Final water resources management plan

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Final Water Resources Management Plan

September 2009

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Summary Report

Preface

United Utilities Water plc (UU) is the water company for North West England and has prepared its 2009 Water Resources Management Plan (WRMP).

UU published its Draft WRMP on 2nd May 2008 for public consultation, in accordance with the Water Act 2003 and the Water Resources Management Plan Regulations 2007. We are very grateful to those organisations and individuals that expressed their views on what they liked about the plan and what we can do to improve it.

On 30th January 2009 UU published a Statement of Response that describes the consultation, and how we have taken account of the views we received. This Final WRMP has incorporated the comments received from consultees by providing the requested additional information, following the advice from regulators and taking account of new information mentioned by consultees that has become available since production of the Draft WRMP. These changes have affected the water resources and demand strategy as summarised in Chapter 4 of this Summary Report.

Changes to our leakage reduction plan

This revised plan shows less leakage reduction in the Integrated Water Resource Zone (which serves 95% of our customers). This is because under the national methodology, agreed by Ofwat and the Environment Agency, we need a supply-demand deficit to drive further leakage reduction. There is now no shortfall in water supplies until 2022 because:-

- The demand for water by our customers is now expected to be lower than we previously thought because of the recent introduction of mandatory water efficiency targets for water companies and the effects of the economic downturn. The volume of water that we will need to abstract from the environment will therefore be lower.

- At the same time, our evaluation of the volume of water available from our existing water sources has increased. This is because we have: reduced the predicted effect of climate change; included the benefit of the new West-to-East Link main; and incorporated new data in our water source yield calculations.

As a result we will be able to maintain the level of service for supply reliability requested by our customers without undertaking any further leakage reduction beyond our current targets until 2022 in the Integrated Zone. Whilst some consultees would like to see leakage reduction irrespective of the supply-demand position, leakage control is very expensive and we have to consider the impacts on customer bills. The water source enhancement schemes that were proposed in the Integrated Zone have also been delayed (until after 2025) as a result of the changes.

Demand reduction, including leakage reduction, does however remain a key long-term aspiration for UU. We are confident that we will be able to show more leakage reduction in the future once the impact of some of the uncertainties becomes clearer, for example the European Union Water Framework Directive.

The needs for West Cumbria have increased since the Draft WRMP because of the revised abstraction licence changes planned by the Environment Agency. Our plan for this zone now includes more leakage reduction and water efficiency as well as a new groundwater scheme.

Publication of the WRMP

On 3rd August 2009, the Secretary of State for Environment, Food and Rural Affairs confirmed that UU has adequately taken account of the views of stakeholders, and gave permission for the publication of the Final WRMP.

UU has published the following reports on its website:-

- Final WRMP (summary report and main report)
- Welsh language version of the Final WRMP summary report
- Statement of Response to the Consultation on the Draft Water Resources Management Plan (first published on 30th January 2009)
- Strategic Environmental Assessment of United Utilities' Draft Water Resources Management Plan (first published on 2nd May 2008)
- Addendum to the Strategic Environmental Assessment (which describes changes to the strategic environmental assessment of the Draft WRMP, in particular taking account of consultee comments) (first published on 30th January 2009).

These can be found at: www.unitedutilities.com/WaterResourcesPlan.htm

Our WRMP has been written so that no information has needed to be excluded from the published plan on the grounds that it would be contrary to the interests of national security.

Chapter 1. Setting the scene

1.1 Background

United Utilities Water PLC (UU) is the water company for North West England. We provide water and wastewater services to 2.9 million homes and over 200,000 businesses across the region.

UU has prepared its 2009 Water Resources Management Plan (WRMP). On 2nd May 2008 UU published its draft document for public consultation. We are grateful to those organisations and individuals that expressed their views on what they liked about the plan and what we can do to improve it. We have taken account of these views in preparing this Final Water Resources Management Plan.

This Summary Report is set out in four sections:-

- **Chapter 1. Setting the scene:** Describes the purpose of the Water Resources Management Plan and the level of service we aim to achieve.

- **Chapter 2. Water supply and demand baseline:** Describes our baseline forecasts for water supply and demand based on our current policies, and potential options to provide more water.

- **Chapter 3. Water resources and demand strategy:** Describes our plans for supply enhancement and demand management to maintain adequate supply-demand balances.

- **Chapter 4. Consultation on the Draft Water Resources Management Plan:** Describes the consultation process and how we have included comments from consultees in this Final WRMP.

More detailed information is provided in the Main Report, which is available in electronic form from UU's website at www.unitedutilities.com/WaterResourcesPlan.htm If you require further information about our Water Resources Management Plan or experience difficulty in accessing the document from UU's website please email water.resources@uuplc.co.uk

1.2 Purpose

The aims of our Water Resources Management Plan are aligned with the core principles in UU's *Strategic Direction Statement* (UU, 2007). The aims are:-

- To identify the best possible water resources and demand strategy that achieves the required level of water supply reliability for our customers, whilst protecting the environment and minimising the impact on customer water bills.

- To adapt to meet the challenge of climate change. In accordance with our *Strategic Direction Statement*, this will be achieved by helping our customers manage their use of water more efficiently, tackling leakage, and developing a more resilient supply system.

- To ensure that abstraction from our water resources is sustainable, and resilient to meet the challenge of increasing drought risk arising from climate change. Our strategy for significantly reducing demand ensures sustainable water abstraction and makes important contributions to climate change mitigation and adaptation.

- To ensure our plans deliver the needs and priorities of our customers and other stakeholders, by taking account of their views throughout our planning.

The Water Resources Management Plan provides a comprehensive statement of our water supply and water demand forecasts over the period to 2035. It also describes the resulting supply-demand balances and the actions we propose to take as part of our preferred strategy to achieve water supply reliability standards for our customers.

1.3 Stakeholder involvement

We have carried out a wide range of activities to try to understand the needs and views of our customers, environmental groups, regulators and other interested parties. We have taken these into account when preparing the plan. For example, we have undertaken customer surveys, have met with many local organisations on a range of water resources issues and have reviewed documents prepared by regulators and research organisations. We have regularly met with the Environment Agency for detailed discussions about our plan and have followed the Agency's official guidelines for its preparation.

Our customer surveys have consistently identified that the reliability of water supply is a high priority for our customers and they desire that hosepipe ban water restrictions should not be more frequent than once in 20 years.

1.4 Level of service

Our Water Resources Management Plan aims to protect and improve the environment and also to meet the needs of our customers for a high reliability of supply and affordable water prices. Our strategy for achieving this is by complying with all legislation, including current abstraction licence conditions and any changes to abstraction licences that are identified as required by the Environment Agency, and by providing the optimal level of service that our customers want.

The views of our customers, regulators and other stakeholders and the needs of the environment have been used to determine that the optimum level of service for water supply reliability standards in North West England is:-

- Hosepipe ban and drought permits to augment supply once in 20 years.

- Drought orders to ban non-essential water use and to further augment supply once in 35 years.

- No allowances for demand reductions achieved through rota cuts or standpipes have been included in our assessments. UU considers that it is unacceptable to plan for the introduction of such measures even during extreme drought conditions.

This level of service represents the best balance between customer expectations for the security of water supplies and the costs and environmental impact associated with the provision of higher standards of service.

1.5 Supply system

UU supplies water to four discrete water resource zones covering North West England:-

- Integrated Resource Zone, serving 6.5 million population in south Cumbria, Lancashire, Greater Manchester, Merseyside and most of Cheshire.

- Carlisle Resource Zone, serving 106,000 population.

- North Eden Resource Zone, serving 14,000 population.

- West Cumbria Resource Zone, serving 152,000 population.

The supply network within the Integrated Zone has a high degree of inter-connection, and serves 95% of the region's population. The other three zones are relatively small, and are remote from the regional network.

The map on the next page shows the areas covered by each resource zone.

We are abstracting less water now than at any time since the 1960s and we expect it to reduce further in the future. Our water supplies come primarily from upland reservoirs and lowland rivers, but are supported by supplies from groundwater and upland streams. In total we have over 200 water sources and we supply around 1900 million litres per day (Ml/d) of drinking water in a normal year but this would be higher in a dry year. Many of our water sources are located in environmentally important areas that are designated for their ecology, landscape or other environmental features.

The Integrated Zone is supplied with around 1800 Ml/d of drinking water, of which about 500 Ml/d comes from water sources in Wales, about 600 Ml/d comes from sources in Cumbria, and the rest from sources in other parts of North West England. It contains a large integrated supply network that enables substantial flexibility in distributing supplies within the zone. UU is currently planning the construction of a bi-directional pipeline, known as the "West-to-East Link", between Merseyside and North Manchester. This will be an enhancement to our supply network to further increase the integration and flexibility of the supply within the Integrated Zone.

Figure 1. Map of UU's water supply area

Chapter 2. Water supply and demand baseline

2.1 Water source yields

We have carried out a detailed assessment of water source yields in accordance with the national best practice methodologies, and in liaison with the Environment Agency. This has indicated that the total water yield of our sources in a dry year is currently 2013 million litres per day (Ml/d), but is expected to reduce as shown in Figure 2 and Table 1.

Figure 2. Trends in water source yields (Ml/d)

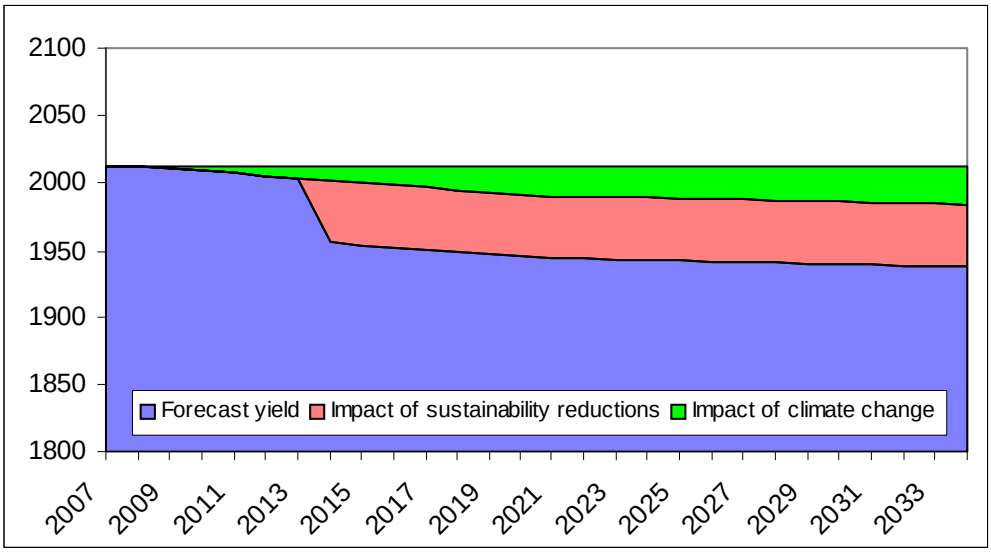


Table 1. Water source yields (Ml/d)

Resource zone	Water source yield at 2006/07	Water source yield at 2007/08	Benefit of West-East Link from 2012/13	Impact of sustainability reductions from 2014/15	Impact of climate change at 2034/35	Water source yield at 2034/35
Integrated	1931.7	1908.0	+16.6	-32.9	-28.1	1863.6
Carlisle	37.7	36.5	0	-3.8	-0.3	32.4
North Eden	9.2	10.3	0	0	0	10.3
West Cumbria	58.9	57.9	0	-9.4	-0.2	48.2
Region	2037.5	2012.6	+16.6	-46.1	-28.6	1954.7

Notes:

- Values may not sum exactly due to rounding
- Ml/d = million litres per day
- The water source yield figures in this report are officially known as “Water available for use” (WAFU)
- The 2006/07 values are those which have been previously officially reported and are based on our 2004 yield review. The 2007/08 values have been derived from our 2007 yield review, which incorporates some changes to water sources and improved modelling methods.

We have calculated the reductions in source yields that are expected in the future for two key reasons:-

- **Impact of sustainability reductions.**
  The Environment Agency is proposing to change the abstraction licence conditions for some of our water sources that are within the European Union Habitats Directive sites and other nature conservation sites. The changes are needed in order to protect salmon and other aquatic species from the potential adverse effects of low flows in watercourses during prolonged dry weather. In the vast majority of cases our abstractions do not adversely impact on the environment.

  The Environment Agency has identified the need to modify our licences in the case of Haweswater and Thirlmere reservoirs and rivers Brennand and Whitendale (Integrated Zone), River Gelt (Carlisle Zone) and Ennerdale Water and Dash Beck (West Cumbria Zone). The Environment Agency has completed its reviews of these abstraction licences and the changes will mean that the quantity of water that we can abstract from Ennerdale Water during dry weather conditions is lower than we assumed in the original Draft WRMP. We expect a total impact on our water source yields of 46.1 Ml/d at 2014/15.

  We are expecting further sustainability reductions in the future as a result of the European Union Water Framework Directive. However, in accordance with the regulatory guidance, these have not been included in our plan because the outcome is too uncertain at present.

- **Impact of climate change.**
  Although there is significant uncertainty about climate change predictions, it is now generally accepted that climate change is happening. It is anticipated that climate change will result in generally wetter winters and drier summers in North West England, but extreme events are likely to become more frequent and more severe. These changes, in particular the drier summers, will impact on our water source yields.

  We have applied the detailed calculations set out in national best practice methodologies for assessing the differing impacts on each of our water sources. The estimates of the impact on our total water source yield at 2035 range enormously between an increase of 139 Ml/d (i.e. wetter climate) and a reduction of 505 Ml/d (i.e. drier climate). We have followed national guidance in determining the central estimates to be included in this plan and the values to be used in our uncertainty analysis to evaluate the “target headroom” requirement. Target headroom is the planning margin to allow for such uncertainties in the supply-demand balance. The central estimates suggest that the climate change effect will increase steadily over time to an estimated region-wide yield reduction of 28.6 Ml/d at 2034/35.

2.2 Leakage reduction

UU has significantly reduced leakage over the last 15 years, more than halving leakage from 960 Ml/d in 1992/93 to 468 Ml/d at 2006/07 (462 Ml/d at 2007/08). This has been achieved through expenditure on a combination of measures in accordance with national best practice. For example we have:-

- Installed a comprehensive network of 2360 district meters that continuously monitor water use and leakage in each district of around 1300 properties across the region.
- Installed 2343 pressure management valves and other pressure reducing methods to optimise water pressure across our distribution networks consistent with satisfying customer requirements.
- Employed a large leak detection workforce of around 190 full-time equivalent personnel, who have been trained and equipped with the latest leak detection techniques.
- Provided a free telephone service for customers to inform us of leaks, and a free supply pipe repair service for households.
- Maintained a sophisticated leakage information system that receives and analyses 15-minute flow and/or pressure data from over 6000 sites across the region. This identifies the areas where high leakage is occurring and directs our leak detection activities.

Further leakage reduction and innovation is an important element of our water resources and demand strategy to maintain adequate water supply reliability and reduce carbon dioxide emissions, as described later in Section 3.4.

