Supplementary Planning Guidance on Sustainable Design and Construction encourages developers to aim for 80 l/p/d.

3.2.23 Ensuring that new development is as water efficient as possible is important to achieving and sustaining water neutrality (Box 3.2). The projected construction of 32,210 homes per year will require an additional 12 million litres of water per day. This means that for every new home built, 2.9 existing homes need to be retrofitted to maintain no net increase in demand. If the water efficiency of new homes is less than projected, then either more existing homes have to be retrofitted, or greater reliance is placed on supply side measures.

3.2.24 The Code for Sustainable Homes provides a 'water calculator' for developers and development control officers to use to predict the water use and so the relative water efficiency, of the development. Government has committed to reviewing the Code for Sustainable Homes and the Mayor is interested in how the 'water calculator' compares to alternative methods, such as the Association for Environment Conscious Building's (AECB) Water Standards[35].

Action 5 The Mayor will work with London's water companies and developers to monitor the water usage in new homes to see if the actual water efficiency matches the predicted water efficiency.

Workplaces

3.2.25 Building regulations do not set a water use standard for workplaces. There are a number of 'best practice' standards. The Association for Environment Conscious Building's (AECB's) Water Standards sets best practice levels. Whilst, WRAP has developed guidance and model clauses to help clients and developers ask for water-efficient buildings when procuring designing, constructing and managing facility services. Their 'Asking for water-efficient buildings through good procurement practice'guidance includes a 'highly efficient practice' level for water efficiency. The Building Research Establishment has a standard assessment for non-domestic buildings and a range of bespoke standards for different land uses, such as hospitals and retail buildings. The Mayor believes that all new development should contribute towards improving London's water efficiency.

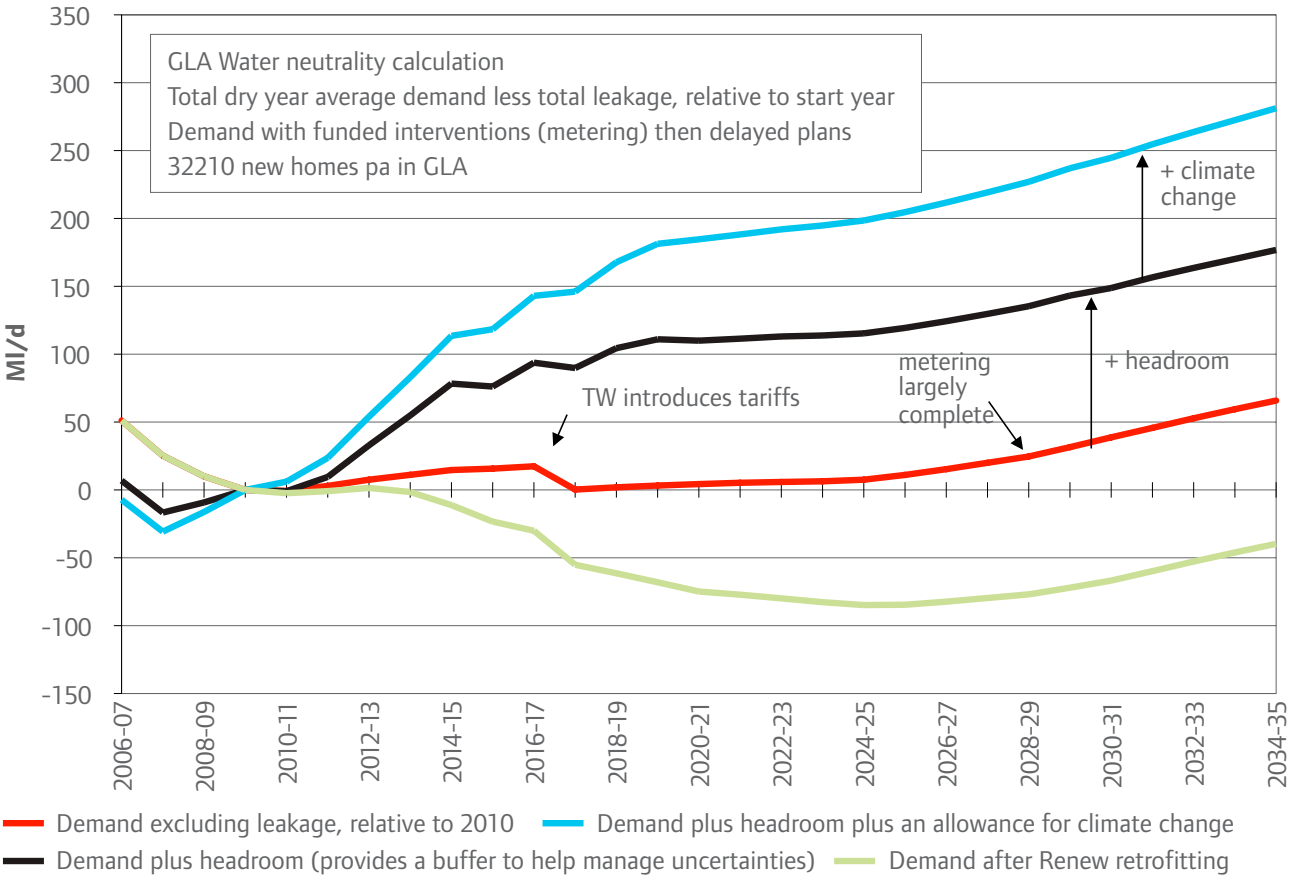
Action 6 In the next review of the London Plan, the Mayor will draft a new policy requiring all new workplaces to achieve an improved water efficiency standard such as AECB's 'best practice' levels or WRAP's 'highly efficient practice'[36].

Box 3.2 Water Neutrality case study

Water neutrality is a concept where the population in a given area can increase in size, but its water demands remain the same. To achieve water neutrality, water demand from the existing population must be reduced to provide water for the incoming population. The Mayor has been working with the Environment Agency to understand whether it is possible to offset the demand from London's growing population, and to determine how long this water neutrality can be sustained for.

Figure 3.4 shows the combined water company measures for London as funded to 2015 and proposed in the WRMPs from 2015 – 2034[37]. Each of the lines shows total annual water demand (not counting leakage) relative to 2009/10. The red line shows the impact of water company proposals for water metering, household water efficiency measures and tariffs (see chapter 4) on reducing demand. It can be seen that water neutrality is effectively achieved when the Thames Water tariffs are initiated in 2017, however it not sustained beyond this without the help of the RE:NEW programme. The green line shows the impact of full implementation of the RE:NEW home retrofitting programme if funded (see Box 3.1). The black line shows the effects of headroom (how much extra water is needed to manage uncertainties) and the blue line the effects of climate change (how much extra water is needed due to the impacts of climate

Figure 3.3 Water neutrality. The figure shows the maximum potential of RE:NEW to save water if fully funded.



change on water availability). It can be seen that RE:NEW can help offset a significant proportion of headroom, but cannot offset the increased demand due to climate change.

Figure 3.4 represents the contribution of the measures in 2017-18 from Fig 3.3 to show how the combination of measures can help to offset the increased demand from new development.

3. Raise Londoners' awareness of the financial benefits of increased water efficiency

3.2.26 Many Londoners are oblivious to how much they could save by being more water efficient. As noted previously, even homes without a water meter are able to save money on their energy bills by using less hot water.

3.2.27 The Mayor thinks that water companies could and should do more to engage with their customers on the opportunities to save money through water efficiency. He believes that the information presented on the water bill could provide greater incentivisation. Figure 3.5 shows an example of information sent to selected water customers by Veolia to communicate how much water they were using and how much they could potentially save through water efficiency. The leaflet provides the customer with a comparison of their use over time and against similar households.

Action 7 The Mayor will lobby government and Ofwat to improve water company customer engagement, for example by providing more informative water bills.

3.2.28 Many Londoners may also not be getting the best deal from their water company. Customers on a meter may qualify for a capped water bill under the Watersure scheme (see chapter 4), and customers without a meter may benefit from choosing a meter (known as 'optant metering'). Even those who want a meter, but cannot have

Figure 3.4 Contribution of measures reducing water demand in 2017/1 relative to demand during 2010

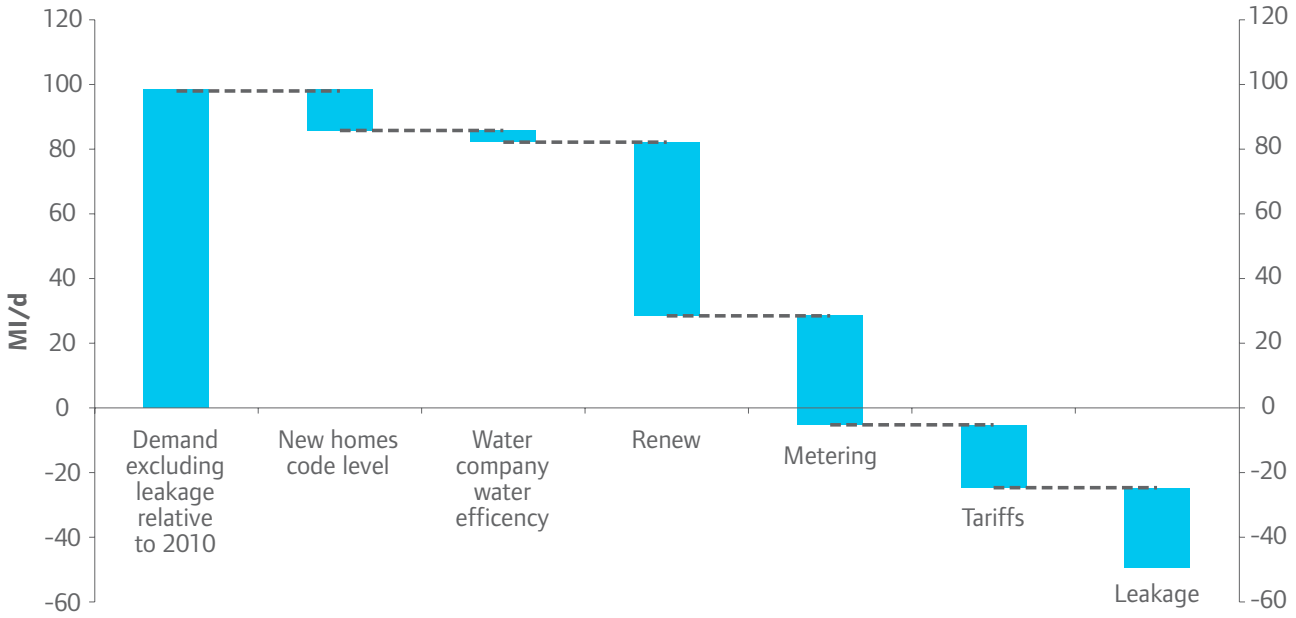
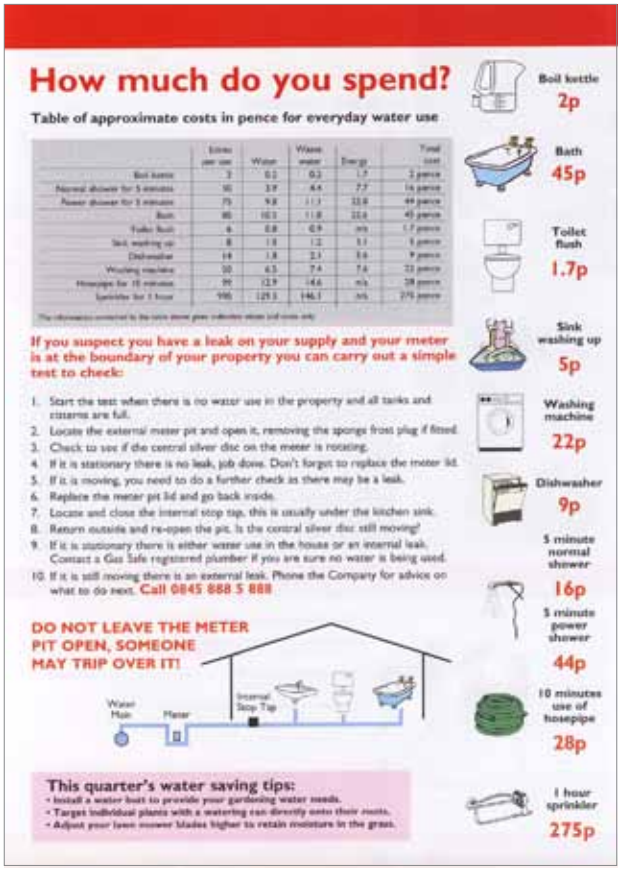


Figure 3.5 Information sent to selected water customers to communicate how much water they were using and could save.



one fitted for practical reasons could apply for an 'assessed charge'.

Action 8 The Mayor will work with London's water companies to raise awareness of Watersure, optant metering and assessed charges through Citizens Advice Bureaux, Voluntary Action Centres and doctors' surgeries and social housing providers.

3.2.29 The relative water efficiency of household appliances needs to be clearly labelled for people to make a considered purchase. The Mayor welcomes the Bathroom Manufactures Association's introduction of a voluntary labelling scheme for water efficient bathroom products, plus the use of the Waterwise Marque to further promote water efficient products. However, there is over 20 different water efficiency labelling schemes operating in the UK at present. The Mayor would support the promotion of a national scheme by government, with a water efficiency ranking system that is clear for consumers.

4. Increasing the number of homes with a water meter

3.2.30 Paying for the volume of water consumed is the fairest way to pay for water, yet only around a quarter, 26 per cent, of London's 3.2 million homes have a water meter. This means that three-quarters of Londoners pay for their water based upon the value of their property in 1991. London has a lower proportion of homes with a meter than the England and Wales average (at 35 per cent) and well below that of London's competitor European cities (where near universal metering is usual).

Table 3.3 Water metering targets by water company

Water company	Metering penetration (excluding voids) by		
	2015	2020	2025
Essex & Suffolk	60%	81%	89%
Sutton and East Surrey	45%	68%	92%
Thames Water	41%	60%	77%
Veolia Water Central	47%	65%	82%

3.2.31 Having a water meter is vital to making people aware of how much water they are using and giving consumers more information to control their bills. Without metering all other water efficiency measures are less effective. Water bills are expected to increase to pay for WFD improvements and upgrading the water infrastructure – people with water meters will have more control over how much their bills rise (Note that sewerage bills are based on water consumption, so metering helps to reduce sewer bills too!).

3.2.32 Research[38] has shown that household metering reduces water use by about ten per cent. It is unsurprising that people tend to use less water when they pay for it by volume used rather than through a standard charge that does not reflect the amount used (and perversely encourages high consumption). The need to measure water use in order to manage it better is a strong argument in favour of water metering. As the south east of England has been identified as an area of serious water stress, compulsory metering is another tool in balancing supply and demand.

3.2.33 Water companies have a much poorer understanding of their customers than other utilities, for example, energy companies. Water meters are a useful tool in helping water companies to understand their customers better, so predict demand more accurately. Some water companies are currently fitting meters, but not using them to charge their customers – these so-called 'blind meters' are used to understand how much water customers consume.