2.3 Water efficiency

UU actively promotes the efficient use of water by our customers. We have implemented a wide range of measures, carried out trials of innovative techniques and undertaken many publicity and education initiatives. We are basing our programmes on the national Water Efficiency Initiatives Good Practice Register. Some examples of the many activities we have carried out in recent years include:-

- Distribution of over 550,000 cistern devices free of charge since 1997, for customers to fit in their toilet cisterns and reduce flush volume.
- Issue of over 150,000 self-audit packs since 2005 to help customers identify how they can save water.
- Undertaking “visit and fix” household audits, on a trial basis, at 300 homes in Carlisle in 2002, and 400 homes in Warrington in 2007. These involved a plumber

fitting water savings devices and the provision of water saving advice.

- Working with many industrial, commercial and institutional customers on water conservation projects at non-household premises.

- Providing water conservation information in a range of free information packs including: "Water Savers" packs, "A Guide to Using Water Wisely" leaflets, "All About Water Meters" leaflets, "Extra Care" magazine, "Waterwise in the Workplace" leaflets, and a special water conservation information pack for schools.

- Promoting water efficiency to 14,000 farms, parks and gardens in 2007, by issuing special water efficiency leaflets.

- Hosting visits to our Environmental Education Centre classrooms for over 10,000 pupils and students each year. These include information about water conservation.

- Providing over 20,000 water butts at discounted prices since 1997.

- Investigating novel techniques. In particular we have completed a major research study with Liverpool John Moores University to identify how to make showers more water and energy efficient. This work has attracted widespread interest and is being used to develop national policies for showers.

Enhanced water efficiency is, we believe, a crucial part of ensuring sustainable water abstraction and reducing carbon dioxide emissions due to activities by UU and our customers. We are planning a substantially increased programme, from 2010, which includes providing free water savers' packs, self-audit packs, cistern devices and other water saving measures to customers. This will include a free water savings pack and cistern device for all newly metered households, and free audits for institutional customers such as schools and hospitals. The programme will enable us to achieve the recently introduced mandatory water efficiency targets (Ofwat, 2008), which sets a target saving of 2.95 Ml/d each year by UU (although the water savings achieved will decay as customers remove or replace devices over time). In addition, we are planning a water efficiency research programme in 2010-15, as part of our water demand reduction strategy described later in Section 3.4.

2.4 Customer metering

Water meters have been installed at all new properties since 1989. In addition we have compulsorily metered non-household properties wherever practical and actively promote voluntary take-up of the free meter option scheme for household customers. As a result, by 2006/07 water meters had been installed and used as the basis for water charges at 621,000 homes (i.e. 21% of our 2.94 million household customers) and 182,000 non-households (i.e. 87% of our 0.21 million non-household customers). We expect household meter penetration to increase to 60% by 2035, as illustrated in Figure 3.

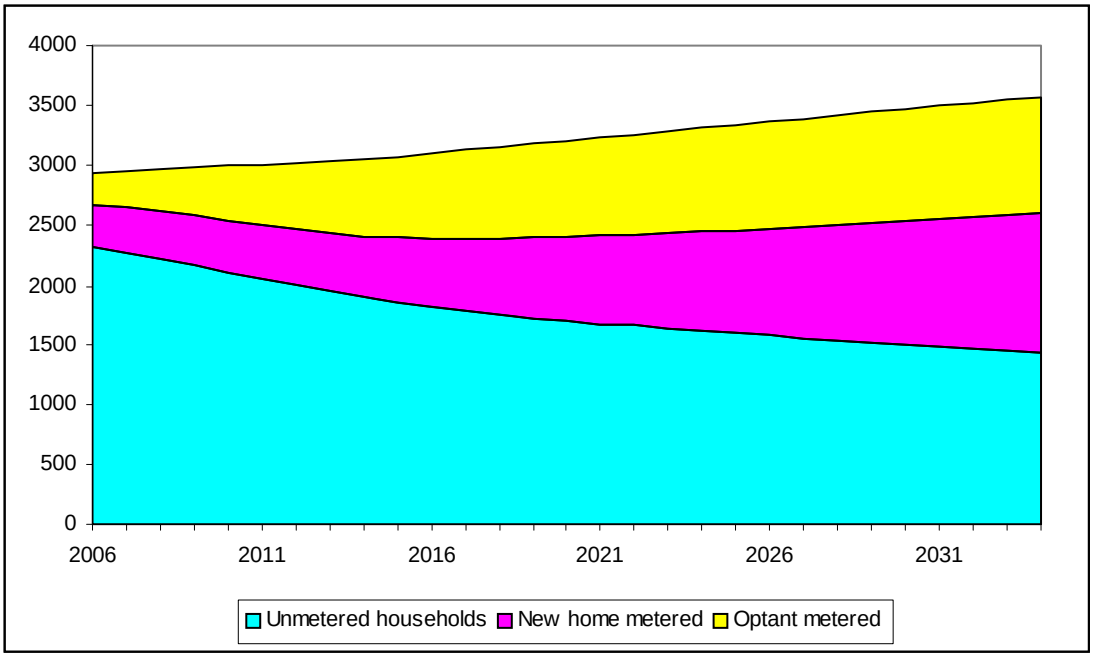
We expect this to be achieved by:-

- Continuing to meter all new properties. This includes the 822,000 new homes expected to be built across the region by 2035.

- Continuing to provide a free meter option, by which over 250,000 households have opted to be metered by 2006/07 since introduction of this scheme in April 2000. We promote the scheme on our website and in our billing leaflet. We expect a further 708,000 households to voluntarily opt to be metered by 2034/35.

We have not included any compulsory metering of existing unmeasured homes as there is no legal power to permit universal compulsory metering in areas like North West England that are not areas of serious water stress. We anticipate that in the longer term it will become a statutory requirement to meter all homes wherever practical (metering is not feasible in some homes because of complex pipe arrangements). However, in line with specific guidance from Ofwat and the Environment Agency, received since publishing the original Draft WRMP, we have excluded compulsory metering from our main plan.

Figure 3. Forecast trends in household customer metering ('000 households)



We have assumed continuation of existing tariff policies in our demand forecasts. However, during 2010-15, we will be investigating new tariffs, alongside use of new meter reading technology. This may result in the implementation of new tariffs by 2015 that could encourage further demand reduction.

The estimated impact of our metering plan on water demand is summarised later in Table 7 (Section 3.4).

2.5 Demand forecasts

We have prepared detailed demand forecasts for each water resource zone in accordance with national best practice methods. Our baseline projections (before taking account of enhanced demand management actions in our water resources and demand strategy) indicate that demand for water in our region in dry weather is expected to reduce slightly from current levels. The anticipated increase in households by 645,000 by 2034/35 (net of demolitions) will put an upward pressure on water use, as well as the expected growth in water use for garden watering and showering. However, this will be balanced by the downward pressures due to the expected effects of:-

- Growth in customer metering. Our studies have shown that customers in North West England reduce their water use by an average of 8.3% in a normal weather year as a result of being metered, with predicted higher savings in a dry year.

- The increasing use of low-flush-volume toilets and other water efficient appliances.

- Forecast reductions in measured non-household demand resulting from macro-economic factors and water efficiency.

- The current economic downturn on house-building rates and water use by non-households over the next few years.

- Our water efficiency programme in accordance with the newly introduced mandatory water efficiency targets.

Table 2 summarises the anticipated changes in population and household water demand. The demand expected to occur in the event of a dry year is of key importance in water resources planning because we need to plan for the circumstances when water availability in water sources is lowest and demand for water is highest. The demands in normal weather are lower, particularly due to less water use in gardens.

The components of the regional dry year demand forecast through the planning period to 2034/35 are illustrated in Figure 4. It shows the way in which we expect household demand and non-household demand to reduce, and the anticipated transfer of a large number of households from unmetered to metered.

The downward trend in average per capita consumption rates is consistent with UU's *Strategic Direction Statement*, which states that a more sustainable resource position needs to be achieved by helping our customers to reduce average water use to around 125 litres per person per day. This is to be achieved through a combination of customer metering, future tariff changes and enhanced programmes to encourage customers to voluntarily save water.

Our forecast average per capita consumption rate at 2030 is 129 litres per person per day, which is consistent with the Government's *Future Water* (Defra, 2008) aspirational ambition of achieving 130 litres per person per day by 2030. However, we anticipate that widespread compulsory metering will become a statutory requirement in the longer term and this will result in even lower levels.

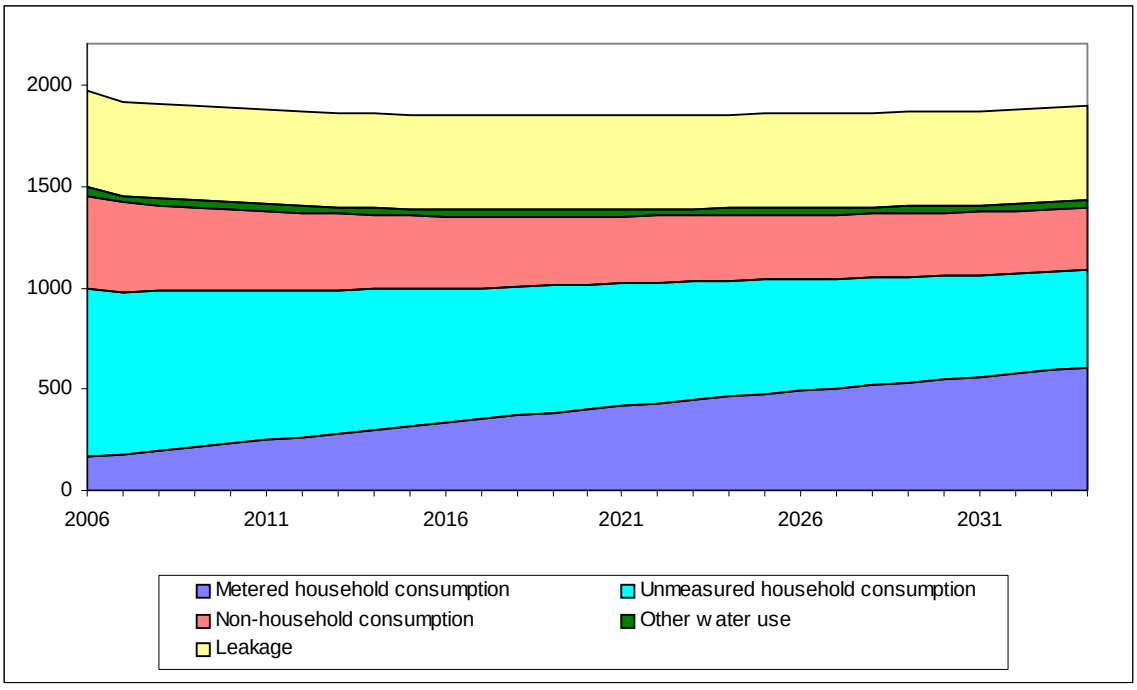
Table 2. Population, household and per capita consumption trends for the UU region

	2006/07	2014/15	2024/25	2034/35
Total population served ('000)	6807	7044	7398	7700
Total households served ('000)	2936	3056	3318	3581
% households metered	21%	38%	51%	60%
Normal weather year average per capita water consumption (litres per person per day)	139	133	130	129
Dry weather year average per capita water consumption (litres per person per day)	149	144	143	145

Notes:

- The population and household numbers are derived from the latest official statistics published during 2008 since issue of the Draft WRMP.
- Our household projections take account of the likely impact of the current economic downturn.
- The per capita consumption rates have been calculated as part of our demand forecasting studies.

Figure 4. Baseline dry weather demand (Ml/d)
(before taking account of enhanced demand management actions)



2.6 Target headroom

In order to prepare a robust Water Resource Management Plan, we need to ensure that appropriate measures are taken to safeguard customers and the environment from the many uncertainties associated with forecasting water supply availability and water demand

over the planning horizon. These include political, social, environmental, climate change and technical factors outside the control of a water company that may significantly influence the supply-demand balance.

We have followed national best practice methods to analyse the uncertainties and how they change over the period to 2035. We have thereby calculated "target headroom" allowances for uncertainty to be included in the supply-demand balance for each water resource zone. The assessed target headroom values are modest, amounting to 56 Ml/d at 2009/10 (equivalent to 3% of regional water source yield) and 132 Ml/d at 2034/35 (7% of regional water source yield).

There is substantial uncertainty in the effects of climate change on future water source yields and water demand. In line with Ofwat's consultation response, and discussion with Ofwat since publication of the original Draft WRMP, we have reduced the contribution of climate change in the calculation of target headroom values. The contribution of climate change uncertainty at 2034/35, for example, has reduced from 156 Ml/d to 86 Ml/d for the whole region.

2.7 Initial supply-demand balance

The initial supply-demand balance for each water resource zone is presented in Table 3. The balances have been calculated from our assessments of water source yields, demand forecasts and target headroom. These initial supply-demand balances are based on baseline demand forecasts and so do not include any additional policies for demand management.

Our baseline demand forecasts include the effects of the following activities:-

- Continuation of existing leakage control policies (described in Section 2.2) to maintain regional total leakage below 465 Ml/d.
- Undertaking an enhanced base-service water efficiency programme (described in Section 2.3), which we estimate will save 9 Ml/d by 2014/15.
- Continuation of metering all new properties.
- Continuation of the free meter option scheme. We expect a further 708,000 households to opt for a meter by 2034/35.
- Continuation of existing tariff structures for water bills.

The effects of climate change on our calculations of water source yield, dry weather demand and target headroom are summarised in Table 4.

Table 3. Initial supply-demand balances 2006/07 to 2034/35 (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Integrated Zone						
Water source yield	1931.7	1904.6	1879.8	1871.3	1868.4	1863.6
Dry weather demand	1873.8	1800.7	1770.6	1765.4	1769.5	1808.7
Target headroom	41.4	53.4	79.3	99.0	106.0	129.5
Supply-demand balance	**16.6**	**50.6**	**30.0**	**6.9**	**-7.1 (deficit)**	**-74.6 (deficit)**
Carlisle Zone						
Water source yield	37.7	36.4	32.5	32.4	32.4	32.4
Dry weather demand	31.2	30.1	30.1	29.8	29.9	30.9
Target headroom	1.0	0.6	0.8	0.6	0.5	0.7
Supply-demand balance	**5.4**	**5.8**	**1.6**	**2.1**	**2.0**	**0.8**
North Eden Zone						
Water source yield	9.2	10.3	10.3	10.3	10.3	10.3
Dry weather demand	6.5	5.6	5.5	5.4	5.4	5.5
Target headroom	0.6	0.4	0.2	0.1	0.2	0.2
Supply-demand balance	**2.1**	**4.3**	**4.7**	**4.8**	**4.7**	**4.6**
West Cumbria Zone						
Water source yield	58.9	57.8	48.4	48.3	48.3	48.2
Dry weather demand	57.9	55.0	54.8	53.8	53.6	54.6
Target headroom	1.4	1.9	1.8	1.6	1.4	1.5
Supply-demand balance	**-0.4 (deficit)**	**1.0**	**-8.3 (deficit)**	**-7.1 (deficit)**	**-6.7 (deficit)**	**-7.8 (deficit)**

Note: Values may not sum exactly due to rounding.

Table 4. Estimated impact of climate change on the supply-demand balances

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Integrated Zone	0	16.0	55.5	96.0	110.6	133.3
Carlisle Zone	0	<0.1	0.2	0.5	0.5	0.7
North Eden Zone	0	0.01	0.02	0.04	0.04	0.05
West Cumbria Zone	0	0.2	0.6	1.1	1.1	1.3
Total regional impact	**0**	**16.2**	**56.3**	**97.6**	**112.2**	**135.4**

Notes:

- Values may not sum exactly due to rounding.
- This table presents the total contribution of climate change on calculations of water source yields, dry weather demand and target headroom. These have been evaluated in accordance with national best practice methods.

Integrated Resource Zone

The Integrated Zone serves over 95% of our customers. The water available for use in this zone is expected to reduce by 24.8 Ml/d between 2009/10 and 2014/15. There will be an increase in 2012/13 of 16.6 Ml/d due to the introduction of the West-to-East Link main. Water availability will then reduce markedly by 2014/15, mainly due to the anticipated 32.9 Ml/d sustainability reductions arising from the proposed abstraction licence changes for our Haweswater and Thirlmere reservoirs and rivers Brennand and Whitendale. There is a need for increasing target headroom over time because of greater uncertainty about potential impacts on our supply and demand forecasts in the longer term.

A small supply deficit is forecast to occur by 2022/23, and the deficit is expected to increase through the remainder of the planning horizon. A programme of supply-demand solutions will be required from 2022/23 to maintain adequate water supply reliability in the Integrated Zone.

The original Draft WRMP (published in May 2008) predicted that a deficit of 41.2 Ml/d would occur in 2014/15. We are now presenting a surplus of 30.0 Ml/d at 2014/15 because of the following key changes:-

- We have substantially reduced the allowance for climate change uncertainty in our assessment of target headroom in line with Ofwat's consultation response on the Draft WRMP, and in discussion with the Environment Agency. The effects of climate change remain very uncertain, because of the wide range of predictions from the various global climate models we are required to use, however we accept that it is not appropriate to fully include this uncertainty in our assessment until the scientific knowledge has progressed further. We expect the UK Climate Impact Programme to publish their latest climate projections"UKCP09" in 2009, which will give an enhanced UK assessment of climate change.

- We have calculated the benefit of the West-to-East Link main to the water source yield of the Integrated Zone, and included it in our assessment as requested by the Environment Agency.

- We have reassessed our outage allowances using new information as part of our water source yield calculations.

- We have included the effect of implementing the recently published mandatory water efficiency targets on water demand by our customers.

- We have included the estimated effects on water demand of the severe economic downturn, which we expect to reduce house-building rates and water use by non-households over the next few years.

Carlisle Resource Zone

A significant reduction in water available for use will occur in 2014/15 because of the 3.8 Ml/d sustainability reduction due to the planned changes to our abstraction licence for the River Gelt. As a result of the enhancement of the River Eden supply to Carlisle in 2004, water available for use is currently expected to be adequate to meet forecast demands. No

supply deficits are forecast in the Carlisle Zone throughout the planning period. However, Carlisle is a growth-point area and major development is planned that will require the provision of a mains reinforcement scheme to maintain adequate supplies to the development area.

North Eden Resource Zone

No supply deficits are forecast in the North Eden Zone throughout the planning period. The increase in water availability in 2007 results from the new Tarnwood groundwater source that has recently been commissioned to replace the Nord Vue and Dale Springs sources.

West Cumbria Resource Zone

There was a small deficit in West Cumbria in 2006/07, but as a result of significant leakage reduction during 2007/08 we currently have adequate water supply availability. A significant reduction in water available for use is expected to occur in 2014/15 as a result of the estimated 9.4 Ml/d sustainability reductions, due to the planned changes to our abstraction licences for Ennerdale Water and Dash Beck. The expected future reductions in non-household demand and leakage will help to minimise the supply deficit that will occur from 2014/15. However, supply-demand solutions will be required to provide 8.3 Ml/d of water availability benefit by 2014/15 to maintain adequate water supply reliability in West Cumbria.

The original Draft WRMP (published in May 2008) predicted that a deficit of 4.1 Ml/d would occur at 2014/15. We are now presenting a deficit at 2014/15 of 8.3 Ml/d because of the following key changes:-

- We have incorporated the Environment Agency's revised proposals for abstraction licence changes at Ennerdale Water to comply with the EU Habitats Directive, which will further reduce water availability.

- We have used a combined water resources model, instead of individual models for each water source, to calculate water source yield, as requested by the Environment Agency in their consultation response.

- In the same way as for the Integrated Zone, we have also reduced the allowance for climate change uncertainty, included the water efficiency targets and included the effect of the economic downturn.

2.8 Option appraisal

Our approach for identification and appraisal of options to maintain adequate future supply-demand balances has been completed in accordance with national best practice methods. As a result we have considered a very wide range of potential options for the Integrated and West Cumbria zones. Some examples of the options considered include:-

- **Leakage reduction** through mains replacement, enhanced detection and repair or pressure reduction.

- **Water efficiency measures** such as offering free showerheads, free household water audits, subsidised water butts or retro-fitting rainwater harvesting systems. We have also investigated the use of greywater recycling (i.e. the use of bath and shower water for toilet flushing or garden watering) but discarded it because of the very high installation and maintenance costs, the very high energy requirements and the potential health risks.

- **Compulsory metering** of unmeasured households that are high water users or on change of occupancy, or metering of remaining unmeasured non-households.

- **Enhancement of existing water sources** such as bringing disused groundwater sources back into use, increasing abstraction from river sources, or transferring raw water from another area. We have also considered the potential for raising the height of reservoir dams but have discarded these as being unpromotable, due to environmental concerns, unless no practical alternative options exist.

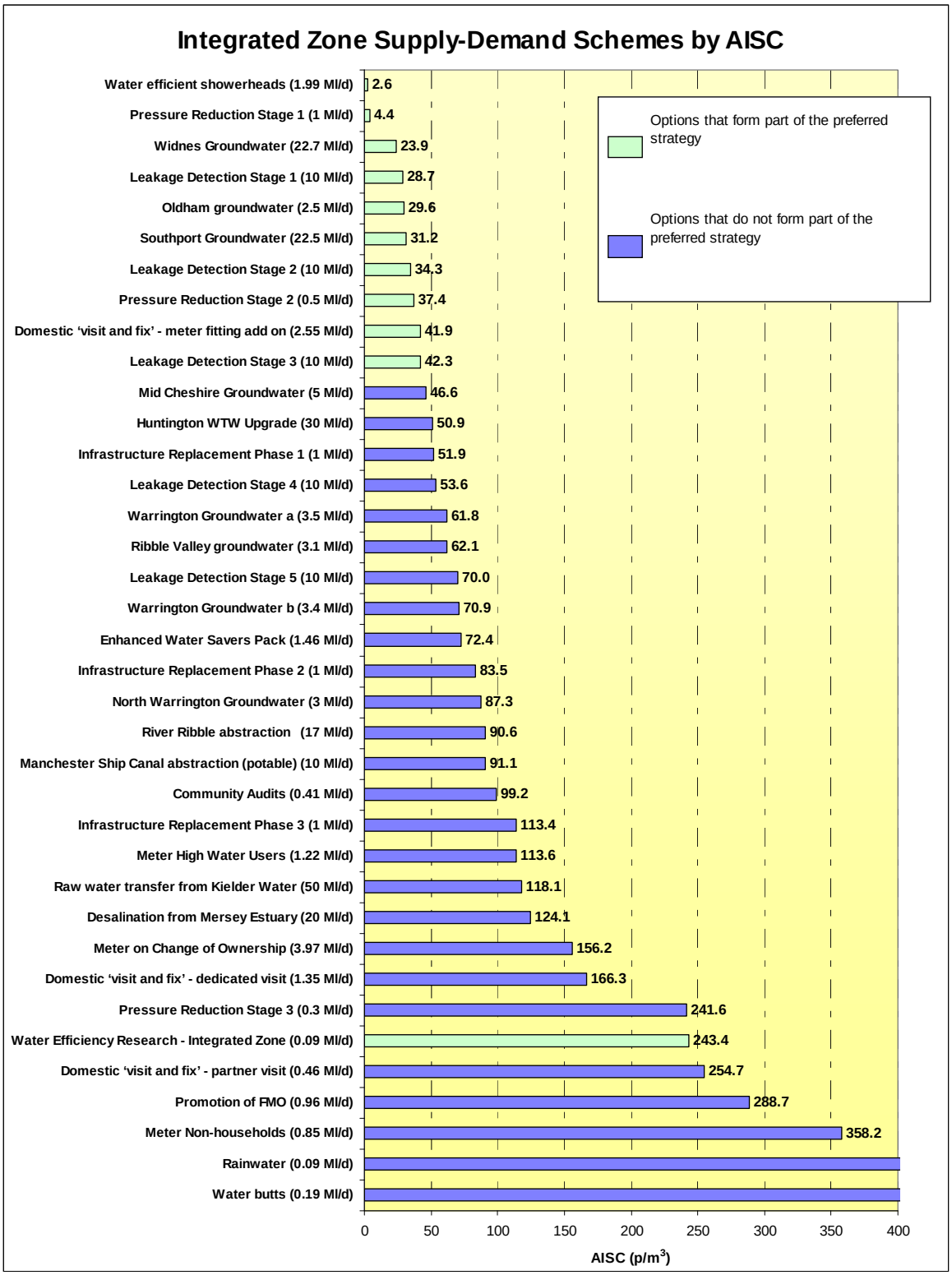
- **Development of new water sources** including new groundwater, desalination, new river abstraction or new canal abstraction. We have also considered an option to build a new reservoir, but have discarded it as being unpromotable, due to environmental concerns, unless no practical alternative options exist.

For each option we have examined its feasibility, capital and operating costs, and the environmental and social effects. The economic appraisal has included a detailed evaluation of the environmental and social costs and benefits. For example we have used the Government's shadow price of carbon dioxide (currently £25.4 per tonne of carbon dioxide at 2007 prices) to assess the impacts of our options on the emission of greenhouse gases because of energy use or savings. The environmental costs evaluated include impacts on biodiversity, recreational activities, heritage, archaeology and landscape. The social costs include disturbance during construction or operation of a scheme.

The feasible options for the Integrated and West Cumbria zones are ranked in terms of their overall unit cost in Figures 5 and 6 respectively. The unit cost presented for each option is what is officially known as "average incremental social cost" or AISC. The AISC values have been calculated in accordance with national best practice and include environmental and social as well as financial costs.

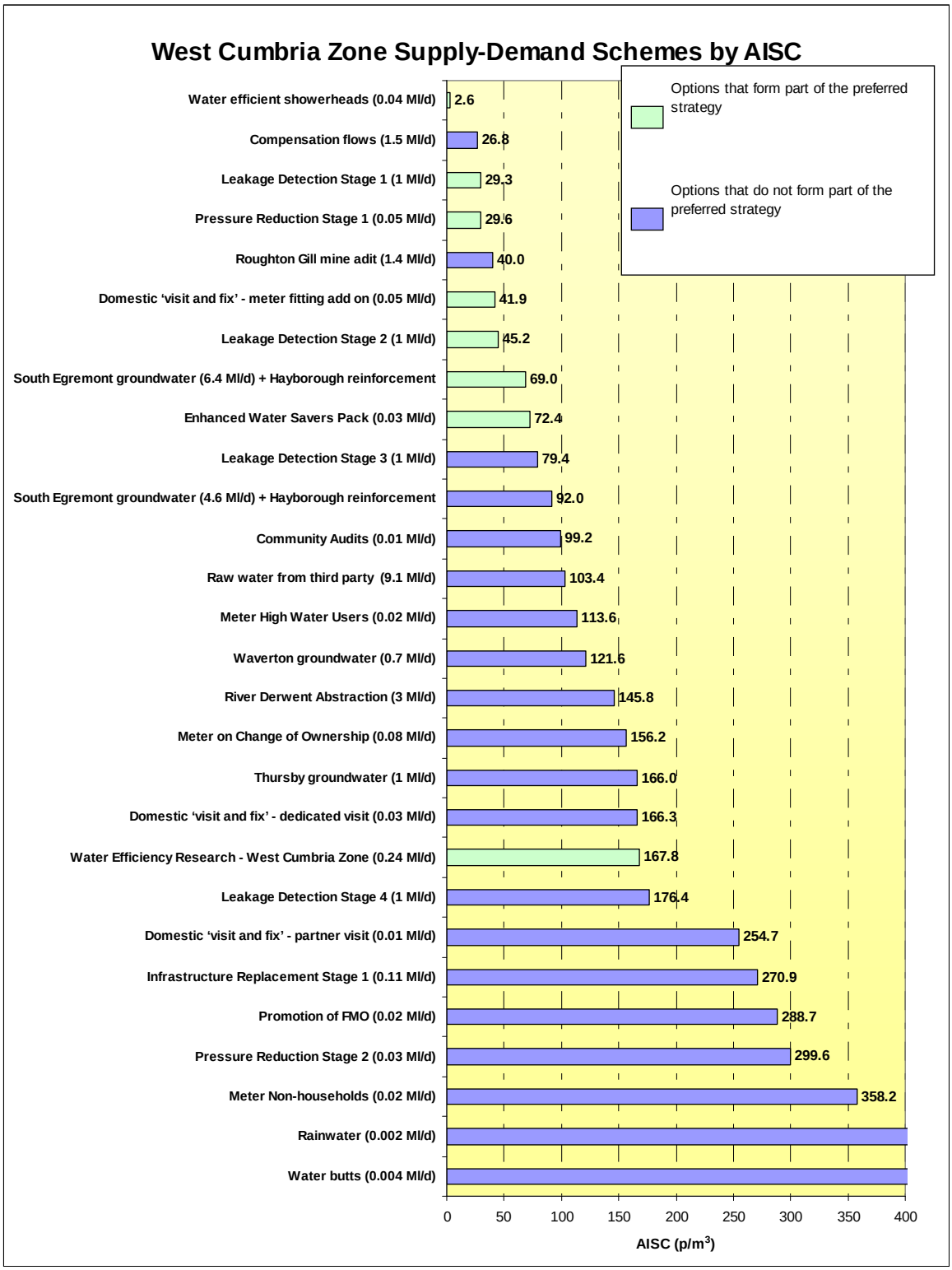
Figures 5 and 6 show, for each zone, the relative ranking of each leakage reduction, water efficiency, metering and supply enhancement option according to their overall total environmental and social effects and financial costs. They also show the potential water volume benefit for each option. For example, the "Pressure reduction stage 1" option for the Integrated Zone (Figure 5) has a very low unit cost of 4.4 pence per cubic metre of water and is the most economic leakage reduction option for this zone, but the volume of water saving that it would achieve is relatively small at 1.0 Ml/d. The graphs also show which options form part of the most economic water resources and demand strategy for the Integrated and West Cumbria zones.