3.2.34 Water meters can also facilitate detecting leaks. If a water company knows how much water it is putting into an area and can measure how much is being used by metering, it can more accurately identify where the leaks are. In combination with a better understanding of customer consumption, this can help reduce headroom and so over provision of water.

3.2.35 London's current low level of metering is partially due to the high proportion of flats (45 per cent of properties in London are flats). Flats are often more difficult to meter because their plumbing was not installed with metering in mind (for example in a block of flats all kitchens may be plumbed together on one supply pipe and all bathrooms on another). Nevertheless, 52 per cent of buildings in the capital are detached, semi-detached or terraced, which can be individually metered relatively easily.

3.2.36 All London's water companies agree that a move to 'universal metering' is necessary, but there is no agreement as to what 'universal'

metering comprises in London and how quickly universal metering should be achieved. Most water companies consider that metering beyond 90 per cent is likely to be prohibitively expensive using current technology (see Table 3.3).

3.2.37 Although all new homes are metered, in some cases, water companies in London have allowed 'bulk meters' to be installed in new blocks of flats rather than individual meters (i.e. one meter at the base of the block with the bill split between the tenants). This has led to letters of complaint to the Mayor when residents have been unable to have individual meters fitted. In response, the Mayor commissioned a detailed investigation of the problems of metering flats[39]. The Mayor expects that all new flats in London should have an individually metered water supply.

Action 9 The Mayor will work with London's water companies, Environment Agency and Ofwat to support the already planned introduction of water metering throughout London, with the aim of metering all houses and blocks of flats by 2020 and all individual flats by 2025.

3.2.38 The government has committed energy companies to install 'smart' energy meters in all UK homes by 2030. It is important that the opportunities to integrate enhanced water metering are considered as part of these programmes.

Action 10 The Mayor will lobby government to investigate the opportunities and benefits of combining the 'smart' energy metering programme with enhanced water metering.

5. Changing the way Londoners pay for their water

3.2.39 The Mayor believes that Londoners should be encouraged and rewarded for using less water, whilst vulnerable customers should be protected (see chapter 4). The Mayor believes that as more and more households are fitted with water meters, water companies should develop tariffs that incentivise and reward lower water use. The Mayor also believes that large households on low incomes, that are subsidised under the current system and customers that become vulnerable under the new system should be protected from massive increases in water bills.

Action 11 The Mayor will lobby government and Ofwat to enable tariffs that incentivise and reward water efficiency, whilst protecting vulnerable customers.

6. Continuing to tackle leakage

3.2.40 More than a quarter of London's water (nearly 600 million litres a day, the equivalent of 238 Olympic swimming pools per day) is lost in leakage between the water treatment plant and the tap (see table 2.8) – that's the equivalent consumption of an extra person living in every home in London! Reducing leakage can contribute to improving security of supply in the same way as developing a new source of water. For example, reducing leakage from the distribution mains by one percentage point would provide enough water for about 47,120 people[40].

3.2.41 All utility networks suffer some losses from their distribution systems, and it would be prohibitively expensive to reduce leakage to near zero, so some level of leakage is tolerated. However, it is determining the point at which leakage is acceptable, where it is no longer viable to repair or replace

water mains, that is important. In order to compensate for the losses, water companies have to invest in treating more water and building bigger supplies, passing the costs onto customers, so customers, in effect pay for water they never get.

3.2.42 Water companies are required to determine their 'sustainable economic level of leakage' (SELL)[41]. This is the point at which, including an approximation of social and environmental concerns, it is cheaper to invest in improving water supplies, than to further reducing leakage. The Mayor disputes that this methodology reflects that true social and environmental costs and benefits. For example, no account is taken of the potentially serious damage caused to other infrastructure such as the London Underground network by leaks and burst mains[42]. A recent study shows that there is very little information available to assess the costs of disruption and loss of business caused by leaks and burst mains.

3.2.43 Leakage has two elements; the volume of water lost through leaks on the distribution mains network (referred to as distribution losses) and the amount lost from customers' supply pipes (referred to as supply pipe losses). In meeting their leakage targets, water companies are:

- replacing old leaky distribution mains
- lowering the water pressure in the distribution network
- finding and fixing leaks on their distribution mains
- repairing leaks on their customers' supply pipes.

Replacing water mains

3.2.44 Half of London's water mains are over 100 years old, and a third are over 150 years old. But it is not just the age of the pipes that leads to high leakage levels. The soil can affect the pipes buried within it in two ways: through corrosion (which causes pitting and structural weakness) and through movement of the soil which puts stress on the pipes and their joints. Research shows that London has a significantly higher proportion of corrosive soils than other parts of the country. Also, London's clay soils are more susceptible to soil movements due to the changes in the soil moisture. The worst problems are generally in inner London, the area served by Thames Water.

3.2.45 Thames Water has been working steadily to reduce leakage from their network and have met their leakage reduction targets for the last five years. Their Victorian Mains Replacement Programme, identifies the worst leaking pipes and prioritises their replacement. In the last round of funding (2005-10), Thames Water replaced in excess of 2,000 kilometres of water mains and aim to reduce leakage to 114 litres per household in 2030-2035. However between 2010 and 2015 the company had planned to replace a further 2,097 kilometres of mains, but have only been funded to replace 1097 kilometres of mains. Thames Water claims that this level of funding is only sufficient to maintain leakage at current levels, and not enough to continue leakage reduction[44]. An independent review of Thames Water's Mains Replacement programme is underway. This is a joint project between Thames Water and Ofwat. The outcomes will have a significant influence on leakage management strategy.

Action 12 The Mayor will encourage Ofwat to develop the evidence base for a sustainable economic level of leakage and benchmark performance on managing leakage, including the costs and benefits of fixing leaks that takes account of costs for London.

3.2.46 Replacing the Victorian mains inevitably affects traffic; but brings long-term benefits; it will reduce the potential for future bursts and leaks, thereby reducing the future need for roadworks. The Mayor wants to minimise the impact of roadworks associated with utility works on Londoners and has therefore agreed a code of conduct with the utility companies, which commits them to measures such as improved signage, using plating to cover excavations when not working on them and working outside peak hours where possible[45]. In the first year of the code, 996 days of traffic disruption were saved through joint working, the amount of work taking place outside peak hours on TfL roads by the signatory utilities doubled, and the capital's first permit scheme began. For the future, the Mayor is keen to see a 'lane rental system' in operation. To be introduced in 2012, this would establish financial incentives for the better management of roadworks, by charging the economic cost of the disruption that roadworks cause on strategically important major roads.

3.2.47 Water companies are required to report on their progress against their leakage targets at the end of the financial year (March). This means that if there is a cold winter, as experienced in 2009-10 and 2010-11, where the frozen ground increases mains breakages, water companies have to intensify their efforts to meet their targets or incur fines. This surge in activity is both expensive, difficult to coordinate works with other utilities and affects Londoners. Extending the leakage reporting period to later in the year may improve the coordination and cost effectiveness of repairs.

Action 13 The Mayor will lobby Ofwat to review the deadline for leakage reporting.

Pressure in the water mains

3.2.48 Should a main or supply pipe fracture or burst, then clearly the higher the pressure, the greater the rate of water loss. Water companies currently have a duty to provide water at a minimum pressure standard. Historically much of London has enjoyed water pressures well in excess of the minimum standard. Some water companies are looking to adjust their pressure levels to help reduce leakage and to bring them closer to the industry standard. However, reducing mains pressure (to albeit legal standards) can have implications for high-rise properties that may need to install additional pumps. This has been a particular concern to London boroughs. Reducing mains pressure is also a potential problem for fire fighting.

3.2.49 In response to these concerns, Thames Water has undertaken to meet half the cost of installing booster pumps in all buildings that need them as a result of reduced mains pressure. In addition, the company is offering interest free loans for a period of five years to cover the remainder of the cost. Care also needs to be taken to avoid any risks of back-flows when pressures are reduced which could otherwise risk contaminating water supplies.

Find and fix

3.2.50 Whereas the Victorian Mains Replacement programme is proactive and long-term, the short-term response is to 'find and fix' leaks in the existing network. In 2010-11 Thames Water dealt with some 58,000 leaks in the network. Many of these leaks are unseen on the surface and have to be detected underground. However, some are bursts that lead to significant disruption of traffic and, at worst, the flooding of buildings. London Underground and Thames Water have a regular four-weekly liaison meeting at which suspected water main leaks

affecting underground assets are identified for investigation, and the results of these investigations and remedial actions are reported. This has resulted in a significant reduction in long-standing problems, and ensures that newly identified locations are properly discussed.

Supply pipe losses

3.2.51 A sizeable proportion of water lost through leaks comes from supply pipes linking individual buildings to the mains. Households are responsible for any leaks in these supply pipes, and some companies offer a free leak detection and repair service the first time a problem arises. The low level of metering in London means that most Londoners will be unaware of such a problem. Although water meters inside the home are valuable for customers to monitor their water use, internal meters fail to pick up leaks outside the property. A solution would be to have boundary meters with 'smart' technology to relay information to a display inside the home. Thames Water is installing boundary meters with its 'LeakFrog' technology[46] as part of the integrated demand management programme as these help to identify customer supply-side leakage.

3.3 Drinking water quality and bottled water

3.3.1 So far there has been little mention of drinking water in this strategy. This is largely down to the excellent quality of drinking water. In the UK our drinking water is of a very high standard, and amongst the best in the world. Nevertheless, misconceptions associated with the quality of tap water, in terms of taste and perceived 'purity' of bottled water, can encourage people to purchase bottled water. In terms of cost, tap water is roughly 500 times cheaper than bottled water, with 50 glasses of tap water costing one penny. Bottled water, per litre, can be more expensive than petrol.

3.3.2 The London on Tap campaign was launched in February 2008 by the Mayor and Thames Water to promote tap water in London's restaurants, cafes and pub. It aims to:

- raise awareness of the high quality of London's tap water, the contribution of bottled water to climate change, and the benefits of drinking water to health and wellbeing
- encourage customers in bars and restaurants to ask for tap water rather than feeling obliged to ask for more expensive bottled brands
- encourage restaurants, bars and hotels across London to proudly serve tap water to customers, giving them a real choice about what water they can drink.

3.4 Water fountains

3.4.1 In 2004, over 1.7 billion litres of bottled water were sold in the UK. While this accounts for a very small proportion of total water use, because of the transport and packaging involved, bottled water has a much higher carbon footprint per litre than water supplied via the tap – more than 300 times the carbon dioxide emissions per litre in the case of some imported brands[47].

3.4.2 The Mayor wants to see a reduction in the demand for bottled water whilst encouraging people to keep hydrated, and is therefore looking for opportunities to install publicly accessible drinking water fountains in public realm projects. The London Plan, for example, requires that new development should incorporate drinking fountains where appropriate (Policy 7.5).

3.4.3 The Mayor supported the Royal Park's 'Tiffany's – Across the Water' programme[48]

Table 3.4. Water fountain schemes.

Programme	Commitment secured for installing :
Help a London Park	1 fountain at Avery Hill (Greenwich)
	2 fountains at Little Wormwood Scrubs (Kensington and Chelsea)
The Mayor's Great Spaces Initiative	1 fountain in Barking Town Square
	1 fountain at Hatcham Gardens in New Cross
	Reactivation of the fountain at Trafalgar Square

which will see the restoration of as many of London's eight Royal Parks' drinking water fountains as possible. The initiative also involved a design competition to create a standard design for drinking fountains located in the Royal Parks and wider. Two designs winners were chosen and will be installed in the Royal parks. The Mayor welcomes other initiatives across London including the recent, successful, City of London pilot in St. Paul's Churchyard.

3.4.4 Across London The Mayor is continuing to explore the viability of restoring or installing drinking water fountains in all the public realm schemes, including those in parks, that we are directly involved in. To date, the following commitments have been secured (see table 3.4).

3.4.5 The Mayor has also developed an initiative whereby the GLA group, the boroughs and other delivery partners have worked with both the public and private sectors to identify new and innovative solutions to the provision of drinking water, at no cost to the tax payer, Where these prove successful, we will encourage London's boroughs and other delivery bodies to pilot any resulting installations and raise awareness.

Action 14 The Mayor will encourage water companies and other partners to promote London's drinking water. This will include facilitating ways of working with London boroughs, our stakeholders and private sector organisations on potential funding models, or schemes, that provide efficient easily accessible and free drinking water to Londoners on the move, at no cost to the taxpayer.

3.5 Global Water Footprint

3.5.1 Water is involved in everything that we use and consume eg the manufacture of goods; their transport; and possibly their use and maintenance. When the water used to produce and supply the goods is taken into account, the true demand for water from Londoners' is far greater than the 167 litres per person per day. It's over 28 times greater, at around 4,645 litres[49]. The majority (about 60 per cent[50]) of the water comes from outside the UK – embodied in goods and services that are imported and consumed in the UK. This 'embodied' water is sometimes termed 'indirect water use' or 'embedded' water. Table 3.5 provides some examples[51]. As much of the burden of supplying large volumes of water is shifted to other parts of the world - where mechanisms for water governance and conservation may be lacking, it not only poses various risks associated with dependency on fragile global water resources for our supplies, but also creates numerous environmental impacts in these regions.

Table 3.5 Average water footprints of a few products (adapted from Waterfootprint.org)

Wine	Tea
Global average water footprint: 120 litres of water for one glass (125ml) of wine. Most of the water is for grape production.	Global average water footprint: 30 litres of water for one cup of tea. A standard cup of tea (250 ml) requires 120 equal-sized cups of water.
Bread	**Cotton**
Global average water footprint: 40 litres of water for one slice of wheat bread. Producing wheat costs 1,300 litres of water per kg (global average). If the bread is consumed together with one slice of cheese (10g), then it all together costs 90 litres of water.	Global average water footprint: 2,700 litres for one cotton shirt. The average water footprint of a pair of jeans is 11,000 litres per kilogram.

3.5.2 You can work out your unique water footprint at: www.waterfootprint.org/?page=cal/WaterFootprintCalculator. This calculator will provide an indicator of how much global water you rely on for your lifestyle. Understanding the impacts of that water demand is more complicated – depending on factors such as where in the world the water is used to produce the goods.

3.5.3 If present levels of consumption continue, two-thirds of the global population will live in areas of water stress by 2025[52]. Climate change, population change, and growing levels of income with a corresponding demand for water intensive goods, are putting pressure on global water sources. As manufacturing falls in London and the rest of the UK, we are effectively exporting our demand for water.

3.5.4 Many businesses across London will be reliant on water from around the world for sourcing raw materials and/or finished goods. And, some of these businesses could have significant influence over the impacts of their water footprints by making adjustments to their operations and/or supply chains. They can also improve the water security for the communities that they rely on to conduct their business by working with stakeholders such as local communities, governments and other businesses sourcing water from the same area.

Action 15 The Mayor of London will lead by example by completing the Water Disclosure Project Questionnaire for the Greater London Authority to examine global water dependencies. The Mayor will integrate risks associated with global water use into the Mayor's Green Procurement Code to encourage companies to consider their water risks.

CHAPTER FOUR

PAYING FOR WATER SERVICES

Vision

The Mayor's vision is that we will help Londoners increase their water efficiency and save money by having a charging system that is fair to all, incentivises and rewards water efficiency, and protects the vulnerable in society.

From vision to action

Achieving this vision will require the combined efforts of London's water companies, the water regulators (Ofwat and Environment Agency), consumer groups (eg Consumer Council for Water), and national, regional and local government; specifically:

- Government and Ofwat must enable a transition from a rateable value system to a tariff based system.
- Water companies must undertake and evaluate tariff trials to establish the tariffs that encourage reductions in water demand and contribute to reducing the impact on Londoners either in, or vulnerable to, water affordability problems.
- Water companies must undertake active engagement with Londoners on water metering so they know what to expect; are engaged and supportive of the transition; and use the water efficient fittings and tariffs correctly.
- Water companies need to help customers make the transition from non-metered to metered billing.
- Water companies need to ensure metered bills are informative so that customers understand how their water uses impact on their bill.
- Water companies need to identify Londoners that are, or could become, vulnerable to water affordability problems and what they need from a package of measures to help to minimise water affordability problems.
- Water companies and London government need to integrate and roll out existing initiatives to tackle water affordability problems (eg metering, water efficiency retrofitting (RE:NEW programme), tariff system and raise awareness).
- National government needs to set out how the Walker review findings will be implemented in the Water White Paper to ensure a protective system is in place to tackle water affordability problems.

Action 16 The Mayor will lobby Defra to amend the working definition of water affordability to include disposable income after living costs, and for London to have its own water affordability assessment.

Action 17 The Mayor will, through the London Water Group, work with the water companies to manage water affordability In London by:

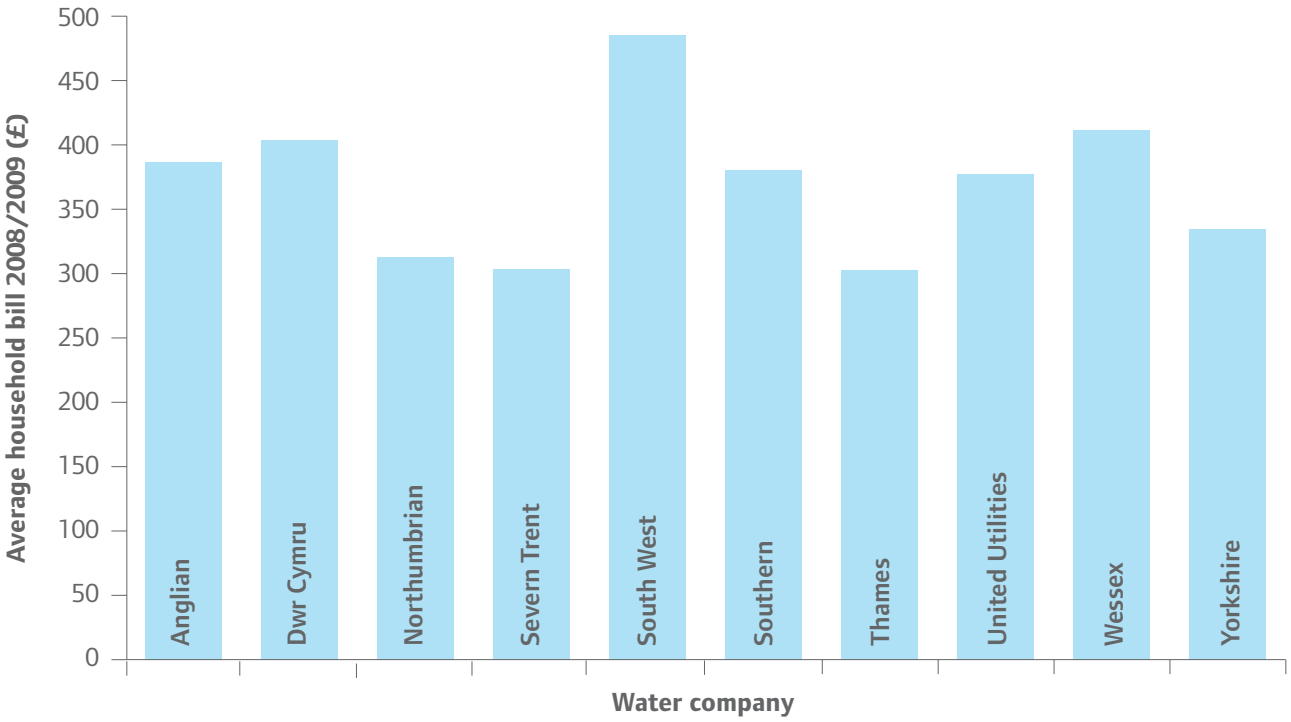
a determining whether a current definition of water affordability is applicable to London
b identifying groups of Londoners that are, or could become, vulnerable to water affordability issues
c identifying the needs of these groups
d examining how the existing initiatives including the Re:new programme, could be integrated and better targeted to tackle water affordability
e lobbing government to secure funding for a water affordability pilot in London.

4.1 Introduction

4.1.1 As discussed in chapters 2 and 3, demand for water is increasing in London and the Mayor believes that increasing metering is the right course of action for London. The Walker Review concurs that universal water metering is the fairest way to pay for water usage[53].

4.1.2 A comparison of the average water services bills in the UK (Figure 4.1) shows that, despite being in a water stressed area,

Figure 4.1 Average household bills for combined water and sewerage by water and sewerage company (adapted from Walker (2009).



Londoners pay less for their water and sewerage than other regions of the UK (average water supply bills for all four companies supplying London are roughly the same). However, London has a relatively higher cost of living compared to many areas across the UK, and so the relatively lower cost of water and sewerage bills does not indicate their affordability.

4.1.3 Most Londoners pay for their water by its rateable value (RV). The RV system charges according to the estimated value of a property, based on the annual rent it would fetch. The RV was the basis on which householders generally paid for their local authority services until 1990. This creates an uneven distribution of charges that do not widely reflect consumption: recent redevelopment means that some properties are undercharged for water consumption, whilst charges may be disproportionately large for large properties with low tenancy[54].

4.1.4 Water bills have two elements; a charge for water and a charge for sewerage. The water element of an unmetered water bill is based on a standing charge (the same for each household) and an additional charge based on the rateable value of the house or flat. Some water companies make the standing charge the largest part of the bill, while others make the rateable value the main part. For the sewerage element, unmetered customers will pay sewerage charges based on the rateable value. Whereas, metered customers will pay for water based on the amount they use (rather than the rateable value of the property). Their sewerage charge will also be based on the amount of water they use. This means metered customers who reduce their water use can potentially reduce both their water and sewerage charges compared to what they would otherwise

be. For water users who use relatively low amounts of water, a metered bill is usually more cost effective.

4.1.5 The Mayor believes that water customers should be enabled to understand their water bills and interact with the information on the water bills so they can manage their water use and any water affordability problems. There has been significant progress in the energy sector through smart metering and visual display units that will enable their customers to:

- measure their energy use in real time;
- understand how they use their energy;
- understand how they can save energy;
- understand how energy saving will impact on their bills.

4.1.6 However, only about six per cent of Londoners are aware of the connection between their water use and their energy bills[55]. The water sector needs to match the progress the energy sector is making on metering technology and the ability to communicate useful information on energy use to customers to inform their choices. Government and Ofwat need to create the framework that will enable customers to understand how, through their own actions, they can reduce and manage their water bills, and the impact on their energy bills. Developments in metering technology and customer communications should be accompanied by education programmes.

4.1.7 Because the majority of water customers currently pay a fixed charge for their water and sewerage services, many Londoners have little understanding of how their bills will be affected by being metered[56]. The Mayor agrees with the Consumer Council for Water that communication with water customers is vital on key issues such as this. The information provided by the meters can empower Londoners to understand how their lifestyle impacts on their water use. And, attitudes and behaviours will determine the success of any drive to help people value water and use it wisely[57].

4.2 Metering and affordability

4.2.1 The Walker Review (see Box 4.1) found that there should be two main objectives for the water charging system – to encourage a sustainable supply of water while being affordable to all, particularly those on low incomes[58]. Water meters on their own do not necessarily reduce and sustain a lower level of water consumption in all households. Varying the price of the water consumed, through tariffs, provides further incentivisation to manage water use. There are a number of different types of tariff – the most common are 'rising block' tariffs, where increasing water use becomes progressively more expensive in a series of predetermined thresholds, and 'seasonal' tariffs, where water is more expensive in summer than in winter, reflecting the seasonal availability of water.

4.2.2 Moving to universal metering will have a varied impact on Londoners. Unmetered households that use a lot of water have effectively been 'protected' from paying for the amount of water they use and if metered are likely to pay more for their water services. In response to concerns regarding the potentially disproportional impact of metering on poorer Londoners, the Mayor and the Environment Agency jointly undertook a study[59] into the likely social effects of the widespread introduction of domestic water metering in London and the wider South East. The research examined three metering scenarios (50, 60, and 90 per cent metering by 2015) and found that:

Table 4.1 Water Charge Affordability by Tariff Policy and Household Composition[61]

Percentage of households spending >3 per cent of weekly income on water & sewerage bills by 2014/15	Current Tarriffs	Zero SC	Rblock Fixed	Rblock Variable	Seasonal	Property band
All Households	9.5%	9.4%	9.4%	9.4%	9.1%	8.9%
All other households with children	16.5%	17.0%	18.0%	18.0%	15.9%	16.1%
Households (excluding single parents) with three or more children	37.9%	37.9%	38.8%	37.6%	35.1%	39.0%
Single parent households with children	22.4%	22.0%	21.8%	21.9%	21.6%	18.9%
Non-pension age households with no children	5.4%	5.3%	5.0%	5.0%	5.3%	4.8%
Households with one adult of pension age	3.8%	3.1%	2.8%	2.8%	3.8%	3.1%
Households with more than one adult of pension age	6.9%	6.7%	6.7%	6.8%	6.7%	7.2%

- Under the more widespread metering scenarios, more households will benefit from lower bills than the number of households experiencing higher bills. However, the projected savings will be marginal (about £20 per year).
- However, those households with higher bills will face an average increase in costs that is notably higher than the average decrease in costs for those households with lower bills.
- Increased metering will have varying effects on costs in different parts of London because of differences in the types of housing, sizes of households and levels of income.
- For the lowest income households, there is evidence that their bills may reduce slightly as metering rises to 50 per cent to 60 per cent metering. This may partly reflect smaller households benefiting from metering and the exclusion under these scenarios of a higher proportion of flats being metered.
- Only under the 90 per cent metering scenario is there evidence that water bills will tend to worsen and this will be concentrated in the lower income groups and categories such as single parent households and households with three or more children. As a 90 per cent scenario is capturing a greater proportion of single parent families that would be better off remaining on unmetered charges.

4.2.3 The research also looked at the impact different tariffs[60] could have on reducing the number of households that were disproportionately negatively affected. The research found that:

- none of the assessed tariffs would significantly soften the effects of moving to higher levels of household water metering (table 4.1 summarises the impact of the tariffs on the household groups)
- low-income households did best under a tariff that related the metered water charge to the council tax band of the property

- low water users like single pensioner households would benefit from rising block options.

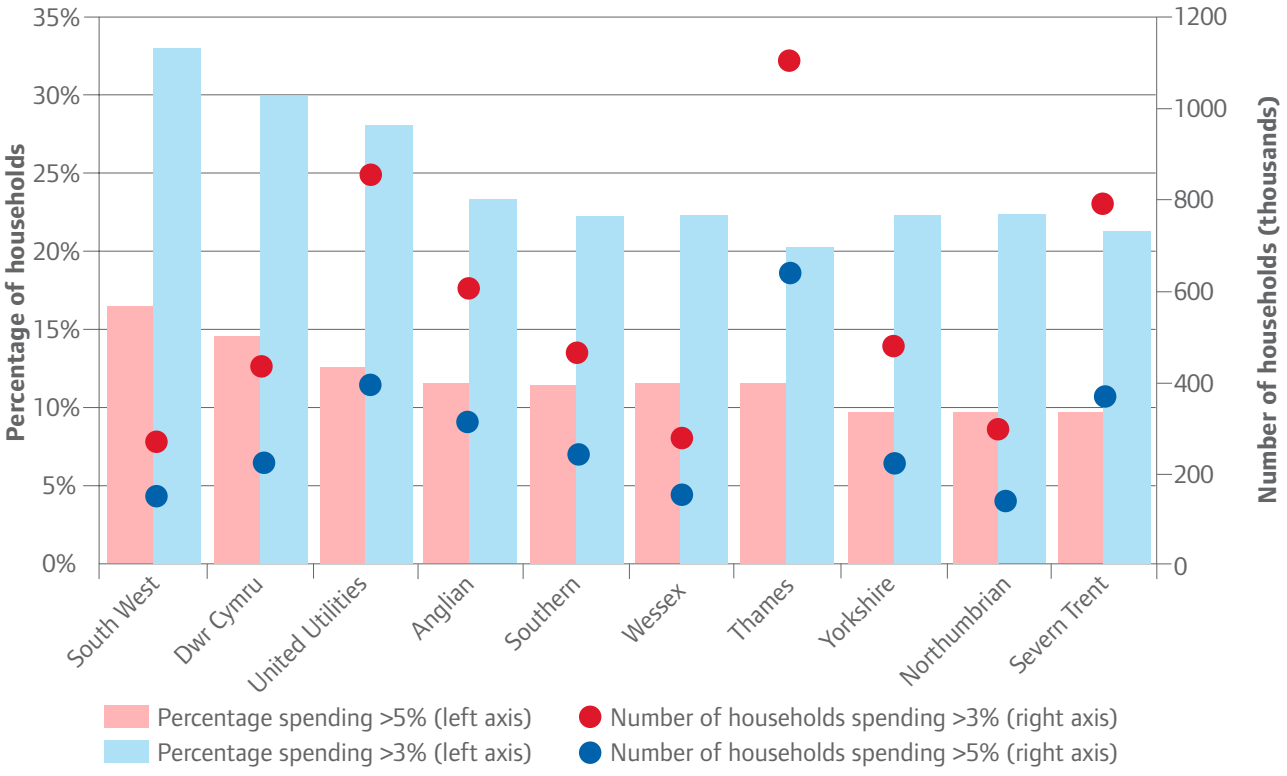
4.2.4 In order to properly address affordability concerns through changes in metering and tariff policies an explicit relationship between the metered tariff and 'ability to pay' would be required. Or an arguably more effective approach would be to direct financial support to the most vulnerable households. For example, through an expanded and extended WaterSure scheme to ensure that low income groups such as pensioners are protected even if they do not have a medical requirement for high water use, or do not have three or more children, or through the Walker Review recommendations.