Figure 5. Ranking of options for the Integrated Zone according to average incremental social cost (pence per cubic metre of water)



Note: The average incremental social cost (AISC) of an option includes environmental and social effects as well as financial costs.
For water efficiency options the water availability benefit is the maximum benefit over 25 years

Figure 6. Ranking of options for the West Cumbria Zone according to average incremental social cost (pence per cubic metre of water)



Note: The average incremental social cost (AISC) of an option includes environmental and social effects as well as financial costs.
For water efficiency options the water availability benefit is the maximum benefit over 25 years

In both the Integrated and West Cumbria zones we have included the water efficiency research programme in our plans for 2010-15, although they have high AISC values, because of their importance to help us identify more cost-effective measures for implementation in the future. In the case of West Cumbria, the least-cost combination of options to provide the 8.3 Ml/d of water supply benefit required would comprise: South Egremont groundwater (6.4 Ml/d); compensation flow control at Crummock Water (1.5 Ml/d) and 0.4 Ml/d of leakage reduction. However, our environmental appraisal has led us to prefer a slightly more costly (in financial terms), but more sustainable, combination of options, which involves more leakage reduction and water efficiency instead of the compensation flow control option.

2.9 Environmental appraisal

In accordance with the European Union Strategic Environmental Assessment Directive, UU has undertaken a comprehensive strategic environmental assessment of the Water Resources Management Plan, including Habitats Regulations Assessment of the plan. The assessment has identified and compared the environmental and social benefits and effects associated with each potential programme of solutions to address supply-demand deficits. It included issues that cannot be evaluated using the environmental and social costs calculated as part of the option appraisal. The assessment has endorsed our proposed plan as being suitable. It found no unacceptable adverse impact associated with any of the combinations of options considered for West Cumbria, but concluded that our preferred combination of options is likely to have fewer negative effects than the least-cost or other combinations of options to overcome the predicted supply shortfall.

The full report "*Strategic Environmental Assessment of United Utilities Draft Water Resources Management Plan*" (Entec, 2008) is available at UU's website. It was published on 2nd May 2008 and issued for consultation. We have taken account of the comments we have received as presented in the *Addendum to the Strategic Environmental Assessment* (Entec, 2009), which is also available at UU's website.

Chapter 3. Water resources and demand strategy

3.1 Strategic principles

UU's water resources and demand strategy is to undertake the best plan that maintains the water supply reliability standards for our customers, ensures sustainable water abstraction and meets the challenge of climate change.

The strategy has been derived based on the following principles:-

- **Economic.** It is the lowest overall financial, environmental and social cost programme, and minimises impacts on customer water bills. We have considered alternative plans that comprise a greater amount of leakage reduction and water efficiency activity. However these would incur additional costs and do not provide significant environmental or social benefits over and above the most economic solutions. This is because the water source enhancement schemes that have been chosen have generally low environmental or social impacts and would be used infrequently, primarily during prolonged dry weather events.

- **Sustainable.** The need to ensure sustainable water abstraction to protect the environment by reducing water abstraction and carbon dioxide emissions has been a key feature of our plan. We have, for example, included significant demand management actions because we believe them to be crucial for long-term environmental sustainability.

- **Compliant.** Our plan complies with statutory requirements and regulatory guidance. It has been prepared in full accordance with national best practice methods.

- **Consistent.** Our plan is fully consistent with UU's *Strategic Direction Statement* which sets out our core principles for our long-term planning, and identifies the need to reduce water demand and carbon consumption.

- **Flexible and robust.** The leakage reduction, water efficiency, customer metering and water source enhancement elements of the strategy can be adapted, added to or reduced in scale if changes take place. There are significant uncertainties associated with the impacts of climate change and the potential for further sustainability reductions in compliance with the European Union Water Framework Directive, that are likely to reduce water source yields.

3.2 Water resources and demand strategy for the Integrated Zone

The strategy for the Integrated Zone has been derived from careful consideration of a wide range of potential options, as described in Section 2.8, in addition to our already planned baseline programmes for customer metering, leakage reduction and water efficiency.

Our plan to maintain an adequate supply-demand balance for the Integrated Zone throughout the planning horizon to 2035 comprises "baseline" and "enhanced" plans.

Our baseline plans for already planned activities are:-

- Construction of a bi-directional pipeline, known as the "West-to-East Link", between Merseyside and North Manchester. It is due to be in operation by 2011. This will help us maintain adequate supplies to Greater Manchester and Merseyside if there is a need to temporarily reduce supply from a major reservoir, for example due to maintenance work or drought conditions. This will be an enhancement to our supply network to further increase the integration and flexibility of the supply within the Integrated Zone.

- Maintain current leakage levels.

- Help our customers save 9 Ml/d by 2014/15 (increasing later on to 12 Ml/d), through our base service water efficiency programme.

- Water demand reduction of 10 Ml/d in a dry year by 2014/15 (increasing to 22 Ml/d by 2034/35) by the household customers that we expect to opt to be metered.

- Non-household customers in the Integrated Zone are expected to reduce water demand by 90 Ml/d by 2014/15 (141 Ml/d by 2034/35) due to the effects of the economic downturn and as part of their continuing water efficiency programmes, which will be encouraged by UU's activities to promote water efficiency.

Our enhanced plans identified as part of our economic programme to maintain adequate supply-demand balances (see also Table 5) are:-

- Further reducing leakage by 23 Ml/d by 2034/35.

- A programme of economic water efficiency measures to save 4 Ml/d by 2034/35.

- Implementing water source enhancements of 48 Ml/d by 2034/35.

In addition, we are planning leakage reduction and water efficiency research programmes during 2010-15. Although further leakage reduction and water efficiency activity are not required in 2010-15 to maintain an adequate supply-demand balance, research studies are important to help us identify more cost-effective measures for implementation in the future.

Table 5. Water resources and demand strategy for the Integrated Zone (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
WAFU	1931.7	1904.6	1879.8	1871.3	1868.4	1863.6
Dry year weather demand (baseline demand management included)	1873.8	1800.7 (4.0)	1770.6 (19.0)	1765.4 (25.0)	1769.5 (31.1)	1808.7 (36.0)
Target headroom	41.4	53.4	79.3	99.0	106.0	129.5
Initial Supply-Demand Balance (Ml/d)	**16.6**	**50.6**	**30.0**	**6.9**	**-7.1 (deficit)**	**-74.6 (deficit)**
Proposed plan:						
Leakage reduction	n.a.	0	0	0	7.1	22.8
Water efficiency	n.a.	0	<0.1	<0.1	<0.1	4.1
Water source enhancements	n.a.	0	0	0	0	47.7
Final Supply-demand Balance (Ml/d)	**16.6**	**50.6**	**30.0**	**6.9**	**0**	**0**

Notes:

- Values may not sum exactly due to rounding.
- The WAFU values from 2012/13 include 16.6 Ml/d benefit from implementation of the West to East Link Main (see Table 1).
- The dry year weather demand includes the effects of our "baseline" leakage reduction, water efficiency plan and customer metering plan (see text).
- The source enhancements included at 2034/35 are Widnes groundwater (22.7 Ml/d), Southport groundwater (22.5 Ml/d) and Oldham groundwater (2.5 Ml/d).

We will also undertake environmental investigations and option appraisals to identify the most appropriate solutions to comply with the future requirements of nature conservation legislation, including the European Union Water Framework Directive.

An alternative view of the Integrated Zone by 2035

We expect the implementation of the Water Framework Directive to significantly impact on our water source yields in the Integrated Zone, and we anticipate that it is likely that a statutory requirement will be introduced to undertake widespread compulsory metering of households in the longer term. We have been asked by regulators to exclude these from our main plan because they are too uncertain. We also hope that in the longer term leakage reduction and water efficiency will become much more cost-efficient than at present, as a result of future technological advances. Therefore, we present in Table 6 our view of how this alternative scenario could potentially impact on our water resources and demand strategy for the Integrated Zone.

Table 6 shows that the potential for our strategy in the Integrated Zone to change significantly before we get to the later stages. It also gives some confidence that these

significant changes would not change our approach in the early years of our plan. We will fully review the WRMP in 5 years time.

Table 6. Alternative water resources and demand strategy for the Integrated Zone, including: estimated impacts of the Water Framework Directive (WFD); anticipated compulsory household metering in the longer term; and lower cost leakage reduction and water efficiency in the longer term (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Initial Supply-Demand Balance (Ml/d)	**17**	**51**	**30**	**7**	**-7 (deficit)**	**-75 (deficit)**
Estimated impact of WFD on water source yield				-30	-60	-100
Estimated demand benefit of compulsory metering					18	60
Modified Supply-Demand Balance (Ml/d)	**17**	**51**	**30**	**-23 (deficit)**	**-49 (deficit)**	**-115 (deficit)**
Proposed plan:						
Leakage reduction	n.a.	0	0	10	30	75
Water efficiency	n.a.	0	0	3	5	15
Water source enhancements	n.a.	0	0	10	14	25
Final Supply-demand Balance (Ml/d)	**17**	**51**	**30**	**0**	**0**	**0**

Note: This is an alternative strategy that has been introduced to demonstrate what might happen in the future. It does not form part of our current plan.

3.3 Water resources and demand strategy for North and West Cumbria

Although no supply deficits are currently forecast in the **Carlisle Resource Zone,** the planned changes to abstraction licence conditions for the River Gelt, together with planned new development, will result in a need to invest in new infrastructure to secure adequate water supply reliability in the rural North Carlisle area.

No supply deficits are forecast in the **North Eden Resource Zone** following investment in the 2000-05 period to secure supply reliability.

Therefore, no additional measures are required in the Carlisle and North Eden zones to maintain adequate supply-demand balances. However, our base-service water efficiency programme and free meter option scheme to reduce water demand will continue to apply to these zones as well as the rest of the region.

Table 7 summarises our plans to maintain an adequate supply-demand balance for the **West Cumbria Resource Zone**. In West Cumbria we need to implement solutions by

2014/15 to replace yield that will be lost due to abstraction licence changes at Ennerdale Water and Dash Beck.

Table 7. Water resources and demand strategy for the West Cumbria Zone (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
WAFU	58.9	57.8	48.4	48.3	48.3	48.2
Dry weather demand (baseline demand management included)	57.9	55.0 (3.0)	54.8 (3.3)	53.8 (3.4)	53.6 (3.5)	54.6 (3.6)
Target headroom	1.4	1.9	1.8	1.6	1.4	1.5
Initial Supply-Demand Balance (Ml/d)	**-0.4 (deficit)**	**1.0**	**-8.3 (deficit)**	**-7.1 (deficit)**	**-6.7 (deficit)**	**-7.8 (deficit)**
Proposed plan:						
Leakage reduction	n.a.	0	1.6	1.6	1.6	1.6
Water efficiency	n.a.	0	0.3	0.2	0.1	0.1
Water source enhancements	n.a.	0	6.4	6.4	6.4	6.4
Final Supply-demand Balance (Ml/d)	**-0.4 (deficit)**	**1.0**	**0**	**1.1**	**1.4**	**0.3**

Note:
- Values may not sum exactly due to rounding.
- The dry year weather demand includes the effects of our "baseline" leakage reduction, water efficiency plan and customer metering plan.

The proposed plan for the West Cumbria Resource Zone comprises "baseline" and "enhanced" plans.

Our "baseline" plans for already planned activities are:-

- Reducing leakage by 3 Ml/d from the 2006/07 level.
- Help our customers save 0.2 Ml/d by 2014/15, through our base service water efficiency programme.
- Water demand reduction in a dry year of 0.1 Ml/d by household customers that will opt to be metered by 2014/15 (increasing to 0.3 Ml/d by 2034/35).
- Non-household customers are expected to reduce water demand by 4 Ml/d by 2034/35 due to the effects of the economic downturn and as part of their continuing water efficiency programmes, which will be encouraged by UU's activities to promote water efficiency.

Our "enhanced" plan identified as the most economic and sustainable programme during 2010-15 to maintain adequate supply-demand balances (see Table 6) is:-

- Develop a new South Egremont groundwater scheme to enhance water source yield by 6.4 Ml/d.

- Further reducing leakage by 1.55 Ml/d by 2014/15.

- Help our customers save 0.33 Ml/d by 2014/15, through a programme of economic water efficiency measures (0.08 Ml/d) and our research programme (0.24 Ml/d). The research project has been included, although it has a high cost per volume of water saved, because of its importance to help identify more cost-effective measures for implementation in the future.

The "enhanced" programme is the most economic and sustainable solution (including environmental and social effects as well as financial costs) to achieve a supply-demand balance.

The strategy for West Cumbria has been derived from careful consideration of a wide range of potential options, as described in Section 2.8, in addition to our already planned baseline programmes for leakage reduction, water efficiency and customer metering. There is a high probability that further changes could have an additional impact on the supply-demand balance in West Cumbria. These include, in particular, possible sustainability reduction at Overwater Reservoir and greater climate change impact in the long-term beyond 2035. This reinforces the need for a robust solution for the long-term.

3.4 Regional water demand reduction strategy

The key elements of our plans to reduce demand are:-

- **Leakage reduction** is an important part of our long-term aspiration. We plan to reduce leakage across the region by 28 Ml/d (from 468 Ml/d to 440 Ml/d) by 2034/35. However, after accounting for the regional water efficiency and metering activities, and the anticipated further reductions in non-household water demand, there are no supply-demand deficits in the region before 2022/23, except in West Cumbria. We have not included further leakage reduction, beyond that already planned, as it would impact adversely on customer bills in a way that would go beyond the level of service that they are willing to pay for. As explained in Section 3.2, we expect that substantially more leakage reduction will be required in the future to enable us to comply with the implementation of the EU Water Framework Directive.

- A large region-wide **water efficiency programme** will be carried out, including an increased programme from 2010/11 in line with the newly introduced Ofwat water efficiency targets. In addition, we will carry out a research programme (described in Section 3.5) and implement economic water efficiency schemes when required. We expect the total water saving (including our current baseline activities) to be 10 Ml/d by 2014/15 rising to 16 Ml/d by 2034/35. A larger water efficiency programme cannot be cost-justified at the present time, but our research

programme is aimed at identifying more cost-efficient measures for inclusion in future plans.

- We will continue to **install water meters** at all new properties and those households who opt to be metered under our free meter option scheme. We expect that further metering will occur at a total of 822,000 new homes and 708,000 households that opt to be metered by 2034/35, who will save an estimated 23 Ml/d. In the longer term, we anticipate that universal compulsory metering of households will be required but it is not included in our plan as it is not currently permitted.

- We expect non-household customer water demand to continue to significantly reduce, by 157 Ml/d by 2034/35. This will result from the effects of the economic downturn (in early years) and as part of their continuing water efficiency programmes, which will be encouraged by UU's activities to promote water efficiency.

- We propose that from April 2010 most newly installed customer meters will have **automated meter read technology**. During 2010-15 we will explore the use of 'smart metering' in conjunction with automated meter read to investigate the benefits of these technologies. In particular we will evaluate the merits of better information about patterns in water use and the use of different tariffs, such as rising block tariffs which encourage greater water savings by charging higher volumetric prices for higher consumption levels. We expect to introduce new tariffs by 2015.

We are abstracting less water from the environment now than at any time since the 1960s and we expect it to reduce further in the future. Our water resources and demand strategy will reduce average water demand in each water resource zone. It therefore goes beyond the principles of "water neutrality", the concept by which "for every new development, total water use in the region after the development must be equal to or less than total water use in the region before the development".

The benefits of our strategy in reducing water abstraction and emission of greenhouse gases (due to lower energy use by UU and our customers) is summarised in Tables 8 and 9. We expect total water put into supply to reduce by 224 Ml/d between 2006/07 and 2034/35 (in a normal weather year), which is equivalent to 12% of water demand at 2006/07. Our plan will also cut carbon dioxide emissions due to UU's water supply activities by 12% from 305 tonnes carbon dioxide per day in 2006/07 to an estimated 269 tonnes per day in 2034/35. Lower energy use by household customers in heating and using less water will reduce emissions by 161 tonnes per day by 2034/35. There will also be significant savings in energy use and associated carbon impact for wastewater treatment and disposal activities by UU and by our non-household customers.

The strategy will therefore make an important contribution to UU's strategic aims to ensure sustainable water abstraction and to mitigate the impact of climate change.

Table 8. Water demand reduction plan – water savings in normal weather year

Programme Type	Activity	Water saving by 2014/15	Water saving by 2034/35
LEAKAGE REDUCTION			
Baseline	Leakage reduction planned to be achieved by 2009/10.	4 Ml/d	4 Ml/d
Enhanced	Further leakage reduction proposed as part of our plans to maintain supply-demand balances in the Integrated and West Cumbria zones.	2 Ml/d	24 Ml/d
	Total water saving	**5 Ml/d**	**28 Ml/d**
WATER EFFICIENCY			
Baseline	Base service programme Water savings to comply with the Ofwat water efficiency targets. Our forecasts include the decay in benefits as customers remove or replace devices over time. The savings associated with publicity and many other activities cannot be reliably assessed and so are not estimated here.	9 Ml/d	12 Ml/d
Enhanced	Economic Programme Implementation of additional showerhead and water audit programmes to help maintain supply-demand balances in the West Cumbria and Integrated zones.	<1 Ml/d	4 Ml/d
	Research Programme Implementation of our 2010-15 water efficiency research programme. The benefit decays as customers remove or replace the devices over time.	<1 Ml/d	<1 Ml/d
	Total water saving (to nearest Ml/d)	**10 Ml/d**	**16 Ml/d**
HOUSEHOLD METERING			
Baseline	Free Meter Option Voluntary opting by an estimated 708,000 further houses to be metered through the free meter option by 2034/35.	10 Ml/d	23 Ml/d
Enhanced	New Tariffs Tariff studies are planned in 2010-15 which may lead to additional water savings by customers in the future, but we cannot quantify these until the studies have been completed.	-	-
	Total water saving	**10 Ml/d**	**23 Ml/d**
NON-HOUSEHOLD DEMAND REDUCTIONS			
Baseline	Industrial, commercial and institutional customers We anticipate that non-household water demand (particularly by industry) will continue to significantly decline. Our publicity and other programmes will help to influence the demand savings but the contribution by UU actions cannot be reliably estimated.	**96 Ml/d**	**157 Ml/d**
OVERALL TOTAL WATER SAVING			
	Including non-household **Excluding non-household**	**122 Ml/d** **26 Ml/d**	**224 Ml/d** **67 Ml/d**

Note: Values may not sum exactly due to rounding.

Table 9. Benefit of our water resources and demand strategy by 2034/35

	Reduction in water demand by 2034/35 (Ml/d)	Reduction in carbon dioxide emissions by 2034/35 (tonnes CO_2e per day)		
		By UU (on water supply)	By customers	Total
Leakage reduction	28	4	0	4
Water efficiency	16	3	66	69
Household metering	23	4	95	99
Non-household reductions	157	25	Not estimated	25
Total	224	36	161	197

Notes:

- CO_2e = carbon dioxide equivalent
- Values may not sum exactly due to rounding
- No reliable data are available to enable an estimate to be made of the energy used by non-households in heating, pumping or processing water as it varies enormously between different customers.

3.5 Research and innovation

There are a variety of challenges and uncertainties that impact on our future water supply and demand. It is therefore important that a range of studies are undertaken to innovate new solutions and to better understand the uncertainties. As a result, we plan to carry out the following research and innovation during 2010-15 in order to develop more cost-efficient demand reduction actions for implementation in future plans:-

- Undertake a water efficiency research programme (see details below) with the key purpose of identifying improved methods for delivering water efficiency programmes during 2015-20.

- Investigate the benefits of mains replacement as a leakage reduction measure. This is important because we are reaching the limit of leakage reduction that can be achieved by detection and repair methods and we need improved ways of replacing mains to make further leakage reduction economic.

- Research into new leakage control technologies including new acoustic leak detection loggers, advanced network modelling techniques and working with manufacturers to develop acoustic microphones suitable for trunk mains.

- Investigate the benefits of automated meter read and “smart meter” technology in improving the data available from water meters.

- Investigate the benefits of different tariffs that could encourage metered customers to further conserve water, and the potential for social tariffs that assist affordability for customers with low incomes.

- Further improvements to our water resource models, including development of rainfall-runoff models for improved assessment of the climate change impacts on the water source yields in our water resource zones.

A significant barrier to the wide use of water efficiency measures by water companies is a lack of clarity around the costs and benefits of water efficiency. Therefore we propose to build on existing research (by ourselves and other parts of the Water Industry), by undertaking an innovative, water efficiency programme during 2010-15. The key components are:-

- **"Green Zone" West Cumbria water efficiency project**
  This is a major water efficiency research project to evaluate the effectiveness of alternative methods of influencing customer behaviour to save water. This is particularly important for the West Cumbria area because of the future water supply shortfall and the challenges of influencing customers in an area that is normally one of the wettest in England. The key aims are:-

  (a) To achieve a water saving in West Cumbria of over 0.2 Ml/d by 2014/15.

  (b) To determine the form of marketing/advertising customers respond to best.

  (c) To determine how people would prefer to request water efficient devices (return postcard, website, telephone), and which are the most popular water efficiency devices.

  (d) To compare the effect of continual campaigns versus seasonal campaigns.

  (e) To evaluate the costs and issues of implementing such a large scale water efficiency campaign.

  (f) To communicate these findings to the wider water efficiency community.

  It is proposed to work closely with other organisations and to use the results to identify more cost-efficient water efficiency measures for the future.

- **Other research**
  We also plan to carry out other research studies as part of Ofwat's expectations for baseline water efficiency activity, including: **"Model Zero-Carbon" new development project** to consider how the implementation of water efficiency measures in new housing developments can help achieve zero-carbon status through low energy and water consumption; and **Rainwater harvesting project** to investigate the water savings and costs of rainwater harvesting at new non-household properties.

3.6 Concluding remarks

We are abstracting less water from the environment now than at any time since the 1960s and we expect it to reduce further in the future.

Our proposed water resources and demand strategy, as summarised below and described further in Sections 3.2 to 3.5, maintains water supply reliability standards for our customers whilst ensuring sustainable water abstraction by demand reduction and supply enhancement, and meeting the challenge of climate change by planning significant reductions in water demand and the emission of greenhouse gases.

The key elements of our strategy for the region to 2014/15 can be summarised as follows:-

- 58 Ml/d of water source yield will be lost due to: abstraction licence changes to ensure our abstractions are more sustainable (46.1 Ml/d); and the estimated effects of climate change (12.1 Ml/d).

- 23 Ml/d of water supply enhancements will be provided comprising the West-to-East Link main in the Integrated zone (16.6 Ml/d yield benefit) and the South Egremont groundwater scheme in West Cumbria (6.4 Ml/d yield benefit).

- 25 Ml/d of water demand reductions (from 2006/07) will be achieved by UU, in partnership with customers and stakeholders, comprising leakage reduction (5 Ml/d), water efficiency measures and research studies (10 Ml/d) and voluntary household metering (10 Ml/d).

- 93 Ml/d of water demand reduction (from 2006/07) is expected to be achieved by non-household water customers due to their water efficiency measures (encouraged by UU) and the effects of the economic downturn.

- Further leakage reduction and water efficiency activity are not economically justified at the present time but we are planning leakage reduction and water efficiency research programmes during 2010-15. Although these are not required in 2010-15 to maintain an adequate supply-demand balance, they are important to help us identify more cost-effective measures for implementation in the future.

We consider that our plan strikes the appropriate balance between the expectations of our customers for a high standard of water supply security at affordable prices and the need to protect the environment. In accordance with Defra, Environment Agency and Ofwat guidance we have followed the “twin-track” approach in the development of our strategy. This requires consideration of supply enhancement and demand management measures on an equal basis, and to select the most economic and sustainable supply-demand solutions. Our option appraisal has fully included environmental as well as cost issues in order to derive the optimal solutions. For example, we have included the implications of our plan on our carbon footprint and that of our customers.

There are significant uncertainties about the level of impact of sustainability reductions and climate change on supply-demand balances. These issues could result in larger deficits than we are currently forecasting, and so we have ensured that our strategy is adaptable to respond to such risks as they arise. In addition, the construction of the new West-to-East

Link main will improve the flexibility and resilience of the water supply in our largest water resource zone.

We will be able to review all elements of our supply-demand assessments when we prepare our 2014 Water Resource Management Plan, and will modify our plans as necessary. A key element of our flexibility is the wide range of options which could be implemented if needed – we can add to or modify the plan as issues change or more information comes available.

We have incorporated the comments from consultees in this Final Water Resource Management Plan. This has included taking account of further advice from our regulators, the revised sustainability reductions currently planned by the Environment Agency and further information that has become available. The key changes to our plan since the original Draft WRMP are summarised in Chapter 4.

More details of our plan are provided in the Main Report which can be found at UU's website at www.unitedutilities.com/WaterResourcesPlan.htm

Chapter 4. Consultation on the Draft Water Resources Management Plan

4.1 Consultation timetable

The timetable for preparing our Water Resources Management Plan (WRMP) is as follows:-

- Publication of Draft WRMP for consultation — 2nd May 2008
- End of consultation period — 25th July 2008
- Publication of Statement of Response and revised Draft WRMP — 30th January 2009
- Approval for publication of the Final WRMP by the Secretary of State for Environment Food and Rural Affairs — 3rd August 2009
- Publication of Final WRMP on UU's website — 30th September 2009

We published our Draft WRMP on 2nd May 2008 on the company's website. It was issued to the 81 statutory WRMP consultees and a further 116 non-statutory consultees via email. A total of fourteen Representations on the Draft WRMP were submitted to the Secretary of State. We are very grateful to those organisations and individuals that expressed their views on what they liked about the plan and what we can do to improve it.

On 30th January 2009 we published a Statement of Response that describes the consultation on the Draft WRMP and how UU has taken account of consultee comments. We sent a copy of the Statement of Response in electronic form to all consultees who provided comments. At the same time we also published a revised Draft WRMP that incorporated these changes.

The following documents relating to our WRMP are available on our website:-

- Final WRMP (summary report and main report)
- Welsh language version of the Final WRMP summary report
- Statement of Response to the Consultation on the Draft Water Resources Management Plan (first published on 30th January 2009)
- Strategic Environmental Assessment of United Utilities' Draft Water Resources Management Plan (first published on 2nd May 2008)

- Addendum to the Strategic Environmental Assessment (which describes changes to the strategic environmental assessment of the Draft WRMP, in particular taking account of consultee comments) (first published on 30th January 2009).

They can be found at www.unitedutilities.com/WaterResourcesPlan.htm

4.2 Changes made to the Draft WRMP

This Final WRMP has incorporated the comments received from consultees by providing requested additional information, following advice from regulators and taking account of new information mentioned by consultees that has become available since production of the original Draft WRMP.

The changes that have been made as a result of the consultation on the Draft WRMP are summarised as follows:-

- Include additional information as requested by consultees: in Chapter 5 on customer preference surveys concerning our level of service; in Chapter 12 on Habitats Regulations Assessment of the preferred solutions; in Appendix 5 on compliance with the WRMP Directions; and in Appendices 6 and 7 on option appraisal.

- Provide additional text on various issues where consultees asked for more information.

- Take account of the latest revisions to the Environment Agency's water resources planning guideline.

- Include the effect of the West-to-East Link main for the Integrated Water Resource Zone and combining our models for West Cumbria in our water source yield assessment, as requested by the Environment Agency. (See Chapter 5 of the Main Report)

- Incorporate the final details on abstraction licence changes to be imposed by the Environment Agency. (See Chapter 5)

- Incorporate new information in the assessment of water source outage allowances. (See Chapter 5)

- Incorporate Ofwat's new mandatory water efficiency targets. (See Chapters 6 and 7)

- Incorporate Ofwat's new guidance on the sustainable economic level of leakage. (See Chapter 6)

- Remove the anticipated compulsory metering of households from our long-term demand forecasts, as requested by Ofwat and the Environment Agency, because this is not currently legally available to UU as our region is an area of low water

stress. (See Chapters 6 and 7)

- Incorporate new, official population and household forecasts for North West England. (See Chapter 7)

- Take account of the current severe "credit-crunch" and economic downturn, that has recently become more apparent, and its likely impacts on economic development and house building over the next few years. (See Chapter 7)

- Reduce the allowance for climate change uncertainty in our target headroom assessment, as suggested by Ofwat. (See Chapter 9)

- Incorporate changes to options where new information is available or in response to comments from stakeholders. (Chapter 11 and Appendix 7)

- Incorporate findings from the water efficiency evidence base, recently published by Waterwise, in the evaluation of water efficiency options. (See Chapter 11)

- Recalculate water source yields, outage, population and household forecasts, demand forecasts and target headroom to take account of the new information described above.

- Incorporate the changes to supply-demand balances that arise from these reassessments, and revise the economic and environmental appraisal of the preferred solutions to maintain adequate supply-demand balances. (Chapters 10 to 14)

4.3 Implications for the water resources and demand strategy

The way in which these changes have affected the water resources and demand strategy can be summarised as follows:-

- A significantly enlarged region-wide water efficiency programme has been included in accordance with the new mandatory water efficiency targets recently introduced by Ofwat (the economic regulator for the water industry).

- A significantly larger predicted shortfall in water supplies in West Cumbria has resulted from the revised abstraction licence changes planned by the Environment Agency and the revised water resources modelling approach requested by the Agency. The strategy for West Cumbria now comprises a combination of leakage reduction, water efficiency activity and an enlarged new groundwater scheme at South Egremont.