4.3 Water affordability in London

4.3.1 The concept of 'fuel poverty' is readily recognised[62] and the government has developed a number of programmes to tackle it, but a significant proportion of Londoners' struggle to pay their water services bills and could be considered to be in 'water affordability'. Unlike fuel poverty, there is no universally accepted definition for water affordability, but a commonly accepted working definition is 'a household that spends more than three per cent of disposable income on water services bills[63].

4.3.2 There is currently no agreed figure for the number of Londoners facing water poverty. This is partly due to different definitions being used, and that calculations for water poverty are based on sewerage company boundaries rather than administration boundaries.

Figure 4.2 Proportion and number of households who spend more than three per cent and 5 per cent of income on water and sewerage bills, by sewerage company area.



Source: Ofwat[64]

4.3.3 An analysis by Ofwat shows that Thames Water has the highest number of households with 'water affordability' problems, over a million customers; this may in part be due to the number of households the company serves. 71 per cent of Thames Water's customer base is in London. Thames Water's own analysis suggests that 200,000 of their unmetered customers in London face water affordability problems, and approximately 300,000 of their total customer base. Part of the reason for the different magnitudes of customers between the Ofwat and the Thames Water analysis is due to different definitions for calculating 'households in water affordability'. Thames Water's calculations are based on income without any reduction for housing costs.

4.3.4 London has higher living costs than other cities in the UK. It also has different socio-economic characteristics to other areas that Thames Water covers such as Oxfordshire. These characteristics will be contributing factors to the level of households facing water affordability problems.

Action 16 The Mayor will lobby Defra to amend the working definition of water affordability to include disposable income after living costs, and for London to have its own water affordability assessment.

4.3.5 Water affordability assessments can be based on district metering areas. This could help stakeholders target water affordability programmes more effectively, as it would help define areas with high densities of customers with affordability issues. This could be particular useful when metering is rolled out. An analysis by the Environment Agency[65] suggests that bill increases or decreases associated with universal metering will vary by location in London.

4.3.6 The fact that over 200,000 Londoners are already facing water affordability problems is already an issue of concern. However, as identified previously, the move to universal metering is likely to mean that more households are likely to fall into the water affordability category. There is particular concern that water metering of certain households such as large, low-income, households and those with particular care requirements could lead to cut backs on essential uses, such as on personal hygiene. There is some evidence to support this concern[66 67], although attempts to prove that this leads to higher rates of disease have failed to show a link. Nevertheless, adequate water is vital to halting the chain of infection and therefore a basic minimum for essential hygiene should be available to all at an affordable price.

4.3.7 Water affordability problems are not properly addressed through the current system of paying for water services. The RV system is not designed to tackle water affordability, or to encourage customers to save water. Low-income customers who are not metered are already seeing their bills rise faster than metered bills, as the sizeable cross subsidies in the rateable value system are eroded[68].

4.4 Tackling water affordability

4.4.1 There is a range of different options to tackle existing, and reduce future water affordability issues:

a tariffs
b social protection
c water efficiency retrofitting
d combined options

Tariffs

4.4.2 As noted previously, tariffs on their own do not appear to provide a 'magic bullet' to reducing water affordability issues.

However, tariffs can help to alleviate some of the impact, but different groups of water customers with water affordability issues may benefit from different types of tariffs and so providing a mix of tariffs needs consideration. Thames Water recognises concerns with regard to the pace of the metering programme and has proposed mechanisms, such as the social tariffs, to protect the most vulnerable customers[69]. In their revised draft Water Resource Management Plan, Thames Water proposed a 15-year progressive programme of targeted compulsory metering of households reaching 77 per cent meter penetration across London. They believe that a targeted programme will result in minimum or deferred impact on vulnerable groups. They propose the introduction of sophisticated tariffs when the level of meter penetration is considered sufficiently high to make the option effective in their view (during 2017-2018).

4.4.3 If tariffs are part of the system to manage the impact of metering on vulnerable groups then they should be in place as soon as vulnerable groups are potentially affected. If they are not in place then the Mayor would like assurances that there are other schemes in place to manage the transition and the impacts on vulnerable groups. Otherwise there may be a significant impact on bills for the customers who remain on unmetered charges as the metering programme progresses and the cross subsidies are reduced. They could potentially face a disproportionate share of water companies' costs. Many of these customers may live in properties that are difficult to meter such as blocks of flats and could be in lower income groups[70].

4.4.4 Pending the approval of a universal metering programme, the Mayor will work with Thames Water to understand the practicalities and advantages of tariff change. Thames Water proposed large-scale tariff trials to refine their policies for tariffs, if their metering programme is approved.

4.4.5 Another option to address water affordability would be to provide an initial allowance of water sufficient for health and hygiene at very low cost, followed by a rising block tariff. Waterwise[71] looked at this option and made the following assessment: If the allowance was made available to all households it heightened affordability issues, because the tariffs for water consumption after the allowance had higher prices to compensate for the 'free water'. If the allowance was targeted only at low-income households, it led to a reduction on affordability impacts for low-income families, however this was limited and so may require additional mechanisms to help alleviate water affordability issues.

Water affordability assistance schemes

4.4.6 'WaterSure' is an existing water affordability assistance scheme to help some vulnerable groups that may struggle to pay their water bills. The scheme works by capping bills. It helps some customers who pay for their water charges via a water meter and could experience difficulties as a result of high water usage, or low income. Londoners are eligible to apply if a member of their household is in receipt of benefits and:

- has a specified medical condition that leads to higher water use, or
- have three or more children under the age of 19.

4.4.7 However, only 26 per cent of Londoners have a water meter, which is a pre-requisite for WaterSure. There is debate over the type

of water affordability assistance scheme that would help the increasing numbers of people who could be classed as having water affordability problems due to increasing levels of metering. This scheme could be an expansion and extension of the existing WaterSure scheme; or a water tariff based system; or a government social protection scheme. Part of this debate revolves around who funds the system – water customers, or taxpayers.

Water efficiency

4.4.8 Another way of assisting vulnerable households is to help them become more water efficient to reduce their water use (see chapter 3). This would then give low-income households the opportunity to become more water efficient and would help support the behavioural changes required to lower water use further. The potential savings in water and energy costs for an average household are shown in Table 3.2. The Mayor's RE:NEW programme focuses on reducing carbon dioxide emissions from homes; it should also help many households at risk of water affordability problems by fitting water effiency devices and reducing their water use. The new government proposal for a Green Deal scheme[72], which could involve giving every home up to £6,500 worth of energy improvement measures – paid for out of the savings made on fuel bills, should include water efficiency measures. However, this may not help many low-income families as fewer families own their own home. Targeted water efficiency measures can also be dovetailed with metering programmes to help those households with water affordability problems.

Combined options

4.4.9 As no single measure is likely to tackle water affordability on its own, a combination of the above approaches will be required. The Mayor believes that we have many of the measures needed to minimise water affordability issues, it is just a case of optimising their implementation.

Action 17 The Mayor will, through the London Water Group, work with the water companies to manage water affordability In London by:

a determining whether a current definition of water affordability is applicable to London
b identifying groups of Londoners that are, or could become, vulnerable to water affordability issues
c identifying the needs of these groups
d examining how the existing initiatives including the RE:NEW programme, could be integrated and better targeted to tackle water affordability
e lobbing government to secure funding for a water affordability pilot in London.

BOX 4.1 Walker Review

The government commissioned Anna Walker to undertake an independent review of water metering and charging[73]. The review recommends that a new, more closely targeted, package of help should be put in place, including:

WaterSure:

- The scheme should be refined to include low-income metered customers with medical conditions only. This will require a change to the Vulnerable Groups Regulations
- WaterSure recipients' bill should be capped at a level at least as low as the national average metered bill, or their actual metered charges, whichever is the lowest.
- Companies and healthcare professionals should increase awareness of the WaterSure scheme to increase uptake.

- the Department of Health should review the provision of medical certificates with the British Medical Association to agree free certificates for WaterSure applicants.

Discounted bill for low-income metered households:

- Low-income metered households in receipt of certain means-tested benefits and tax credits should be eligible for a 20 per cent discount on their volumetric bill.

Discounted tariff for low-income metered households with children:

- There should be discounted tariffs for low-income metered households with children.
- Water efficiency and benefit entitlement check programme:
- Targeted water efficiency measures and benefit entitlement check programmes should be introduced where possible as part of programmes such as Warm Front, and the Homes Energy Efficiency Scheme.

Government and Ofwat

- The government should consult further once they have taken a decision on who should pay for affordability measures.
- Ofwat should track affordability problems facing the water industry and should take appropriate and/or provide advice to the government to ensure that water and sewerage services remain affordable. And report on the position of 'affordability' in an annual report on affordability and debt.

The Mayor of London supports the recommendations of the Walker Review, and would like the government to describe how these will be implemented in the Water White Paper.

CHAPTER FIVE

MANAGING RAINWATER

Vision

The Mayor's vision is that we adopt a more creative approach to managing flood risk from rainfall in London. Taking opportunities to slow the progress of water from 'rain to drain' and using rainwater for non-potable uses to reduce demand for treated mains water.

From vision to action

The sustainable management of rainwater drainage in London will only be possible if all the partners, from government to Londoners, collectively work to reduce the amount of water entering into the drains. This means:

- All the organisations with a responsibility for surface water management need to work collaboratively to identify what is the best scale and location to manage surface water flooding.
- These same organisations need to investigate more sustainable alternatives to ever-increasing the drainage network and demonstrate the cost-benefits of 'green' vs 'grey' infrastructure.
- Londoners need to be assisted to see themselves as part of the solution, rather than victims of the outcome.

The Mayor applies the following hierarchy for the drainage of rainwater in the London Plan. The aim is to manage as much water as possible towards the top of the hierarchy:

1 Store rainwater for later use
2 Use infiltration techniques, such as porous surfaces in non clay areas
3 Attenuate rainwater in ponds or open water features for gradual release
4 Attenuate water by storing in tanks or sealed water features for gradual release
5 Discharge rainwater direct to a watercourse
6 Discharge rainwater to a surface water/drain
7 Discharge rainwater to the combined sewer.

Action 18 The Mayor will work with partners through the Drain London Forum to manage surface water flood risk and ensure a consistent approach across London. This will include:

a identifying flood risk hotpots and working with partners to determine who is best placed to manage these
b developing a Community Flood Plan Programme to support communities that wish to increase their resilience to flooding
c developing at least three demonstration projects to show how urban greening measures can help to manage surface water flood risk.

5.1 Introduction

5.1.1 This chapter is concerned with the drainage of rainwater away from homes and businesses in London. Following this, chapter 6 examines the removal of wastewater. The Mayor's Climate Change Adaptation Strategy[74] focuses on managing flood risk from rivers and the sea.

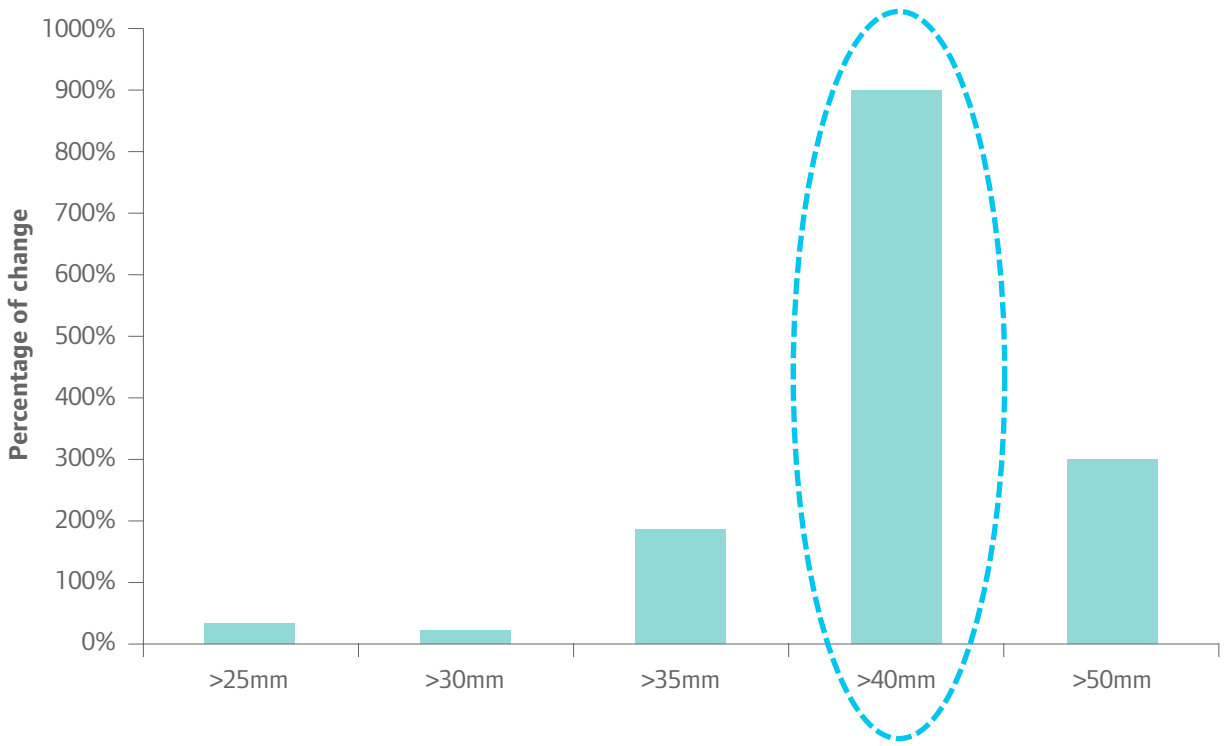
5.1.2 Rainwater either evaporates to the atmosphere, seeps into the ground to replenish groundwater levels, flows over the ground and returns to streams and rivers, or enters the drainage systems. London has two distinct drainage systems (see Figure 6.1). In central and inner London, the system is a combined drainage network (called the combined sewer), that takes both rainwater and wastewater away from buildings. The problems associated with the combined system are mainly related to its capacity, these are considered in chapter 6. In outer London the rainwater system is separate and drains rainwater into streams and rivers whilst the foul sewer drains sewage to sewage treatment works (STW). The problem with this system is that there are widespread misconnections between the

two systems – these are also considered in chapter 6.

5.1.3 The intensity of rainfall has increased. Research[75] into daily rainfall intensity in London shows that from 1960 onwards more extreme daily rainfall has been observed. More than 15mm of rain in a single day is a considered a 'heavy rainfall day'. The observed increases are for rainfall events above the 15mm threshold. Prior to 1960, only one day recorded rainfall exceeding 40mm, compared to ten days after this period (Figure 5.1). A day with 45mm rainfall had a 30 year return period before 1960, and now has less than a one in six year return period of occurrence. The analysis relates to a single location in east London, but the results hint that the findings may apply across London. These trends would have been missed under an analysis of annual or monthly records, demonstrating the importance of analysing data that is of the temporal and spatial scale relevant to the outcome.