- In the Integrated Water Resource Zone (which serves about 95% of the region) there is now no predicted water supply shortfall until 2022/23. Therefore, whereas we had previously been proposing to carry out leakage reduction and water source enhancement in this zone during 2010 to 2020, no such schemes are required before 2022/23. These changes have resulted from: reduced allowance for climate

change uncertainty (in line with consultation responses on the Draft WRMP from Ofwat and other consultees); more explicit inclusion of the water supply benefit of the West-to-East Link (as requested by the Environment Agency); revised allowance for water source outage; inclusion of the enlarged water efficiency programme; and taking account of the scale of the economic downturn that has recently become more apparent. As previously we are not permitted to take account of the implementation of the European Union Water Framework Directive which we expect will have a significant effect after 2015.

- A new water pipeline will be needed in Carlisle to reinforce the water supply network to maintain adequate supplies to areas of development. No other schemes are required to maintain adequate supply-demand balances in the Carlisle or North Eden water resource zones.

- We have included a new table (Table 6) which considers the probable needs for more water supply-demand actions in the future by taking into account issues we are unable to include in our main plan. We therefore expect, for example, that the future implementation of the EU Water Framework Directive will determine the need for much more leakage reduction than we are currently able to propose.

4.4 Further information

If you require any further information or have difficulty obtaining any WRMP documents from UU's website, please contact:-

Simon Boyland
Water Supply Demand Manager
United Utilities Water PLC
Thirlmere House
Lingley Mere Business Park
Great Sankey
Warrington WA5 3LP
water.resources@uuplc.co.uk

Part 2.

Main Report

Chapter 1. Introduction

This chapter describes the purpose of United Utilties' Water Resources Management Plan and outlines its contents.

1.1 Background

United Utilities Water PLC (UU [1]) is the water company for North West England. We provide water and wastewater services to 2.9 million homes and over 200,000 businesses across the region.

UU has prepared its 2009 Water Resources Management Plan (WRMP) (this document). It describes in detail our assessment of the available water supplies and the demand for water by UU customers. The plan also sets out our proposed strategy for water resources and demand management to achieve the required level of water supply reliability.

UU published its Draft WRMP on 2nd May 2008 for public consultation, in accordance with the Water Act 2003 and the Water Resources Management Plan Regulations 2007. We are very grateful to those organisations and individuals that expressed their views on what they liked about the plan and what we can do to improve it.

On 30th January 2009, UU published a Statement of Response that describes the consultation, and how we have taken account of the views we received. This Final WRMP has incorporated the comments received from consultees by providing the requested additional information, following the advice from regulators and taking account of new information mentioned by consultees that has become available since production of the Draft WRMP. On 3rd August 2009, the Secretary of State for Environment, Food and Rural Affairs confirmed that UU has adequately taken account of the views of stakeholders, and gave permission for the publication of the Final WRMP.

This document and the Statement of Response can be found on UU's website at: www.unitedutilities.com/WaterResourcesPlan.htm

[1] Abbreviations used throughout this report:-

Defra	Department for Environment Food and Rural Affairs
EA	Environment Agency (also referred to as the Agency)
EU	European Union
Ml/d	million litres per day
Ofwat	Water Services Regulatory Authority, previously known as the Office for Water Services
UKWIR	UK Water Industry Research Limited
UU	United Utilities Water PLC
WAFU	Water available for use, an important measure of the reliable yield from water sources
WRMP	Water Resources Management Plan

The way in which our WRMP is structured to address these issues is set out below.

Topics covered and structure of the WRMP	
Where is the plan summarised ? How has the consultation changed the WRMP ?	Summary Report
What is a WRMP and how is it put together ?	Sections 1.2 and 1.3
How has UU taken account of customer and stakeholder views in preparing the WRMP ?	Chapter 2 Consultation and involvement
How does UU's long-term strategy affect water resources and demand ?	Chapter 3 UU's strategic direction
Where do we get our water from and how are water supplies managed in North West England ?	Chapter 4 Our water supply system
What is the supply capacity of our water sources and how will it change in the future ?	Chapter 5 Water source yields
What is UU doing to reduce leakage and help conserve water ?	Chapter 6 Water demand management
What are the demands for water and how will they change in the future ?	Chapter 7 Water demand forecasts
How will climate change affect water supply and what is UU doing to reduce greenhouse gas emissions ?	Chapter 8 Climate change
How are uncertainties taken account of in the WRMP ?	Chapter 9 Target headroom
If no further action is taken what will the water supply-demand balance be ?	Chapter 10 Initial supply-demand balance
What water supply options and demand management options have been considered, and how have they been compared ?	Chapter 11 Options
What are the environmental implications of the options and findings of the strategic environmental assessment ?	Chapter 12 Environmental appraisal
What is UU proposing to do, and what will happen if things change ?	Chapter 13 Water resources and demand strategy
What are the key findings of this document ?	Chapter 14 Conclusions

1.2 Need for water resources plans

Water companies have a statutory duty to provide domestic and non-domestic customers with a reliable supply of water for domestic and business purposes. They must also plan to ensure that they are able to meet the demands that are likely to arise in the future.

UU and other water companies have prepared water resources plans on a voluntary basis for many years. The Water Act 2003, which amended the Water Resources Act 1991 and the Water Industry Act 1991, introduced statutory provisions for water companies to produce these plans, now usually referred to as "water resources management plans". The new provisions include a requirement for consultation with stakeholders on the draft plans so that they can be better informed of the planning process and contribute to the development of the plans. It is intended that this will improve the consistency and transparency of WRMPs.

A WRMP does not present operational plans for the management of our water supply and demand in the event of a drought. These are described in detail in our *Final Statutory Drought Plan* (UU, 2008). The WRMP does however set out our strategy to minimise the effects of drought or prolonged dry weather conditions, and ensure that hosepipe bans, water restrictions and other drought powers are required no more frequently than our target levels.

Every 5 years the water industry carries out a detailed review of service and expenditure needs for all our water and wastewater services, which is known as the "Price Review" or sometimes called the "Periodic Review". It results in a review of the water prices that may be charged by water companies over the following 5 years. The price limits are determined by Ofwat, the economic regulator for the water industry. The needs for water supply enhancement, leakage reduction, new customer metering, additional water efficiency or other supply-demand activities as set out in our WRMP are included in the Price Review for the period 2010-15.

In late 2009 Ofwat will publish their Final Determination which will specify those parts of our plan that they support for funding from water prices. It is therefore important that our WRMP is as robust as possible and is strongly based on the needs of our customers and the environment. The consultation on the Draft WRMP was an important part of this.

1.3 UU's approach to water resources planning

The Water Resources Management Plan Direction 2007 (Defra, 2007) sets out specific requirements for the preparation and publication of a WRMP. A list of the Directions is presented in Appendix 5 together with explanation of how we have complied with them.

The Environment Agency has issued their *Water Resources Planning Guideline* (EA, 2008) which sets out detailed guidance on how water companies should prepare their WRMPs. The EA's Guideline includes a helpful summary of water resources planning, which is presented in the text box on the next page.

UU has comprehensively followed the Agency's guideline in preparing the WRMP.

Quotation from the Environment Agency's Water Resources Planning Guideline:

"A water resources plan shows how a water company intends to maintain the balance between supply and demand for water over the next 25 years. The plans are complemented by the water company drought plans, which set out the short-term operational steps a company will take as a drought progresses.

Companies should set out a baseline forecast of demand for water for 25 years, assuming current demand policies. This should include Government policy and any forthcoming changes in legislation about demand management. Companies should also consider the impact of climate change on demand.

This should then be compared against a baseline forecast of available water supply, assuming current resources and future changes that are known about. Companies also should consider the impact of climate change on supply and forecast the required level of headroom to allow for uncertainty in the assessment. Headroom is a buffer between supply and demand designated to cater for specified uncertainties.

This gives a calculated surplus or deficit of water for each year. This is known as the baseline supply-demand balance and companies aim not to have a deficit.

Where there is a deficit, companies should choose water management options to meet the difference. A company's water resources plan should consider the costs and benefits of a range of options and justify the preferred option set.

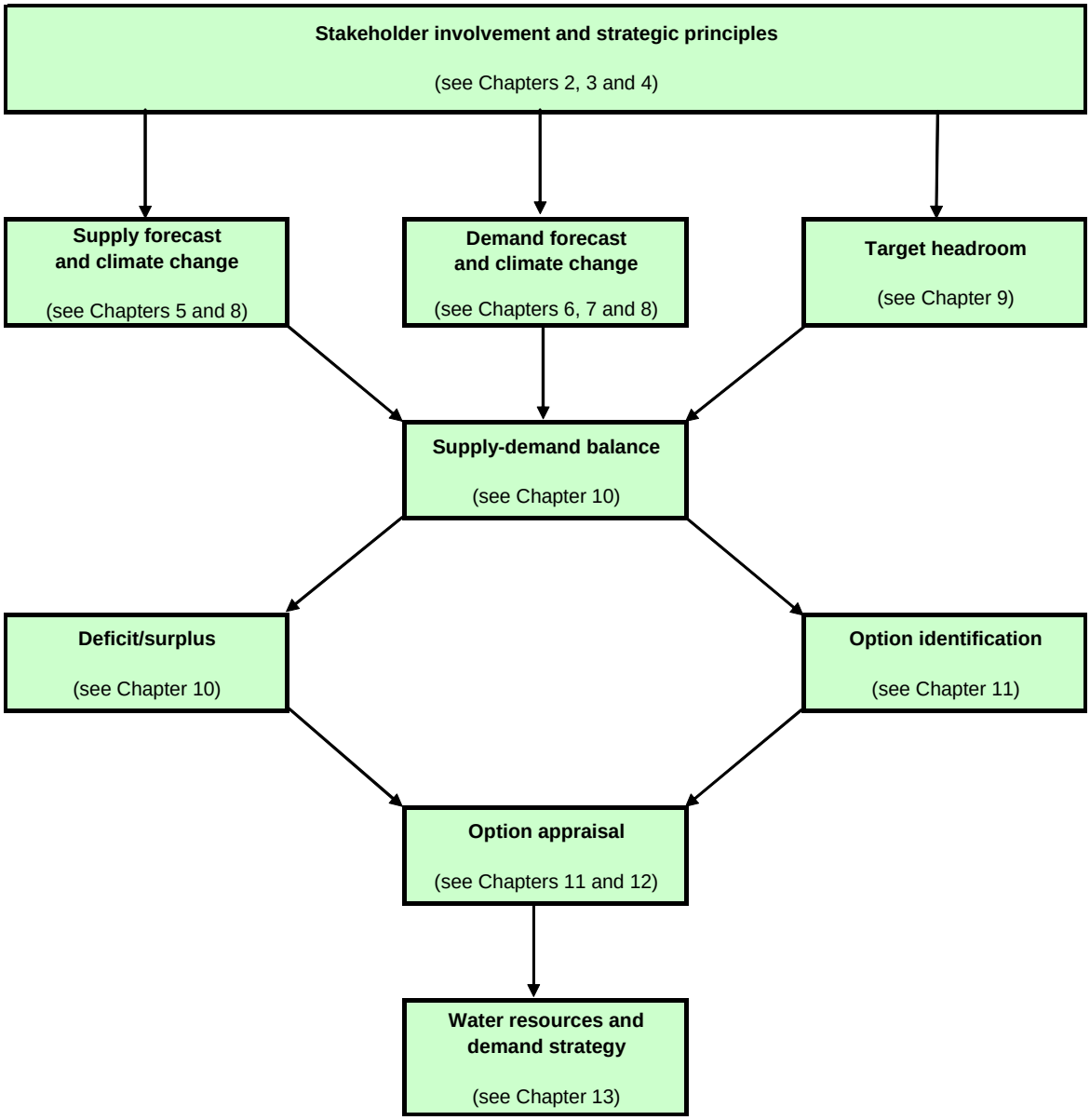
The company should then prepare a final supply-demand balance, taking into account its preferred options for water management, to demonstrate that the plan meets the forecast demand.

A company's water resources plan should be a stand-alone document that provides a realistic strategic plan for managing water resources. Companies should provide evidence in their plans in support of their preferred strategy and full details of assumptions they have made. Companies should demonstrate a clear understanding of the performance of their systems, the main factors affecting their supply-demand balance, and how their preferred plan is both flexible and robust to the various risks and uncertainties, including the potential impacts of climate change."

The Environment Agency has also prepared an easy-to-read factsheet about water resources management plans that can be found at www.environment-agency.gov.uk/waterplans

Figure 1.1 sets out the concept behind developing a water resources management plan and shows where in this document each element is presented.

Figure 1.1. Summary of UU's WRMP



Chapter 2. Stakeholder involvement

This chapter describes how we have listened to the views of our customers, regulators and other interested parties and took them into account in preparing the WRMP. These views have been particularly important in determining the best level of service for security of supply and the key issues we should consider.

2.1 Customer involvement

UU has 2.9 million household and over 200,000 business customers and we greatly value their views as we wish to provide them with the services they want at prices they can afford. We have obtained their views on water supply issues on several occasions, as summarised below.

The last drought in North West England was in 1995, which included a 14-month period of hosepipe bans. We undertook extensive consultation with customers in preparing for the 1999 Price Review. At that time customers expressed concern about the frequency of hosepipe restrictions at once in every 10 years, and over 90% expressed a preference for an improvement in the level of service. This provided strong support for UU to undertake investment to achieve an improved level of service of hosepipe restrictions no more than once in every 20 years.

This improved level of service was achieved by 2004/05 by reducing leakage to half the level that occurred before the 1995 drought and by water supply enhancements in North and West Cumbria (see Section 4.7 for details).

The higher level of service was supported by the results from the 2004 Price Review national and regional market research, which showed that water reliability is a high priority with customers, and the majority of customers supported maintaining our current levels of service. The adopted standard was supported by the Environment Agency (EA) as representing an appropriate balance between customer and stakeholder expectations, expenditure requirements and environmental sustainability.

During 2007 we carried out further research of customer views in preparation for the 2009 Price Review:-

- UU's detailed **willingness-to-pay studies** asked our customers to express the extent to which they would be willing (or otherwise) to see their water bills increase in order that increases in level of service could be obtained. We obtained the views of 2000 household customers and 500 non-household customers. Customers showed that they highly valued a secure water supply and most were willing to pay higher bills if the frequency of water restrictions was reduced from the current level. However, this was a lower priority than some other service improvements that they require, such as improving river quality. Also the amount of increase in water bills that they are willing to pay to improve the frequency of hosepipe ban water restrictions from once in 20 years to a level of once in 30 years

is insufficient to achieve that service improvement.

The willingness-to-pay studies support maintaining the existing hosepipe ban frequency of no more than once in 20 years and demonstrate there would be opposition to adopting more frequent restrictions. Further details of the study are presented in Section 5.7.