5.1.4 On top of wetter winters, heavy rainfall events are projected to become more frequent and intense in the future. One analysis[76] suggests that a one in 30 year rainfall event today, is likely to double in frequency by the middle of the century and that a one in 100 year event today is likely to have trebled in frequency by the end of the century. This is of significant concern because London's drainage system is designed to manage up to a one in 30 year event, but in practice is often maintained to a lower standard. So across London, drainage systems could fail more frequently causing localised flooding. Action is needed to manage this 'avoidable' flooding (see Managing Surface Water Flood Risk).

Figure 5.1 Percentage increase in total daily rainfall levels from 1960-2006 compared to the pre-1960 period



(adapted from Lloyds (2010). East London Extreme Rainfall Importance of Granular Data).

5.2 Surface water flooding

5.2.1 London is reliant upon a network of drains, rivers and greenspaces to keep dry. Surface water flooding occurs when rainfall can neither soak into the ground nor drain away through the drainage system. Therefore, surface water flooding can result from prolonged periods of rainfall, when rain falls on ground that is already waterlogged, during rapid snowmelt, or during very heavy rainfall, when the intensity of the rainfall overcomes the capacity of the drainage system.

5.2.2 The flooding that occurred in the summer of 2007 (see Case Study 5.1) was a powerful reminder that surface water flood risk is a real and present threat. The Mayor's Regional Flood Risk Appraisal[77] identifies that surface water flood risk was poorly understood and recorded and therefore presents an inadequately quantified and potentially significant risk to London. The London Climate Change Adaptation Strategy goes further and proposes that surface water flood risk is the greatest short-term climate risk to London.

Case Study 5.1 Summer 2007 floods

Nationally, more than 55,000 homes were flooded during the summer of 2007. The wettest summer since records began in 1766 caused misery for hundreds of thousands of people and more than £3 billion of insured losses. The wet May and early June meant that the ground was saturated and could no longer absorb rainfall. Extreme rainfall in late June and late July caused flash flooding where it fell and then accumulated in rivers to extend the impact to the floodplain. London did not escape the effects of this wet weather, 390 properties were flooded, including 158 schools and parts of two hospitals[78]. Whilst this weather was extremely unusual for summer, climate change is predicted to cause wetter winters with more extreme rainfall events and therefore floods of this scale should be expected in the future.

Managing surface water flood risk

5.2.3 Solving the problem of surface water flooding by enlarging the drainage system alone, even if technically feasible, would be prohibitively expensive. The Mayor has therefore developed a multi-faceted approach to managing surface water flood risk in London. This involves:

a bringing together the organisations with responsibility for and information on surface water flood risk management in London to take and share responsibility
b mapping, identifying and prioritising areas at risk of surface water flooding
c assessing the different flood risk management options, seeking opportunities for multi-functional benefits
d publishing planning policies to encourage a more sustainable approach to surface water management.

5.2.4 The summer 2007 floods and the subsequent Pitt Review[79] into lessons learnt from the floods, led government to review its flood risk management policy and publish the Flood and Water Management Act 2010 (FWMA)[80]. The FWMA defines responsibility for managing surface water flood risk, giving the Environment Agency overall strategic responsibility and within London, London boroughs have the local responsibility.

5.2.5 Because so much of London's surface is concrete and tarmac, and therefore impermeable to rainfall, we are very reliant upon our drainage system to keep us dry. However, the responsibility for drainage

currently rests with many agencies, including Thames Water (for their drainage network), the Environment Agency (for main rivers), the London boroughs (for land drainage and the local road network), Transport for London and the Highways Agency (for their road networks) and private landowners. Until recently, no single agency had responsibility for reporting, or recording, surface water flooding as it occurred and there was no mechanism for bringing the parties together to identify and manage the risk.

5.2.6 This confusion over responsibilities led the Mayor to create a partnership involving all the organisations with responsibility for and information on surface water management in London. The partnership, called the Drain London Forum, undertook a scoping study to assess how much was known about the location and ownership of London's drainage network and to propose a process through which information can be shared and maintained in order to develop Surface Water Management Plans for each London Borough and a Londonwide overview of surface water flood risk and management options.

Building and sharing responsibility

5.2.7 Under the terminology of the FWMA, London boroughs are 'Lead Local Flood Authorities' (LLFAs) with a requirement to produce a Local Flood Risk Management Strategy. Boroughs are also required to produce a Local Flood Risk Management Plan under the Flood Risk Regulations 2009. The Drain London project has delivered a Surface Water Management Plan (SWMP) for every London Borough. This SWMP will be the key piece of evidence for boroughs to use in producing their Local Flood Risk Management Strategies and Plans. Through this unified approach the Drain London Forum is ensuring that borough approaches are consistent and coherent with neighbouring boroughs and enable a London wide overview.

5.2.8 The Drain London Forum has also created informal borough partnerships which group boroughs into groups consistent with the representation of Members of the Environment Agency Regional Flood and Coastal Committee (RFCC). This is at an early stage but offers good opportunities to improve communications with regional level organisations such as Environment Agency and Thames Water and opens up new opportunities to access the flood risk management funding allocated by the RFCC.

5.2.9 A key component of communications will be to ensure that each borough addresses its LLFA role in an integrated way across various borough departments. There are clear roles for highways/drainage departments, emergency planning, spatial planning, and potential roles for parks/open space, housing/estates and communications/ engagement departments.

Mapping, identifying and prioritising flood risk areas

5.2.10 Following the scoping study, the Drain London Forum was awarded £3.2million government funding to manage surface water flood risk in London, in conjunction with the 33 boroughs and other strategic drainage stakeholders. The first outputs are the SWMPs for each borough, which identify Local Flood Risk Zones and the Critical Drainage Areas that contribute to the flooding in those areas. The project will go on to assist in the delivery of green infrastructure (eg green roofs), Community Flood Plans, detailed investigation of high priority Local Flood Risk Zones and Demonstration Rainwater Storage Projects.

It will also enable the Mayor and strategic partners to focus on those elements of critical infrastructure that may be at risk of surface water flooding across London.

5.2.11 Each London borough, as a Lead Local Flood Authority will have to produce, consult on and adopt a Local Flood Risk Management Strategy and Plan over the next few years, these will be based on the Drain London SWMPs.

Action 18 The Mayor will work with partners through the Drain London Forum to manage surface water flood risk and ensure a consistent approach across London. This will include:

a identifying flood risk hotpots and working with partners to determine who is best placed to manage these

b developing a Community Flood Plan Programme to support communities that wish to increase their resilience to flooding

c developing at least three demonstration projects to show how urban greening measures can help to manage surface water flood risk.

Flood risk management options

5.2.12 As noted above, the cost of enlarging London's drainage network would be prohibitively expensive. *A Blueprint for a Green Economy*[81] notes that we need 'slow water'. Slowing water down by capturing, absorbing or temporarily retaining, rainwater reduces pressure on the drainage system and can provide wider, additional benefits. It is also necessary to ensure that tried and tested emergency plans exist for vulnerable communities and that critical assets at flood risk are made flood resilient.

Capturing and using rainwater

5.2.13 Using rainwater before it goes down the drain can help to relieve the pressure on the drainage system. Instead of using water from the mains, businesses and householders could use rainwater for toilet flushing, clothes washing and outdoor uses. Non-potable uses may account for over a third of all water used within a house. Using rainwater has the added benefits of reducing the amount of water and energy needed to supply water and reducing the bills for water consumers. Correctly collected and stored rainwater can meet all these requirements with little treatment.

Sustainable Drainage

5.2.14 Conventional drainage systems, with pipes and sewers, are designed to take surface water away from streets and buildings as quickly as possible and discharge it into the main sewers and watercourses. Sustainable drainage systems (SuDS) seek to mimic natural drainage, managing more water closer to the source, in order to reduce the volume and speed of waters flowing into sewers and watercourses after storms, and therefore reduce the risk of flooding. The effectiveness of some infiltration SuDS methods is limited where the geology is impermeable clay.

5.2.15 Some SuDS methods, such as using porous surfaces to let rainwater to soak into the ground, can avoid, or reduce, the need to construct surface water drains to distant outfalls. At the same time, many SuDS methods can improve the environment through the creation of habitats, such as ponds, reduce pollution and help cool the city. Imaginative sustainable drainage schemes can be developed as attractive landscape features, providing interesting opportunities for local people to enjoy

nature. The London Climate Change Adaptation Strategy proposes a London-wide 'urban greening programme' with an emphasis on central London to combat increasing flood risk and rising summer temperatures.

5.2.16 The Code for Sustainable Homes also promotes the management of surface water run-off in new development. The code requires that surface water run-off rates and annual volumes should be no greater after new homes have been built than before. Further requirements apply where rainwater holding facilities or SuDs are used to attenuate run-off into either natural watercourses or surface water drainage systems[62]. In London where over 96 per cent of new housing is constructed on brownfield sites, the Mayor expects to see significant reductions in surface water run-off following such redevelopment.

5.2.17 In the past, householders faced few barriers to increasing the amount of impermeable paving around their property. Paving front gardens was a permitted development right and therefore could generally be carried out without planning permission. Growing recognition that this gradual loss of permeability in urban areas, known as 'urban creep', has increased flood risk, led government to amend planning legislation. London Wildlife Trust has estimated that an area of London's gardens equivalent to around 2.5 Hyde Parks is lost from vegetation to hard surfaces each year[82]. Planning permission is now required for impermeable surfaces in front gardens larger than five square meters[83]. However, this tightening up of planning policy to limit further loss of permeability of front gardens has been offset by a relaxation on the construction of extensions and conservatories on back gardens.

5.2.18 The FWMA also amends section 106 of the Water Industry Act 1991 to make the right to connect surface water run-off to public sewers conditional on meeting the new standards. It gives the responsibility for approving SuDS in new development, and adopting and maintaining them where they affect more than one property, to a SuDS approving body, which in London will be the boroughs.

Emergency planning and building resilience

5.2.19 Each London borough has produced a Multi-Agency Flood Plan, which sets out how the borough will respond to a flood and the assistance it can expect from neighbouring boroughs and central government. The Mayor is keen that communities at high risk of flooding also develop their own Community Flood Plans, that set out how the community will respond to a local flood and what help they need and can expect from their borough and emergency services. The Drain London project will fund the development of at least two pilot Community Flood Plans, with the aim of enabling every community at high risk to develop their own plans.

5.2.20 Consideration also needs to be given to the ability of the existing water infrastructure (such as water treatment plants and pumping stations) to cope with flooding. This includes assessing both the resilience of the whole supply network and the network's ability to cope with the vulnerability of individual sites. Under the Climate Change Act, water companies are required to identify their

assets at risk and manage the risks to key assets.

5.2.21 Londoners can find out about measures that could increase the resilience of their homes to flooding by checking out the London Climate Change Partnership guide 'Your Home in a Changing Climate' available at: www.london.gov.uk/lccp/publications/home-feb08.jsp. English Heritage has also produced a guide targeted at heritage buildings, this is available at: www.climatechangeandyourhome.org.uk

Planning policy

5.2.22 In response to the challenge of managing flood risk, the Mayor has developed a 'drainage hierarchy' in the London Plan (Policy 5.13). This encourages developers to recognise the contribution of their development to both increasing and managing surface water flood risk.

Policy 2 Drainage Hierarchy

The Mayor applies the following hierarchy for the drainage of rainwater in the London Plan, the aim is to manage as much water as possible towards the top of the hierarchy:

1 Store rainwater for later use
2 Use infiltration techniques, such as porous surfaces in non-clay areas
3 Attenuate rainwater in ponds or open water features for gradual release
4 Attenuate rainwater by storing in tanks or sealed water features for gradual release
5 Discharge rainwater direct to a watercourse
6 Discharge rainwater to a surface water/drain
7 Discharge rainwater to the combined sewer.

5.2.23 The Mayor specifically encourages green roofs and sustainable drainage through planning policies in his London Plan (Box 5.1).

Box 5.1 Green roofs and development site environs, London Plan Policy 5.11 (Mayor of London 2011. London Plan)

Planning decisions

A Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:

a adaptation to climate change (ie aiding cooling)
b sustainable urban drainage
c mitigation of climate change (ie aiding energy efficiency)
d enhancement of biodiversity
e accessible roof space
f improvements to appearance and resilience of the building
g growing food.

LDF preparation

B Within LDFs boroughs may wish to develop more detailed policies and proposals to support the development of green roofs and the greening of development sites. Boroughs should also promote the use of green roofs in smaller developments, renovations and extensions where feasible.

5.2.24 The Mayor's Supplementary Planning Guidance for Sustainable Design and Construction sets the standards for drainage in new developments. Table 5.1 outlines these standards.

5.3 Flooding from groundwater

5.3.1 The majority of groundwater in London is found in the chalk layers of the 'London Basin'. The London Basin is 'u-shaped', with tens of metres of sands, silts and clays overlaying layers of chalk across most of the central part of London. Further away from

Table 5.1 Supplementary planning guidance on Sustainable Design and Construction

Essential Standards	Mayor's Preferred Standards
Use sustainable drainage systems (SUDS) measures, wherever practical. Achieve 50 per cent attenuation of the undeveloped site's surface water run off at peak times	Achieve 100 per cent attenuation of the undeveloped site's surface water run off at peak times

the centre of London, the chalk comes to the surface (outcrops) forming the higher ground to the north (Chilterns) and to the south (North Downs). This geology is illustrated in Figure 2.1.

5.3.2 Flooding from groundwater is a general term that can refer to two broad categories: Groundwater Flooding and Rising Groundwater.

Groundwater flooding

5.3.3 Following prolonged periods of rainfall, groundwater flooding can typically last weeks, and tends to happen late in the winter when groundwater levels reach a peak. It usually results from poor drainage or where proper attention has not been paid to the geology of the site when constructing buildings. High groundwater levels near sewers can cause sewer flooding or make the groundwater flooding more unpleasant and a potential health hazard.

5.3.4 Our understanding of groundwater flooding is far from complete. The Environment Agency has the strategic overview for monitoring groundwater flooding. As part of its responsibility, the agency will collate records, as well as assess and monitor the problems associated with groundwater flooding. At the same time, the agency will consider ways to incorporate the risk information into its flood risk mapping strategy. The Drain London project has produced maps for each London borough which collate up to four separate groundwater data sets to provide a map of Indicative Potential for Elevated Groundwater (IPEG). This should improve the awareness and understanding particularly for those at risk, as well as for land-use planners and developers. London boroughs, as the lead local flood authorities must consider groundwater flooding in their Local Flood Risk Management Strategy and Plan.

Rising groundwater

5.3.5 The chalk layers under London offer a pollution-free source of water. With the growth of industry in the 19th and early 20th centuries, the volume of groundwater abstractions rose steadily resulting in a widespread lowering of the groundwater levels. These abstractions gradually declined after World War II as industry began to move away from London. Some of the large public abstractions ceased in the late 1950s and throughout the 1960s. By the late 1970s, the rebound of chalk groundwater levels was noticeable.

5.3.6 During the period of intensive groundwater use an extensive range of underground infrastructure was built in London. This includes building foundations, electricity, gas and telecommunications, road and foot tunnels and most notably the London Underground network.

5.3.7 Until recently, rising groundwater levels were placing London's underground infrastructure

at a real risk from inundation. In 1999, a team started to investigate how best to resolve the problem. It concluded that abstractions from London's groundwater should increase by 50 million litres of water a day. Since then, the Environment Agency has granted licences to take the surplus groundwater. It is the agency's view that the chalk groundwater levels are now being managed in a stable manner and no longer pose a significant threat to the underground infrastructure.

5.3.8 Interest in the use of groundwater for cooling buildings and infrastructure has been growing at the time when the Environment Agency's concern has shifted from the problem of rising groundwater levels to the need to stabilise groundwater levels. The Environment Agency has to issue an abstraction licence in order to permit groundwater to be used for cooling a building. The Agency is increasingly requiring the water to be returned to the aquifer after use in order to achieve stability rather than for it to be drained away or used for other purposes.

5.4 Diffuse pollution

5.4.1 Diffuse pollution arises from a number of sources, rather than from a single source (known as point source pollution). Individually the sources may be small and diverse, yet their collective impact is often damaging. Urban run-off typically contains pollutants such as organic waste, pesticides, fertilisers, hydrocarbons and nutrient sediment. It is caused when rainfall 'washes' pollutants from roads and other paved areas via drains into watercourses (see chapter 6). Many watercourses are lacking in vegetation that can allow such contaminants to settle out or be absorbed. This problem is acute in the London area because of the extent of urban land use. Another source of contamination arises from misconnections of properties to surface water drains (see Chapter 6).

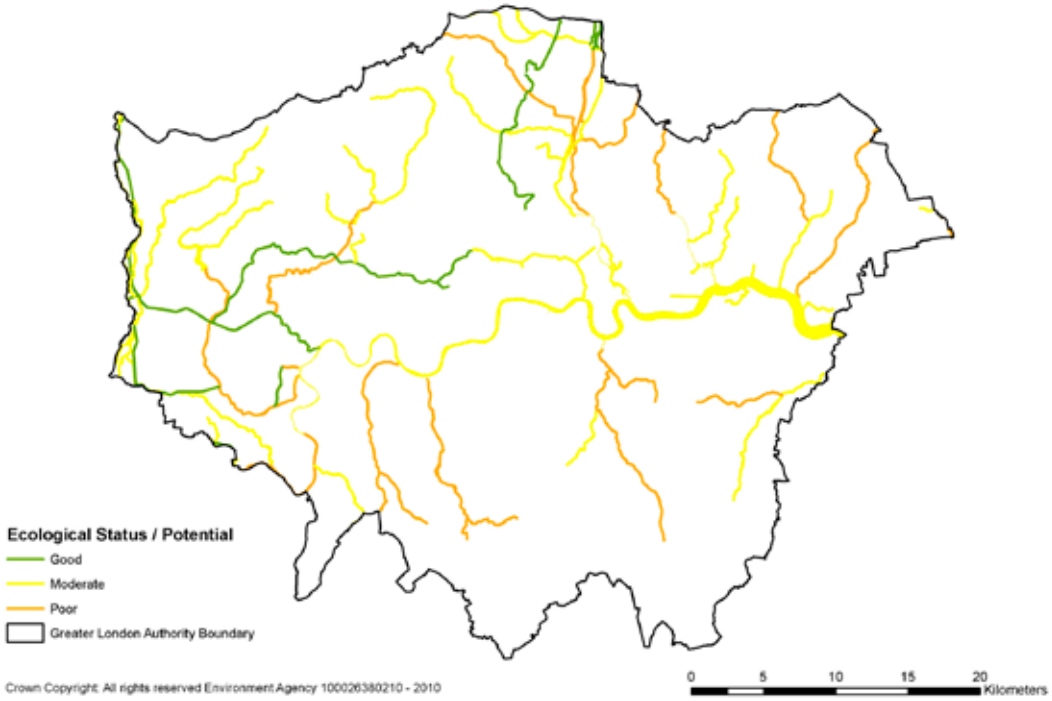
5.4.2 Unlike point source pollution, it is not as easy to control diffuse pollution through permits or licences. Here the regulatory approaches require a greater degree of subtlety and/or more innovative approaches such as specific projects to address pollution.

5.5 Water Framework Directive

5.5.1 The Water Framework Directive is a European Union Directive designed to protect and improve the environmental condition of all water bodies. It applies to surface waters (including lakes, streams and rivers), groundwater, estuaries and coastal waters (out to one nautical mile).

5.5.2 The directive aims to deliver 'good ecological status/potential' by 2015 based on assessments of the chemical, physical and ecological health of water bodies. The Environment Agency has published River Basin Management Plans[84] (RBMPs) that assess the pressures and impacts on surface water and groundwater bodies and a list of actions (known as measures) to ensure that they meet the objective of good ecological status or potential. London is covered by the Thames RBMP which was published in December 2009. The Mayor is disappointed with the document as it is extremely long and complex and it is not at all clear that the measures will achieve the aims intended. The Mayor will work with the Environment Agency to improve the RBMP over further iterations up to 2027.

Figure 5.2. Ecological Status of Rivers in London, River Basin Management Plan



5.6 Rivers and canals

5.6.1 Pollution and the loss of habitat (often an important buffer to diffuse pollution) has led to a deterioration in the quality of London's rivers throughout the 19th and 20th centuries. It is only in the last 40 years that there has been an improvement in the quality of the River Thames.

5.6.2 Despite the improvements in river quality, many Londoners still think the Thames contains little, if any, life. People typically cite its muddiness (which is natural in a tidal river) and the floating rubbish as evidence of its apparent 'inert' state. Yet, more than 100 species of fish have been found in the Thames Estuary in recent years, many of them within London, including wild Atlantic salmon, trout, dover sole, plaice, eel, haddock and bass. There are regular sightings of grey heron and cormorant along the Thames in central London – evidence of its fish life. Dolphins, seals and seahorses have also been seen although a sighting is different to an established or stable population living in the Thames.

5.6.3 However, there is room for improvement in fish status across many of London's rivers. Many rivers are still encased in flood protection concrete straitjackets, and along with degraded habitats make water quality standards challenging to achieve. The Mayor has worked with the Environment Agency and other partners to produce the London Rivers Action Plan[85]. This is an active programme of river restoration across London.

5.6.4 The first assessment and classification of London's rivers under the Water Framework Directive has been completed (Figure 5.2) and whilst some rivers are rated as good,

many rivers in the Greater London area are of poor or moderate ecological status.

5.6.5 Over-abstracting water from rivers can have long-term impacts on the biodiversity which also depend on that water for their survival. Lower water volumes can result in fish becoming stranded. Also, lower volumes of water are generally more sensitive to external temperature changes. During hot weather, low water volumes can have higher temperatures reducing the level of dissolved oxygen in the water which fish and other aquatic life need to survive. Low river flows can also result in reduced spawning success, because fish are unable to reach the suitable areas of the river to lay their eggs and for the juvenile fish to grow. This can have a negative impact on fish populations for years to come.

CHAPTER SIX

DISPOSAL OF WASTEWATER IN LONDON

Vision

The Mayor believes that wastewater should be seen as a resource and not a by-product that is best kept out of mind. Opportunities should be sought to not just reduce the greenhouse gas emissions from wastewater, but to use it as a source of low-carbon energy.

From vision to action

To achieve the vision, collective action is required from government to Londoners - this means:

- water companies should develop new wastewater resources cost effectively and with the least environmental and social impacts as possible
- Defra needs to enable the development of using sewage to generate renewable energy by tackling regulatory barriers
- Londoners need to be helped to recognise that waste disposed into the sewer and drainage network has a direct impact on their environment.

The vision will be achieved through:

Action 19 The Mayor will work with Thames Water and other partners to support the construction of the Thames and Lee Tunnels, as a means of greatly reducing storm discharges from the combined sewer system and improving the quality of the water in the River Thames. The Mayor will ensure cost effectiveness and reduced disruption at all individual locations by continuing to lobby Thames Water on local issues.

Action 20 The Mayor will work with Thames Water and other partners to identify ways in which the management of sewage can generate renewable energy and reduce greenhouse gas emissions.

6.1 Introduction

6.1.1 Thames Water is the sewerage undertaker for almost the whole of London (a small part of Havering is served by Anglian Water). It is responsible for collecting wastewater from homes and businesses and treating it at one of the sewage treatment works (STW) listed below, before returning the treated water (known as effluent) back to the River Thames or one of its tributaries. Table 6.1 lists London's STWs and Figure 6.1 overleaf shows the network of sewers feeding into them. It also shows the areas served by the combined sewers and the separate foul and surface water sewers.

6.1.2 The Mayor encourages Thames Water and other partners to identify opportunities to use new technologies to contribute towards the Mayor's targets for renewable and decentralised energy and reducing greenhouse gas emissions. Particularly through the production of biogas from sewage. The Mayor will work with Thames Water to address regulatory and practical issues limiting the co-digestion of food waste with sewage.

6.1.3 The 'consented flow' is the maximum volume of wastewater in cubic metres per day (m3/d) that the sewage treatment work's operating consent allows it to treat.

6.1.4 The Environment Agency regulates the release of sewage effluent to 'controlled waters' by providing 'consents to discharge'. The consent limits the quantities of the various pollutants that can be released and helps to keep the quality of 'controlled waters' within acceptable limits. 'Controlled waters' cover all watercourses from rivers, lakes, reservoirs and underground resources through to estuarine and coastal waters. European legislation, principally the Urban

Table 6.1 London's sewage treatment works

Sewage treatment works	Water course	Catchment	Population served (000s)	Consented flow*(m^3/d)
Beckton	Thames Tideway	Barking & Dagenham, Brent, Camden, City of Westminster, City of London, Ealing, Hackney, Hammersmith & Fulham, Haringey. Islington, Kensington and Chelsea, Newham, Redbridge, Tower Hamlets, Waltham Forest	1,420,000	3,300
Crossness	Thames Tideway	Bexley, Bromley, Croydon, Greenwich, Lambeth, Lewisham, Merton, Southwark, Sutton, Wandsworth	982,000	1,870
Mogden	Upper Thames Tideway	Barnet, Brent, Ealing, Harrow, Hillingdon, Hounslow, Richmond Upon Thames, and parts of Berkshire, Buckinghamshire and Hertfordshire	690,000	1,860
Long Reach (just outside London)	Thames Tideway	Bexley, Bromley, Croydon, and parts of Kent & Surrey	311,040	800
Riverside	Thames Tideway	Barking & Dagenham, Havering, Redbridge	216,000	396
Deephams	River Lee via Salmon Brook	Barnet, Brent, Enfield, Haringey, Waltham Forest and parts of Essex and Hertfordshire	443,000	852
Hogsmill A	Hogsmill River	Kingston upon Thames, Sutton and parts of Surrey	185,000	334
Hogsmill B	Beverley Brook	Kingston upon Thames, Sutton and parts of Surrey	20,000	
Beddington	Wandle River	Croydon, Sutton and parts of Surrey	234,000	355

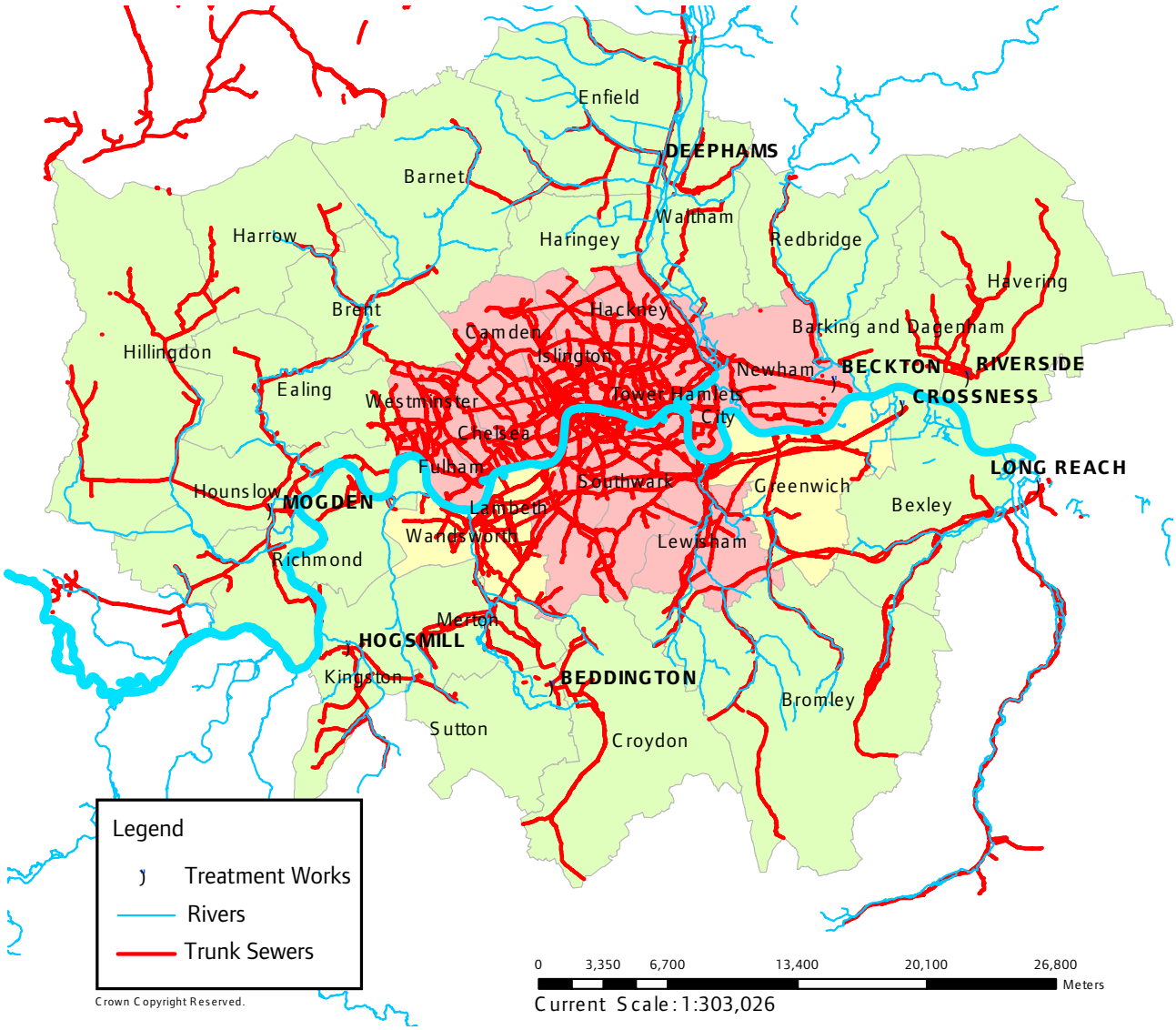
Waste Water Treatment Directive (UWWTD), together with UK regulations, set the general standards for sewage treatment.