- UU's **customer preference surveys** explored the views of customers about what supply-demand solutions they prefer. The study involved telephone surveys of 200 household customers, detailed discussions with six customer focus groups (total of 43 people) and interviews with four local community leaders and Members of Parliament. The individuals and groups were asked to express their preferences for the types of solution that UU should adopt to avoid a future shortage of water. These demonstrated strong support for leakage reduction, or a mixed programme of leakage reduction, water efficiency promotion and some additional water supplies. These options were preferred to solely implementing new water supplies. There was a strong opposition by unmetered customers with lower incomes to selective compulsory metering of homes on change of ownership as part of the programme. In each case the customers were informed of the relative impact of these options on water bills.

  There was a widespread view that UU should be doing more to reduce leakage and should be promoting water efficiency by customers provided that UU was seen to be reducing leakage.

These studies have been undertaken in consultation with the Consumer Council for Water, which is the "consumer watchdog" for water customers. We have taken account of these views in our appraisal of options (see Chapter 13).

2.2 Regulator involvement

The Environment Agency has issued detailed guidance on how water companies should prepare their WRMPs. UU has worked closely with the Agency at national and local level to ensure that we are following their guidance. Also we have worked hard to ensure that this WRMP meets the needs of Environment Agency and other regulators as well as our customers and other interested parties. Indeed UU has an excellent past record of producing high quality water resources plans that have been accepted by the Agency.

We have met regularly with the Environment Agency throughout the preparation of the WRMP to discuss our methodologies and approaches to ensure that we are following best practice. We have also discussed in detail the options we are considering and how we are taking full account of environmental implications to ensure sustainable use of water now and in the future.

We have liaised closely with the Environment Agency, Natural England and the Countryside Council for Wales to understand and agree the needs for abstraction licence changes, or to identify other improvements to comply with the requirements of the European Union Habitats Directive (to protect designated species in areas designated as Special Areas of Conservation). See Section 5.3 for more details.

UU also meets regularly with Ofwat to discuss our water and wastewater services and potential investment needs. Ofwat have published their guidance (Ofwat, 2007) on how water companies should assess water supply-demand issues in the 2009 Price Review. We have taken this guidance fully into account in this WRMP.

UU has worked closely with Defra in the preparation of their national water strategy *Future Water: The Government's water strategy for England* (Defra, 2008) to assist them in evaluating water supply challenges for the water industry. This has helped us to keep fully aware during the preparation of the WRMP of Defra's high priority for climate change mitigation and adaptation, and enhanced water efficiency activity.

We have quarterly meetings with the Consumer Council for Water to discuss UU's performance and customer priorities for our services. At these meetings we report on the water supply position and our progress on leakage reduction and demand management. The Council takes an active interest in our water supply and demand issues and feeds back comments to us.

In October 2005 the Government set up the Water Savings Group, comprising very senior personnel from Defra, Department for Communities and Local Government, the Environment Agency, Ofwat, Water UK, Waterwise and the Consumer Council for Water, to work together in practical ways to reduce water consumption. The Water Savings Group is leading major new initiatives to greatly enhance water efficiency activity in the future, including:-

- Defra are seeking faster meter penetration especially through compulsory metering programmes in water-stressed areas.

- The Department for Communities and Local Government is proposing mandatory water efficiency standards for all new homes.

- EA has recommended that water efficiency targets should apply to water companies, and have defined those areas that are water-stressed and so require more intense water efficiency actions.

- The Consumer Council for Water has undertaken surveys of customer views on water efficiency and is proposing a nationwide education campaign.

- Ofwat has published a good practice register for water efficiency, which sets out more demanding requirements for future water efficiency plans, and has recently set voluntary water efficiency targets.

- Waterwise has encouraged large-scale water efficiency trials and research studies across the country to examine the effectiveness of water efficiency programmes in practice.

The preparation of our WRMP has been shaped by the views of our regulators and has taken account of the key documents from regulators listed in Table 2.1 concerning water resources and demand planning issues.

Table 2.1. Key regulatory documents used in preparing the WRMP

Regulator	Document
Environment Agency (EA)	• *Water Resources Planning Guideline* (EA, 2008) describes in detail how water companies should prepare their WRMPs (see also Section 3.2). • EA has produced national and regional water resource strategies (EA, 2001) and has consulted (EA, 2007) on the preparation of their next strategy, which has subsequently been published (EA, 2009). • *Identifying Areas of Water Stress* (EA, 2007) proposes a way of classifying different parts of the country. The UU region is classified as "Low" water stress. • EA is progressively undertaking their Catchment Abstraction Management Strategies across all catchments in the country. These provide key information on the current status of water availability in each catchment. • EA is responsible for managing the preparation of River Basin Management Plans to advise on the actions needed in each river basin to comply with the European Union's Water Framework Directive. Significant Water Management Issues (SWMIs) have been identified and draft River Basin Management Plans have been published at the end of 2008. These will contribute to the identification of future improvement programmes.
Department of the Environment, Food and Rural Affairs (Defra)	• *Water Resources Management Regulations* (Defra, 2007) sets out the process for preparing WRMPs in accordance with the Water Act 2003. • *Consultation on Water Metering in Areas of Serious Water Stress* (Defra, 2007) proposes that water companies can consider widespread compulsory metering of customers in areas of "Serious" water stress. • *Future Water: The Government's Water Strategy for England* (Defra, 2008) identifies the national priorities for the water industry including climate change mitigation and adaptation, and further water efficiency actions.
Department for Communities and Local Government (DCLG)	• *Code for Sustainable Homes* (DCLG, 2006) proposes voluntary standards for water efficient appliances fitted in new homes. • *Water Efficiency in New Buildings* (DCLG, 2007) describes proposals to require all new homes to be water efficient and to meet a target maximum of 125 litres per bedspace.
Ofwat	• *Setting Price Limits for 2010-15: Framework and approach – a consultation paper* (Ofwat, 2007) describes how water companies should prepare their Strategic Business Plans for the 2009 price review – the water supply-demand elements are to be based on the company's WRMP.

	• Ofwat's Best Practice Register for Water Efficiency published as part of their annual report on security of supply (Ofwat, 2007) describes a wide range of water efficiency measures that water companies should consider. • Ofwat have recently introduced voluntary water efficiency targets for water companies (as part of their annual report on security of supply: Ofwat, 2007). • Ofwat have recently published reports on leakage appraisal and per capita water consumption assessment (Ofwat, 2007), which include advice to water companies.

2.3 Pre-consultation on the WRMP

In May 2007, in accordance with WRMP regulations, we invited statutory pre-consultation consultees to inform us of any issues they wished us to include in our WRMP. Responses were received from the Environment Agency and Defra. The key issues and the way in which we have addressed them are presented in Table 2.2.

Table 2.2. Issues raised by the Environment Agency and Defra at pre-consultation

Issue raised by EA	**UU response**
Consider the EA's Water Resources Planning Guideline	We have comprehensively followed the Guideline in preparing the WRMP. See Section 1.3 for example.
Take account of the information that EA have provided on sustainability reductions	The EA information has been used in preparing the WRMP. See Section 5.3.
Demonstrate how UU will manage the supply-demand balance in the West Cumbria Zone	The supply-demand issues and potential solutions for West Cumbria have been examined in detail. See, for example, the findings presented in Sections 11.6 and 13.3
Explore the options for bulk supplies and resources shared with neighbouring water companies, especially Lake Vyrnwy.	We have been in contact with neighbouring water companies to identify potential options. In particular we have discussed the use of Lake Vyrnwy with Severn-Trent Water and concluded that no additional water is available.
Consider the benefits for sustainable water resource management from the proposed West-to-East Link.	The West-to-East Link facilitates our supply-demand strategy for the Integrated Zone. More details are given in Section 4.2.
Issue raised by Defra	**UU response**
UU should comply with the WRMP directions and regulations.	We have followed the requirements concerning the process for preparing and consulting on the WRMP. Our compliance with WRMP directions is described in Appendix 5.

2.4 Other stakeholder involvement

We maintain active liaison on key water resources issues with a large number of other interested parties including Natural England, Countryside Council for Wales, North West Regional Assembly, national park authorities, local authorities, environmental organisations and committees, river trusts, wildlife trusts, angling associations, Water UK, other water companies and others.

Our links have been particularly strong with stakeholders in those parts of Cumbria and Lancashire where we have proposed water resource improvement schemes or have carried out environmental assessments. In such cases we have been keen to meet with interested parties in order to discuss and work together to ensure that our proposals are appropriate and, where necessary, are modified to minimise any environmental impact or avoid disruption.

We invited all these organisations to comment on the Draft WRMP and held consultation meetings to talk through the key elements of the plan.

We have been actively involved in a wide range of research programmes. Many national best practice methods for water supply-demand and climate change issues have been developed through the UK Water Industry Research Limited (UKWIR) that UU has actively supported. In many cases water industry regulators such as the Environment Agency, Ofwat and Defra have also been involved. We have initiated various research projects with local universities. For example, a major study on how to make showers more water and energy efficient has been recently completed by UU and Liverpool John Moores University on behalf of the water industry (UU and LJMU, 2007).

2.5 Level of service: balancing customer and environment needs

A vital part of our water resources and demand strategy is to strike the right balance between potentially competing requirements:-

- **Ensuring sustainable water abstraction to protect the water environment**.
  In most cases and for most of the time in North West England there is adequate water available for abstraction – indeed the Environment Agency have classified most of the region as having adequate water availability (EA, 2001). However, as described in Section 5.3, there are local cases where the Environment Agency plan to modify our abstraction licence conditions in order to minimise the risk of low flows in certain watercourses that may be harmful to particular aquatic plants or species.

- **Ensuring a high level of reliability of water supply for our customers.**
  Our customers consistently inform us (see Section 2.1) that having a reliable water supply is a top priority and are concerned that hosepipe bans and other water restrictions should be very infrequent.

- **Ensuring that water prices are affordable.**
  Actions to improve the environment or to minimise the frequency of water

restrictions can be very costly and it is important for our customers that the impact on their water bills is low. This is particularly important in a region like North West England where incomes are often well below the national average, and many find it difficult to afford increases in prices.

UU is committed to doing all it can to meet all these needs and to achieve the right balance in its plans. We have expressed this publicly, for example in our *Strategic Direction Statement* (UU, 2007). Our strategy for achieving the best balance has been derived by listening to the views of our customers, regulators and other stakeholders, as described above (Sections 2.1 to 2.4).

These considerations have led us to decide that the best level of service for UU's customers can be expressed as follows.

UU's minimum level of service for water supply reliability standards to all customers is:-

- **Hosepipe ban and drought permits to augment supply once in 20 years.**
- **Drought orders to ban non-essential water use and to further augment supply once in 35 years.**
- **No allowances for demand reductions achieved through rota cuts or standpipes have been included in our assessments. UU considers that it is unacceptable to plan for the introduction of such measures even during extreme drought conditions.**

Customers have strongly indicated that more frequent water restrictions are unacceptable and the provision for lower frequency of restriction would be costly. It is not realistic to plan to never have hosepipe bans as this would require the construction of very large new reservoirs (or equivalent other supply-demand options) with consequent significant impacts on water bills and the environment.

UU will continue to comply with all abstraction licence conditions for each of its water sources and with any changes in licence conditions that result from the Environment Agency's review of consents. This is an important part of ensuring sustainable water abstraction to protect the water environment. In addition, we are continuing to investigate the potential environmental impacts associated with drought permits or drought orders to augment water supplies. The results from these environmental studies will help us ensure that if we need to implement such measures they are undertaken in a way that does not significantly impact adversely on the environment.

Chapter 3. UU's strategic direction on water resources and demand

This chapter outlines UU's long-term strategic direction for water resources and demand to 2035.

3.1 Strategic direction

Our WRMP has been built on the principles set out in UU's recently published *Strategic Direction Statement* (UU, 2007), in particular the long-term strategy for water resources and demand at 2035, as presented on the next page. This has been shaped by the views of our stakeholders. The stated core principles of our strategic direction include:-

- "**Demonstrating responsible stewardship of the water and wastewater network we operate, including protecting public health and the environment, and maintaining those assets for the long-term."**

  This is confirmed, for example, by United Utilities' Sustainable Development Policy (UU, 2006) which recognises the need for sustainable development that conserves natural resources, protects and enhances the environment, supports the communities we serve, and maintains economic growth. Our responsibilities include: protecting and improving the water environment and particularly sites and species designated under the Habitats Directive; conserving biodiversity; protecting the landscape as a result of our actions; and taking reasonable steps to further the conservation and enhancement of designated sites including sites of special scientific interest.

- "**Listening to what our customers and other stakeholders tell us.**"

  One of the top priorities of our household and non-household customers is the provision of a safe and secure water supply. It is therefore very important to UU that our Water Resources Management Plan ensures that we continue to have adequate water supplies to meet customer requirements and that our plan presents no barrier to the region's economic growth or housing development. Further information on the views of our customers in relation to water resources is presented in Section 2.1.

- "**Ensuring our water resources are more sustainable and resilient to meet the challenge of increasing drought risk arising from climate change**."

  This is a fundamental purpose of our Water Resources Management Plan.

- "**Reducing significantly the carbon impact of our activities, aiming to halve greenhouse gas emissions by 2035 from their current level.**"

  This Water Resources Management Plan helps support this aim as described in Section 13.7.

Extract from UU's Strategic Direction Statement concerning water resources and demand

Our water business will need to adapt to meet the challenge of climate change. We will help our customers manage their use of water more efficiently, tackle leakage from our own network, and develop a more resilient supply system.

This will be achieved by:-

A more sustainable resource position – reflecting a balanced approach:

- Abstracting less from the environment so as to protect plant and animal life
- Helping our customers to reduce demand – from 139 litres per person each day to 125 litres
- The introduction of metering for almost all our customers
- Continuing to reduce leakage from our water network by around a further 20 per cent on top of the halving achieved since privatisation
- Developing groundwater sources to adapt to climate change

A more resilient network:

- We will ensure our critical assets are protected from flood
- We will construct a major new East-West link across the south of our region, contributing to securing supplies, meeting the challenge of climate change and reducing carbon impacts
- We will make greater use of monitoring and control to maintain supplies

Water resources and demand

Our strategy is to progressively reduce demand and leakage by 2035 so that we will sustainably abstract significantly less water from the North West environment. In order to protect habitats, we expect continued pressures on the amount we are allowed to take out of the environment and climate change may reduce the amount of water available to be abstracted.

We will help our customers to reduce the amount of water they use to meet their daily needs, whilst still providing reliable supplies. Currently, customers in the region use on average 139 litres each per day. On current trends we expect that amount to reduce to about 125 litres. A number of factors are driving this change, some acting so as to increase consumption others to reduce it.

The move to water metering is a significant driver of reduced consumption. When metered, households reduce their demand by about 10 per cent. Household appliances, such as washing machines and dishwashers are becoming steadily more efficient. And, lastly, there is an increasingly widespread recognition of the desirability of using water efficiently.

Acting in the other direction is the reduction in household size. This is a significant effect – consumption per person is around 40 per cent greater in a single-person household than

in a two-person home. In addition, water using appliances are increasingly found in the home and some, such as showers, now use more water than they used to. Also the amount of water used for garden watering is increasing.

We believe that consumption could be reduced beyond the level we currently forecast. The ingredients required for further significant reductions are however either not yet in place or are comparatively untested.