Combined sewers

6.1.5 In the mid 1800s, Sir Joseph Bazalgette designed and initiated the building of London's combined sewers. The sewers, still in operation today, remove wastewater and rainwater in the same pipe from properties in central and inner London. In order to avoid the flooding of streets and properties with raw sewage during intense rainfall events, Bazalgette designed a series of overflow outlets from the combined sewers into the tidal River Thames and its tidal tributaries (together referred to as the Thames Tideway). There are now some 57 such outlets, known as Combined Sewer Overflows (CSOs), which allow diluted storm sewage (excess sewage and rainwater) to spill untreated into the Thames Tideway.

6.1.6 The expansion of the area served by the combined sewers, together with population growth and an increase in impermeable surfaces, has resulted in greater flows through the sewers in wet weather. During dry spells most sewers have enough capacity to cope with flows. However, some parts of the system now have limited space capacity. During rainy periods the situation changes

Figure 6.1. The London sewer system. Thames Water, 2011.



dramatically. The sewers quickly fill up with rainwater, and the excess moisture of rainwater and untreated sewage overflows into the Tideway. Such is the strain on the system nowadays that even relatively moderate rainfall (as little as 2mm) can trigger an overflow. The Environment Agency has identified 35 of the 57 CSOs as operating in an unsatisfactory polluting way. Discharges occur at some CSOs between 50 to 60 times each year. Widespread heavy rainfall can lead to over a million tonnes of untreated sewage and rainwater legally discharging directly into the rivers on one occasion and average yearly totals are around 39 million tonnes. The Environment Agency has estimated that this could rise to as much as 70 million tonnes a year by 2020 with increasing population and intense storms patterns. Despite much improvement in the water quality of the River Thames this is clearly unacceptable in the 21st century.

6.1.7 The discharges also fail to comply with requirements of the UWWTD. This requires wastewater to be collected and transported

for treatment before discharge. However, the UWWTD recognises that overflows will occur because it is not possible to construct collecting systems and treatment plants that will treat all wastewater under all conditions. It therefore requires Member States to adopt measures to limit pollution from storm water overflows.

6.1.8 The Thames Tideway has a delicate oxygen balance, particularly in the summer months. There is relatively little freshwater flowing over Teddington Weir in dry weather conditions, therefore any storm discharge from the CSOs and sewage treatment works can adversely affect the quality of the Tideway in three main ways:

- A rapid drop in the dissolved oxygen puts wildlife at risk
- A rise in the levels of pathogens can lead to greater public health risks for those using the watercourses directly
- Sewage-derived litter is offensive and reinforces the perception that the river is lifeless.

6.1.9 Although only ten per cent of litter in the Thames Tideway is sewage derived, it may well be concentrated locally. In 2007 skimmer boats were brought into operation which remove water-borne sewage derived litter.

6.1.10 Concern is often expressed about the health effects of storm discharges from the CSOs. The City of London and the Health Protection Agency undertook a study on the health risks of recreational users of the Thames between January 2005 and March 2006. The stretch between Kew Bridge and Putney Bridge was chosen for study because of the concentration in recreational use by 26 clubs. Less than one per cent of days when river water samples were taken were acceptable by the World Health Organisation standard. However, the number of cases of illness reported was considerably lower than expected. This may be due to people not reporting their illness, or making the connection with exposure to dilute sewage. However, the report also suggests that it is quite possible that users have developed a measure of immunity or improved tolerance to the pathogens.

6.1.11 During 2010, Thames Water introduced an early warning system to warn river users of sewerage discharges from Mogden Sewerage Treatment works. Thames Water is investigating the practicality of extending this to other CSOs.

6.2 Thames and Lee Tunnels

6.2.1 In 2007, the government announced its support for the planning and construction of two tunnels, known as the Thames Tideway Tunnels (comprising the Lee and Thames Tunnels), to link up the CSOs and capture their discharges rather than have them flow into the Thames Tideway. The Lee Tunnel is 6.9km long running from Abbey Mills in the Lee Valley to Beckton STW. It was granted planning permission in 2009 and construction work commenced in spring 2010 with completion expected in 2014. The Tunnel will eliminate almost all discharges from the Lee Valley and provide an important aspect of the Olympic Legacy. The Abbey Mills CSO accounts for almost 50 per cent of total discharges to the Thames Tideway. However, until the Thames Tunnel is complete, the Lee Tunnel will effectively transfer some of the larger overflows into the Thames at Beckton

STW, as it relies on the Thames Tunnel for additional storage capacity.

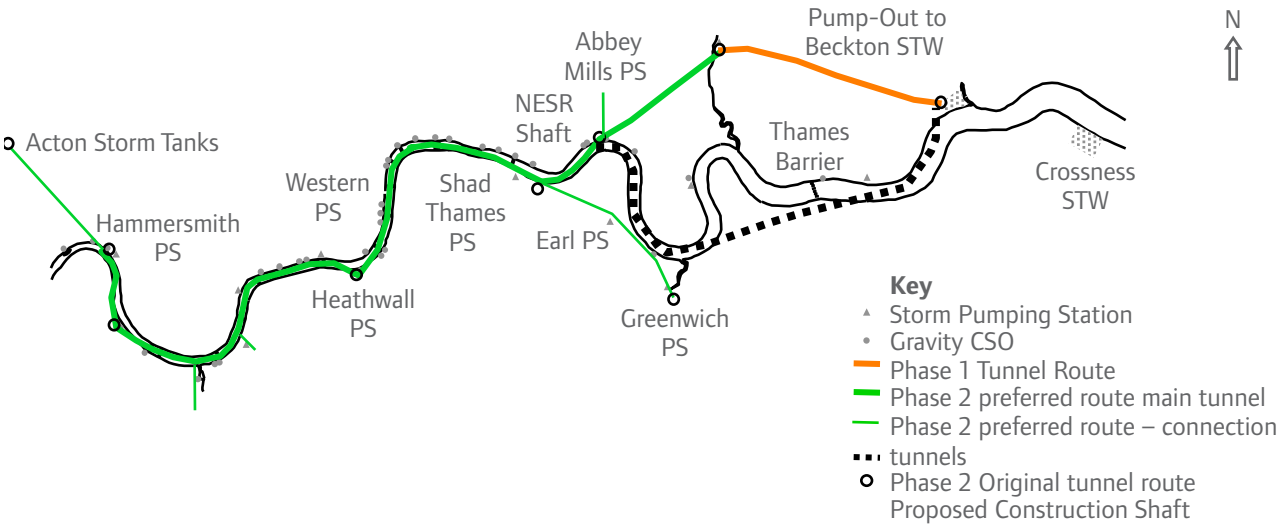
6.2.2 In September 2010, the government confirmed its commitment to the construction of the Thames Tunnel. In the same month, Thames Water published for consultation its preferred route for the Thames Tunnel and the necessary work sites (Figure 6.2). The proposal comprises a tunnel from Hammersmith Embankment following the Thames to King Edward VII Memorial Park in Shadwell, then heading North East to join the Lee Tunnel at Abbey Mills. The route requires 22 construction sites of which five will be tunnel construction sites. This route is shorter than originally proposed but requires additional connection tunnels notably from Acton Storm to Hammersmith Embankment and from Greenwich/Deptford to Kings Stairs Gardens.

6.2.3 Thames Water is continuing to refine and develop the Thames tunnel proposal with the aim of reducing construction impacts, costs and engineering risk where possible. A second round of consultation will take place in autumn 2011. This is expected to lead to an application for planning permission to the Infrastructure Planning Commission / Major Infrastructure Planning Unit in mid 2012

6.2.4 In parallel with the Thames Tideway Tunnels, Thames Water is undertaking a major programme of improvements to its four STWs along the Thames in London (Mogden, Beckton, Crossness and Riverside). Expansion at Beckton STW is necessary to allow the rainwater and sewage that will drain into the Thames Tideway tunnels to be pumped out and the sewage treated before discharge. Improvement at Beckton STW and the other works will improve the storage capacity, treatment standard and operational robustness of the works.

6.2.5 The Thames Tideway Tunnels scheme was approved by the government after extensive study. The Thames Tideway Strategic Study was set up in 2000 to assess the environmental impact of the intermittent discharges on the Thames Tideway and to identify potential solutions 'having regard to costs and benefits'. The study was submitted

Figure 6.2 Thames Tunnel Sewer as proposed in phase 1 consultation 2010.



Note: the proposal continues to be refined and the Phase 2 consultation in autumn 2011 may differ slightly.

to the government in 2005, and further studies were undertaken in 2006. In March 2007, the government announced that it supported the construction of a tunnel from West London to Beckton with additional spur tunnel from Abbey Mills Pumping Station to the Beckton STW.

6.2.6 The Mayor supports the construction of the Thames Tideway Tunnels as a solution to the problem of the CSO discharges, as well as the proposed improvements to the sewage treatment works. The Mayor is mindful however of the need to ensure that implementation is cost effective and that construction minimises the inevitable disruption that such a large scale construction project will bring. The Mayor recognises that the operation of the tunnel will increase energy use in sewer management and will work with Thames Water to ensure this energy use is minimised and is from a sustainable source wherever practical. The Mayor also wants to secure the maximum wider benefits for London, including the 4,000 jobs the project will create and positive uses for the works sites after the tunnels have been completed.

6.2.7 The Mayor is lobbying to reduce the construction, operational and permanent impacts of the Thames Tideway Tunnel. The Mayor has assessed the impacts of construction at all the proposed sites, including the noise, smell and visual amenity impacts. Based on this, the Mayor is ensuring cost effectiveness and reduced disruption at the site level by lobbying Thames Water on the local issues.

Action 19 The Mayor will work with Thames Water and other partners to support the construction of the Thames and Lee Tunnels, as a means of greatly reducing storm discharges from the combined sewer system and improving the quality of the water in the River Thames. The Mayor will ensure cost effectiveness and reduced disruption at all individual locations by continuing to lobby Thames Water on local issues.

6.3 Flooding from sewers

6.3.1 Flooding from the foul sewers can result from:

- tidal or river floodwaters interfering with the effective operation of the sewers and becoming contaminated with sewage
- the sewers can no longer cope with the volumes of sewage (referred to as overloaded sewers). Such flooding can be aggravated by groundwater infiltrating into the sewers, from the illegal connection of private surface water drains to the foul sewers, through the increased volumes of sewage from new developments and by runoff from increased impermeable areas
- blockages, collapses or pump failures.

6.3.2 Once sewage escapes from the foul sewer, it can flood properties both internally and externally. It can escape from the foul sewer through drain gratings and manholes or back up through sanitary fittings inside properties. It can flood houses and other buildings, gardens, streets and open spaces. It can also flood into the London Underground system as well as electricity supplies, telecommunications and other critical infrastructure.

6.3.3 Whatever the cause, flooding of this nature is distressing to occupants of houses affected and people living nearby, and is generally far less predictable than river or tidal flooding. In both 2006/07 and 2007/08 Thames Water removed over 500 properties from the risk of flooding once or twice in ten years, but

12,477 properties remain at risk of flooding once in 20 years. However, these are not all in London.

6.3.4 In the longer term, there is a need for a better understanding of London's sewer capacity, and more effective controls of increased surface water inputs to the sewer system. The implementation of the sustainable drainage hierarchy will help to do this. The FWMA has removed the automatic right of connection to sewers. This means that construction work which has drainage implications must be approved by an approving body, and these bodies will ensure that drainage is managed sustainably. Further government guidance is expected on this prior to boroughs becoming SUDS approval bodies.

6.3.5 There are circumstances where solving the problem of sewer flooding can be extremely expensive. Some modern practices (for example, converting basements into dwellings) can increase the incidence of sewer flooding.

6.4 Misconnection of the foul sewer and surface drains

6.4.1 In the areas of London with separate surface and foul drainage systems, problems occur when the two systems are inter connected, known as a misconnection. This can either be the connection of surface water into the foul sewer system which will lead to overloading of sewers and or sewage treatment works. Or connecting foul drainage into the surface water drainage system, which means that untreated sewage will be discharged to local rivers and streams. Householders, or professional plumbers often inadvertently, illegally, misconnect household appliances or waste pipes, as part of small scale domestic improvements.

6.4.2 Where the misconnection introduces foul water into the surface water system, this means that untreated sewage can find its way into London's streams, rivers and canals without any prior treatment. The misconnection of several houses or businesses in the same area can cause damage to the local watercourse. This is important for the Mayor's work to promote river restoration[87]. It is unsatisfactory to seek major funding to restore the river's structure and character if the water quality continues to be severely compromised. Thames Water estimates that one in every 20 houses in London has a misconnection. In some areas, this figure is likely to be considerably higher.

6.4.3 Where the misconnection introduces surface water into the foul sewer, this will lead to increased flows to the STW, which on a large scale can lead to overflows from the sewage network and/or sewage works and ultimately costly upgrades to the sewage system.

6.4.4 If a misconnection is the likely cause of the pollution, then Thames Water and the Environment Agency will try to find the offending properties and if successful, notify the owner(s). At the same time they will pass on the details to the environmental health department of the respective borough. An environmental health officer will then check that the householder has rectified the problem.

6.4.5 Currently, local authorities are the only bodies with the powers to require a householder to correct a misconnection. If the householder does not put things right within a specified time then the local

authority can have the repair work carried out and require the householder to pay the costs.

6.4.6 The ConnectRight campaign brings together a range of partners including the Environment Agency, to tackle water quality problems. The ConnectRight website helps people to identify whether their property has misconnections and suggests some actions that people can take, including asking surveyors to identify misconnections in house surveys. Visit www.connectright.org.uk/

6.5 Fat, oil and grease

6.5.1 Fat, oil and grease (FOG) contribute significantly to blockages in sewer systems and these often result in flooding of properties and/or the pollution of watercourses. Although both domestic and commercial customers produce FOG, it is recognised that FOG from restaurants, takeaways and other cooked food establishments are the cause of most of the blockage problems. This is particularly the case where there is a concentration of such establishments, for example in many high streets.

6.5.2 Although there is guidance on grease management from catering premises, illegal disposal of commercial cooking oil in the sewer system is a problem. This material congeals as it cools in the sewer and, if not removed, will cause a blockage.

6.5.3 There is a long-established infrastructure in the UK for the collection of used cooking oil (UCO) from food establishments. However, since December 2004, changes to legislation have prohibited the use of UCO in the production of animal feed and UCO therefore no longer has much intrinsic value. For this reason, many food establishments have to pay for it to be taken away, greatly increasing the risk of it being tipped into the sewer. While UCO is only one constituent of FOG that can cause blockages, it is produced in far greater quantities than fat or grease and although it may be liquid at room temperature or when taken out of a deep-fryer, it can solidify once mixed with cold water in the sewer. FOG can also be a problem for local authorities if it is illegally 'dumped' with domestic or commercial refuse.

6.5.4 If collected, there are opportunities to convert the UCO into biodiesel for use as a vehicle fuel. This not only solves the problem in the sewer system, but also can cut greenhouse gas emissions by replacing conventional diesel fuel. UCO is collected from City Hall and the London Fire Brigade Headquarters as well as from Transport for London and Metropolitan Police catering sites across London for reprocessing into biodiesel. The London Waste and Recycling Board has set up a brokerage service to amongst other things, link the sources of UCO to biodiesel producers to encourage the use of biodiesel in public sector transport fleets.

6.6 Sewage Treatment Works (STW)

6.6.1 The process of treating sewage at STWs produces three main outputs. The treated water (known as effluent, which is discharged back into rivers), sewage gas, and solid material (known as sewage sludge). Sewage sludge is relatively high in calorific value and nutrients suitable for use as fertiliser.

6.6.2 The treatment of sewage sludge can be used to generate renewable energy. The STWs at Mogden, Long Reach, Deephams, Hogsmill and Beddington generate electricity by using sewage gas to fuel gas engines.

6.6.3 Over the longer term, sewage gas can become an important source of non-fossil fuel hydrogen for use in stationary fuel cells to generate heat and power and in fuel cells used to power vehicles. There have been a number of demonstrations of sewage gas, after treatment, being used to power fuel cells around the world but none so far in the UK. The use of fuel cells in vehicles have been very successfully demonstrated by the three fuel cell buses operating the RV1 route in London for three years as part of the CUTE (Clean Urban Transport for Europe) project. However, the hydrogen used in this case is derived from conventional fossil sources. Using sewage gas, which is mainly methane, as a renewable fuel source reduces the release of this powerful greenhouse gas to the atmosphere and can help to replace other fossil fuels such as coal or gas to generate energy.

6.6.4 The EU and Defra consider the use of sewage sludge on agricultural land as the best practicable environmental option in most circumstances. The use of sludge on agricultural land supports the vision through the goals of healthier soils and wiser, sustainable use of natural resources. However, evidence submitted to the House of Lords Science and Technology Committee review of Water Management[88] suggests that supermarkets, mindful of the views of their customers, have 'distanced themselves' from crops grown using sewage sludge as a fertiliser. This seems to indicate that there is decreased rather than increased public confidence in disposal of sludge to land, although this is not the view of water industry professionals.

6.6.5 Beckton STW is London largest sewage works and produces 37 per cent of London's sewage sludge, Mogden and Crossness together produce a further 38 per cent (see Table 6.1 and Figure 6.1). Almost 50 per cent of the digested sludge is recycled to land, including a small amount of limed sludge produced at Beckton and Crossness. Whilst the use of sewage sludge on agricultural land is considered to be the best practicable environmental option, it can involve high transportation costs. Over the next ten years Thames Water is looking to enhance its processes at a number of its sludge treatment centres. This will reduce the volume of sewage sludge and there will be less dependence on distributing sewage sludge to farmland.

6.6.6 Additional capacity for the management of sewage sludge will be needed as a result of population growth and tighter environmental standards. Thames Water has prepared a 25-year sludge strategy that favours processes that (a) maximise energy recovery and (b) minimise sludge volumes. Where there is suitable land bank availability, recycling sludge to land remains the favoured option. To help protect this outlet Thames Water anticipates it will need to invest in sludge treatment to improve the quality of the treated material applied to land. However, in predominately urban areas, the use of 'thermal destruction processes with energy recovery', in other words incineration, is thought likely to be more appropriate, thus avoiding the increased environmental impact and costs of transporting the treated sludge to land. There are current sewage sludge incinerators at Beckton STW and Crossness STW.

6.6.7 In the longer term, the benefits of carrying out co-digestion with other wastes, such as municipal wastes, are attractive, particularly from the point of view of increasing energy production. However, the potentially negative

effects of increased traffic movements required to transport additional material on site, regulatory controls and the increased operational complexity involved, would need to be assessed on a site-by-site basis. The London Plan states that the Mayor will work in partnership with the boroughs and Thames Water to ensure the timely provision of appropriate new facilities at existing sewage treatment works within London.

6.6.8 The Mayor's Revised Municipal Waste Management Strategy will be published in September 2011 following a consultation during 2010. The Mayor will work with Thames Water and with the London Waste and Recycling Board to identify any potential synergies between solid waste and sewage waste management. The Mayor will also work with Thames Water to investigate ways in which the sewage sludge strategy can be developed to meet the objectives and targets of his Climate Change Mitigation and Energy Strategy by maximising the production of renewable energy whilst meeting the operational needs of Thames Water. A recent study by National Grid draws attention to the significant potential for renewable gas production in the UK. Whilst sewage treatment is one of the smaller sources, it would still make a worthwhile contribution. The London Waste and Recycling Board supported by the Mayor is looking to establish strategic partnerships in innovation to develop potential opportunities for gas to grid projects. This may include biogas to grid projects from the co-digestion of sewage with food waste.

Action 20 The Mayor will work with Thames Water and other partners to identify ways in which the management of sewage can provide renewable energy and reduce greenhouse gas emissions.

Odour nuisance

6.6.9 Sewage is by its very nature odorous. In general, STW were built in areas that were well away from where people lived and worked and were not therefore designed specifically to limit odour in the surrounding area. Nevertheless, the operators of STW have taken account of odour and generally operated their works so that odour nuisance is controlled in so far as the treatment processes allow.

6.6.10 Now, in many cases, housing and other developments have significantly encroached on the land around STW as well as around other waste management facilities. This has greatly increased the number of people affected by sewage works odour. The public has become less accepting of low-level nuisance from industrial and similar activities, expecting a better environment. These factors have contributed to a general perception that the problem of odour nuisance from STW has been steadily increasing over the last two decades.

6.6.11 Thames Water has carried out odour surveys, and drawn up Odour Management Plans for sites at risk of causing odour nuisance. At Crossness STW, a permanent sludge liming plant equipped with an odour control unit was completed in 2006 and existing odour control units were refurbished. The project to reduce odour at Mogden STW was completed in 2008 with the installation of covers and equipment to extract air to odour control units. An assessment of the project carried out by an independent odour specialist concluded that site odour emissions had reduced by over 66 per cent from 2005 levels. The current expansion of the Beckton STW includes covering the Primary Settlement Tanks, which are the most odorous

element of the process. Once complete this will lead to a significant reduction in odour. Odour will need to be continually monitored in an ever more densely populated and sustainable London.

IMPLEMENTATION PLAN

Chapter	Action	Responsibility for action	Responsibility for outcome	Timescale
Chapter 3. Managing water use	**Action 1** The Mayor will lobby Defra to ensure that there is greater coherency between the planning, funding and delivery of water company business and resource plans.	Greater London Authority	Defra	By end 2012
	Action 2 The Mayor will lobby Defra, Environment Agency and Ofwat to develop a simple, transparent mechanism for comparing the costs and benefits of supply and demand measures in water company plans that fully accounts for the short- and long-term social, environmental and economic costs.	Greater London Authority	Defra, Environment Agency and Ofwat	By 2013 (to influence Price Review 14)
	Action 3 The Mayor will work with London's water companies and other partners to further integrate water efficiency into London retrofit programmes.	Greater London Authority, London Councils, London Boroughs, Energy Savings Trust and Water Companies: Thames Water, Veolia Water Central, Sutton & East Surrey and Essex & Suffolk	Same as responsibility for action	Ongoing
	Action 4 The Mayor will lobby government to ensure that improving the water efficiency of homes is promoted and supported in the Water White Paper and the Green Deal.	Greater London Authority	Government	Autumn 2011
	Action 5 The Mayor will work with London's water companies and developers to monitor the water usage in new homes to see if the actual water efficiency matches the predicted water efficiency.	Greater London Authority	Water Companies: Thames Water, Veolia Water Central, Sutton and East Surrey and Essex & Suffolk	From 2012
	Action 6 In the next review of the London Plan, the Mayor will draft a new policy requiring all new workplaces to achieve an improved water efficiency standard such as AECB's 'best practice' levels or WRAP's 'highly efficient practice'.	Greater London Authority	Same as responsibility for action	Ongoing

Chapter	Action	Responsibility for action	Responsibility for outcome	Timescale
	Action 7 The Mayor will lobby government and Ofwat to improve water company customer engagement, for example, through providing more informative water bills.	Greater London Authority	Government, Ofwat	From 2011
	Action 8 The Mayor will work with London's water companies to raise awareness of Watersure, optant metering and assessed charges through Citizens Advice Bureaux, Voluntary Action Centres, doctors' surgeries and social housing providers.	Greater London Authority, Water Companies: Thames Water, Veolia Water Central, Sutton and East Surrey and Essex & Suffolk	Citizens Advice Bureaux, Voluntary Action Centres, doctors' surgeries and social housing providers	From 2011
	Action 9 The Mayor will work with London's water companies, Environment Agency and Ofwat to support the already planned introduction of water metering throughout London, with the aim of metering all houses and blocks of flats by 2020 and all individual flats by 2025.	Greater London Authority	Water Companies: Thames Water, Veolia Water Central, Sutton and East Surrey, and Essex & Suffolk Environment Agency, Ofwat	From 2011
	Action 10 The Mayor will lobby government to investigate the opportunities and benefits of combining the 'smart' energy metering programme with enhanced water metering.	Greater London Authority	Government	Autumn 2011
	Action 11 The Mayor will lobby government and Ofwat to enable tariffs that incentivise and reward water efficiency, whilst protecting vulnerable customers.	Greater London Authority	Government Ofwat	Ongoing
	Action 12 The Mayor will encourage Ofwat to develop the evidence base for Sustainable Economic Level of Leakage and benchmark performance on managing leakage, including the costs and benefits of fixing leaks that takes account of costs for London.	Greater London Authority	Ofwat	By 2014 (to influence Price Review 14)
	Action 13 The Mayor will lobby Ofwat to review the deadline for leakage reporting.	Greater London Authority	Ofwat	From 2011

Chapter	Action	Responsibility for action	Responsibility for outcome	Timescale
	Action 14 The Mayor will encourage water companies and other partners to promote London's drinking water. This will include facilitating ways of working with London boroughs, our stakeholders and private sector organisations on potential funding models, or schemes, that provide efficient, easily accessible and free drinking water to Londoners on the move, at no cost to the taxpayer.	Greater London Authority	Greater London Authority, London Boroughs, Private sector	Ongoing
	Action 15 The Mayor will lead by example by completing the Water Disclosure Project Questionnaire for the Greater London Authority to examine global water dependencies. The Mayor will integrate risks associated with global water use into the Mayor's green procurement code to encourage companies to consider their water risks.	Greater London Authority	Greater London Authority	By end 2012
Chapter 4 – Paying for water services	**Action 16** The Mayor will lobby Defra to amend the working definition of water affordability to include disposable income after living costs, and for London to have its own water affordability assessment	Greater London Authority	Defra	By end 2012
	Action 17 The Mayor will, through the London Water Group, work with the water companies to manage water affordability In London by: a determining whether a current definition of water affordability is applicable to London b identifying groups of Londoners that are, or could become, vulnerable to water affordability issues c identifying the needs of these groups d examining how the existing initiatives including the RE:NEW programme, could be integrated and better targeted to tackle water affordability e lobbing government to secure funding for a water affordability pilot in London.	Greater London Authority	London Water Group	By end 2012

Chapter	Action	Responsibility for action	Responsibility for outcome	Timescale
Chapter 5 – Managing rainwater	**Action 18** The Mayor will work with partners through the Drain London Forum to manage surface water flood risk and ensure a consistent approach across London. This will include: a identifying flood risk hotspots and working with partners to determine who is best placed to manage these b developing a Community Flood Plan Programme to support communities that wish to increase their resilience to flooding c developing at least three demonstration projects to show how urban greening measures can help to manage surface water flood risk.	Greater London Authority	Drain London Board and London Boroughs	By end 2012
Chapter 6 – Disposal of wastewater	**Action 19** The Mayor will work with Thames Water and other partners to support the construction of the Thames and Lee Tunnels, as a means of greatly reducing storm discharges from the combined sewer system and improving the quality of the water in the River Thames. The Mayor will ensure cost effectiveness and reduced disruption at all individual locations by continuing to lobby Thames Water on local issues.	Greater London Authority	Thames Water	Ongoing
	Action 20 The Mayor will work with Thames Water and other partners to identify ways in which the management of sewage can provide renewable energy and reduce emissions of greenhouse gases.	Greater London Authority	Thames Water	Ongoing

APPENDIX ONE

ACRONYMS AND ABBREVIATIONS

AECB	Association for Environment Conscious Building
BBP	Better Buildings Partnership
BSWE	Base Standard Water Efficiency
CAMS	Catchment Abstraction Management Strategy
CC Water	Consumer Council for Water
CSO	Combined Sewer Overflow
Defra	Department for the Environment, Food and Rural Affairs
EiP	Examination of Public (of the London Plan)
FOG	Fats, oils and greases
FWMA	Flood and Water Management Act (2010)
GLA	Greater London Authority
l/p/d	Litres per person per day (unit of water consumption)
Ofwat	Water industry financial regulator
RBMP	River Basin Management Plan
RE:FIT	Public sector buildings energy efficiency retrofit programme
RE:NEW	Home energy and water efficiency retrofit programme
SELL	Sustainable Economic Level of Leakage
SME	Small and Medium-sized Enterprise
STW	Sewage Treatment Works
SuDS	Sustainable Drainage System
SWMP	Surface Water Management Plan
UCO	Used cooking oil
UKCIP	UK Climate Impacts Programme
UKCP09	UK Climate Projections 2009
UKRHA	UK Rainwater Harvesting Association
UWWTD	Urban Waste Water Treatment Directive
WFD	Water Framework Directive
WRMP	Water Resource Management Plan
WRZ	Water Resource Zone

APPENDIX TWO

NOTES AND REFERENCES

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Chinese
如果需要您母語版本的此文件，
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Hindi
यदि आप इस दस्तावेज की प्रति अपनी भाषा में चाहते हैं, तो कृपया निम्नलिखित नंबर पर फोन करें अथवा नीचे दिये गये पते पर संपर्क करें

Vietnamese
Nếu bạn muốn có văn bản tài liệu này bằng ngôn ngữ của mình, hãy liên hệ theo số điện thoại hoặc địa chỉ dưới đây.

Bengali
আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি (কপি) চান, তা হলে নীচের ফোন্ নম্বরে বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Greek
Αν θέλετε να αποκτήσετε αντίγραφο του παρόντος εγγράφου στη δική σας γλώσσα, παρακαλείστε να επικοινωνήσετε τηλεφωνικά στον αριθμό αυτό ή ταχυδρομικά στην παρακάτω διεύθυνση.

Urdu
اگر آپ اِس دستاویز کی نقل اپنی زبان میں چاھتے ھیں، تو براہ کرم نیچے دئے گئے نمبر پر فون کریں یا دیئے گئے پتے پر رابطہ کریں

Turkish
Bu belgenin kendi dilinizde hazırlanmış bir nüshasını edinmek için, lütfen aşağıdaki telefon numarasını arayınız veya adrese başvurunuz.

Arabic
إذا أردت نسخة من هذه الوثيقة بلغتك، يرجى الاتصال برقم الهاتف أو مراسلة العنوان أدناه

Punjabi
ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ ਵਿਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਹੇਠ ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Gujarati
જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં જોઈતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.