The ingredients likely to be needed are as follows:

- **Metering would need to become near universal in households**. Currently, around a quarter of the region's homes are metered; on current trends this would increase to 60 per cent by 2035. We would like to accelerate this, initially through voluntary initiatives, alongside a national commitment to metering in all homes no later than 2035.

- The second ingredient is likely to be **more sophisticated pricing for water**, which encourages conservation, particularly in the summer when resources are most stretched. Metering is a vital prerequisite for pricing. The UK experience of tariffs such as these is limited, so we will want to trial different tariffs for their effectiveness and customer acceptability. There is already research evidence that customers see merit in "rising block" tariffs that charge a lower price for an initial block of consumption.

- **More sophisticated or "smart" meters** would more readily allow tariffs that vary price by time of year. UU will wish to test the cost effectiveness of such devices but they could well be widespread by the 2030s. The government has already recently proposed that smart electricity meters should be installed and offered to households in the next few years.

- Other changes are less within UU's control. But we can **expect increasing moves towards water efficient appliances** – based upon the experience of energy efficient white good labelling now being commonplace. We would like to enhance our role in evaluating and promoting efficient appliances, building on recent research we have carried out into the water efficiency of showers. As well as the clear benefits of reduced water demand, changes such as this can make a material difference to the carbon footprint of water activities, reducing the energy needed for our water supplies but, more significantly, the associated carbon footprint of households – typically energy use by households in heating water is around ten times that of UU in delivering it.

Changes in building standards will have a role to play, though they will only affect new house-building. The government has recently proposed a minimum performance standard for new buildings of 125 litres per person per day.

As well as these demand changes, we expect alteration to how we secure our water resources; relying more on groundwater to maintain supplies during drier summers and winters. Reservoirs should be full in the spring, but may not receive significant in-flows again until the following winter. As we rely on surface sources for 80 per cent of our water, additional supplies may be required from groundwater sources that are less affected

by changes in rainfall within each year. These new sources will be relatively small-scale and local in nature and so will not represent a major change to the amount of energy we use to pump water around our region.

We will reduce the amount of water that leaks from our network. We want our approach to making secure supplies of water available to our customers to be based on the best combination of new sources of water, reduced demand, and reduced leakage, taking full account of all the social and environmental impacts of these various measures. If the cost of finding and fixing leaks were to fall dramatically relative to other measures, then leakage could be expected to play a more prominent role. But on current evidence we expect it to make sense to reduce leakage in the longer term by around 20 per cent from current levels.

The outcome of these measures will be reduced pressure on our water resources, making us more able to withstand periods of water shortage. We aim to avoid imposing restrictions on customers' use of water, such as hosepipes bans, more often than once in 20 years. But with climate change it is possible that what would have been one in 20 year drought events will occur more frequently. In these circumstances reduced demand will help maintain existing service levels, rather than necessarily increase them. In any case, the evidence from UU's customer survey work is that customers do not at present have a strong preference to increase service above the current one in 20 year standard. UU believes that this strikes the right balance in a changing climate between customer needs for a reliable supply of water and the need to protect the water environment.

3.2 WRMP aims

The aims of our Water Resources Management Plan are aligned with the core principles in the *Strategic Direction Statement*. The aims are:-

- To identify the best possible water resources and demand strategy that achieves the required level of water supply reliability for our customers, whilst protecting the environment and minimising the impact on customer water bills.

- To adapt to meet the challenge of climate change. In accordance with our *Strategic Direction Statement*, this will be achieved by helping our customers manage their use of water more efficiently, tackle leakage from our own network, and develop a more resilient supply system.

- To ensure that abstraction from our water resources is sustainable, and resilient to meet the challenge of increasing drought risk arising from climate change. Our strategy for significantly reducing demand ensures sustainable water abstraction and makes important contributions to climate change mitigation and adaptation.

- To ensure our plans deliver the needs and priorities of our customers and other stakeholders.

Chapter 4. Our water supply system

This chapter describes the water supplies for UU's customers in North West England and how they are managed.

4.1 Water supply in North West England

UU supplies drinking water to some 6.8 million people (2.9 million homes) and 200,000 businesses or organisations in Cumbria, Lancashire, Greater Manchester, Merseyside, most of Cheshire and a small area of Derbyshire.

UU owns and operates 89 water supply reservoirs, 36 river and stream intakes, 5 lake abstractions, and 79 groups of groundwater sources (boreholes, springs, mine and adit sources). The water is treated at 107 primary water treatment works and supplied to our customers through an extensive network of aqueducts and water mains. In total we supply around 1900 million litres per day (Ml/d) of drinking water in a normal year but this would be higher in a dry year. Many of our water sources are located in environmentally important areas that are designated for their ecology, landscape or other environmental features. (These numbers relate to the year 2006/07).

Figure 4.1 shows the areas served by our four water resource zones. Water supplies to the majority of the region (comprising more than 95% of the total population) are managed in a fully integrated manner and constitute a single resource zone. Only sources in North and West Cumbria are not supported directly or indirectly from the major regional supply system. Our resource zones and their boundaries are unchanged from our 2004 Water Resources Plan and there are no plans for changes in the future.

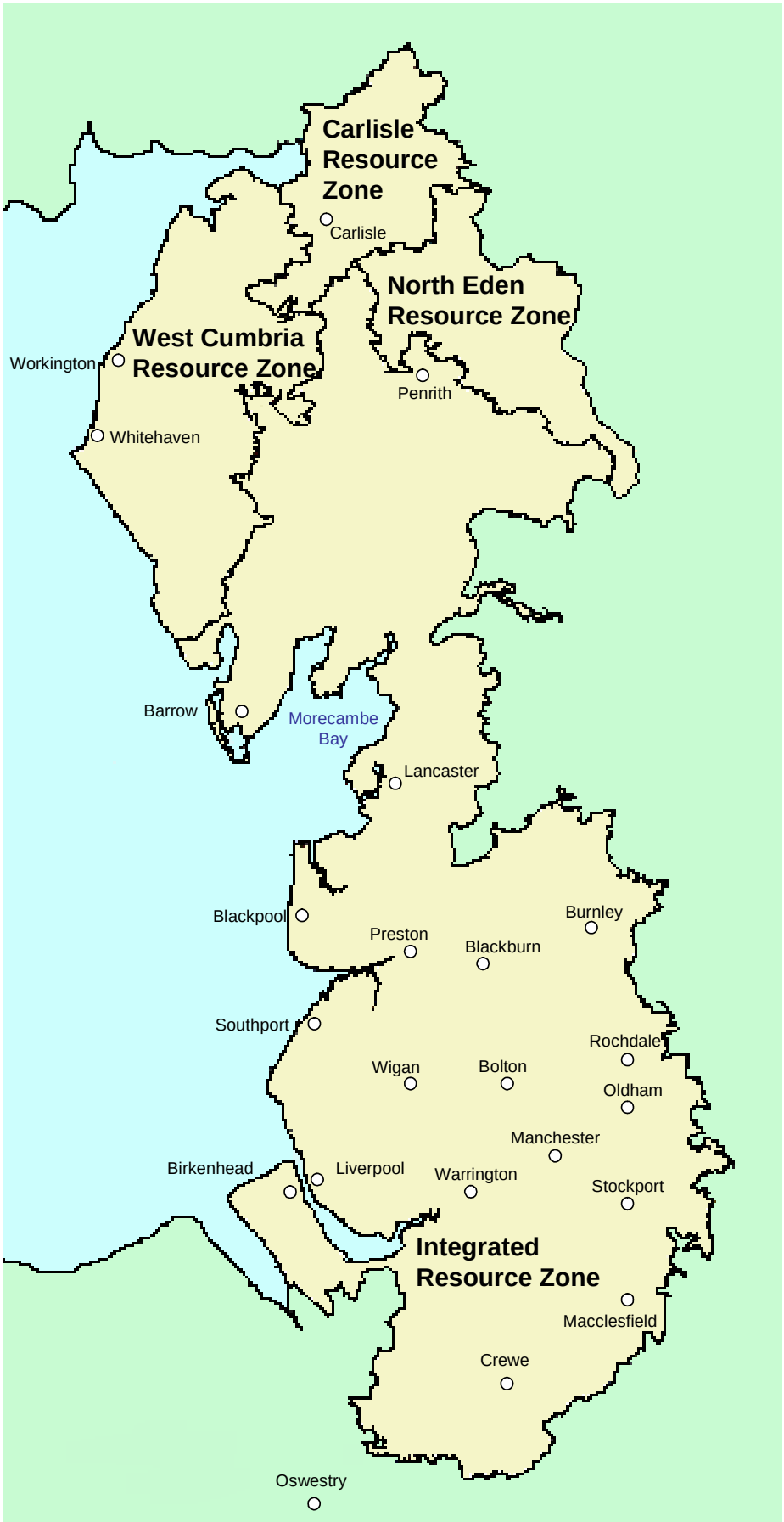
We have four separate water resource zones:-

- **Integrated Resource Zone (comprising over 95% of the population)**
- **Carlisle Resource Zone**
- **North Eden Resource Zone**
- **West Cumbria Resource Zone**

Table 4.1. Key facts about our water resource zones at 2006/07

Water resource zone	Population served ('000)	Average potable water supply (Ml/d)
Integrated	6535	1809
Carlisle	106	29
North Eden	14	6
West Cumbria	152	54
Region	6807	1898

Figure 4.1. United Utilities' Water Resource Zones



No water supply licences or inset appointments or other agreements have been granted for supply of water to any of our customers by a competitor. We have recently received one application for an inset agreement and may receive others within the Integrated Zone. The quantity of water involved is very small compared with the Integrated Zone total supply, and any agreements are unlikely to directly impact on the amount of water we have to provide.

All of our water sources are managed in accordance with operating policies and control rules to provide a secure water supply to our customers. These policies and control rules show the actions to be taken at any time of the year to protect water supplies against the worst drought conditions on record (such as pumping from rivers or lakes when river flows are high enough to enable the conservation of water stored in our reservoirs). UU carries out continuous hydrological and hydrogeological monitoring, in conjunction with the EA, to enable day-to-day monitoring of the water resources situation. This information is a key input to the regular assessments of supply security that are carried out using water resource simulation models to identify the sustainable yields of sources and the actions required to maintain water supplies. These assessments provide the basis for identifying the need for, and timing of, any drought management measures.

A detailed Production Plan is produced at least monthly to reflect these operating polices and sustainable yield assessments. The Production Plan indicates the required abstraction from each water source, treatment works production and treated water aqueduct transfers to meet forecast demand. Demand and water resources are monitored on at least a weekly basis and the Production Plan is continually reviewed during the month and adjusted if circumstances change.

The management of water supplies during drought conditions represents a progression of actions that reflect the severity, geographical extent and speed of development of the drought. UU will firstly take actions that are under its own control before implementing actions requiring special legal powers.

UU has identified four triggers that act as decision-points for drought management actions: Trigger 1 Prepare drought action plan and communications plan; Trigger 2 Commence drought actions; Trigger 3 Intensify drought actions; and Trigger 4 Drought powers in place. The activities are summarised in Table 4.2. The nature of the triggers varies for each resource zone, and the nature of the drought management actions that will be considered also varies depending on the prevailing situation. Drought actions may be applied either company wide, by resource zone or to target a specific geographic area depending on the nature of the drought event prevailing at that time.

Many of our drought management actions are an integral part of our normal water source operational activities. Only in serious drought conditions will the use of specific legal powers and/or other exceptional measures be required. In the event of a potential drought we undertake a lot of activities to, if at all possible, avoid the possibility of reaching Trigger 4 which is the point at which any drought powers would be implemented (a hosepipe ban, a drought order or a drought permit). Full details of our drought management plans are presented in UU's Final Statutory Drought Plan (UU, 2008), which can be found on our website at www.unitedutilities.com/WaterResourcesPlan.htm

Table 4.2 UU generic drought triggers and associated actions

	Operational Actions	Customer Communication Actions	Regulatory Actions
Normal Operation	Continuous water resource monitoring. Operation of water sources according to control and operating rules	Maintain normal customer communications to promote water conservation, UU free leak repair service and LeakLine	Ongoing monthly water resources meetings with the EA
Trigger 1 Prepare Drought Action Plan and Communications Plan	Rezone water sources to supplement water supplies and conserve reservoir storage in the worst affected parts of the region	Prepare Drought Communications Plan Step-up media communications (e.g. increase issue of press releases)	Prepare Drought Action Plan with EA Set up UU/EA Drought Liaison Group Natural England liaison
Trigger 2 Commence Drought Actions	Bring reserve water sources into supply Review leakage detection and repair activities. Enhance leakage control resources in those areas where the greatest demand savings can be achieved	Further enhance customer communications (e.g. UU Roadshows and issue of cistern devices) to provide regular updates on the water resources situation and reinforce water conservation advice	Consider options for drought powers (e.g. hosepipe ban, prescribed uses order, drought permits) and discuss with EA and NE Discussions with EA, NE and Defra to agree environmental monitoring and mitigation actions Consider impact on designated sites
Trigger 3 Intensify Drought Actions	Bring all available licensed water sources into supply	Further enhance customer communications (e.g. adverts in newspapers) to explain seriousness of the supply situation and the actions being taken to safeguard essential water supplies + seek co-operation in minimising non-essential uses of water	UU-EA Director-level liaison established Prepare and apply for drought powers e.g. drought permits and prescribed uses order Prepare for implementation of a hosepipe ban
Trigger 4 Drought Powers in Place	Consider use of non-commissioned sources	Further enhance customer communications (e.g. television and radio adverts) to explain the reasons behind the drought powers and need to comply with water use restrictions	Drought powers in place e.g. hosepipe ban, prescribed uses order, drought permits

4.2 Integrated Water Resource Zone

The Integrated Water Resource Zone serves 6.5 million people living in South Cumbria, Lancashire, Greater Manchester, Merseyside, most of Cheshire, and a small part of Derbyshire. This zone supplies around 1800 Ml/d of drinking water, of which about 500 Ml/d comes from water sources in Wales, about 600 Ml/d comes from water sources in Cumbria and the rest from sources in other parts of North West England.

The Integrated Zone is centred upon the major aqueducts which deliver water from the Lake District to South Cumbria, Lancashire and Greater Manchester, and from mid-Wales and the River Dee to Cheshire and Merseyside. There are connections from the aqueducts to all towns and centres of population in these areas, so that local sources (impounding reservoirs and boreholes) can be operated in a fully integrated manner with the major regional sources. During and following the 1995-96 drought, a new strategic pipeline was constructed to link the Merseyside and Manchester supply systems.

UU is currently planning the construction of another new bi-directional pipeline, known as the "West-to-East Link", between Merseyside and North Manchester. It is due to be in operation by 2011. This will help us maintain adequate supplies to Greater Manchester or Merseyside in the event of needing to temporarily reduce supply from a major reservoir, for example due to maintenance work or drought conditions. This will be an enhancement to our supply network to further increase the integration and flexibility of the supply within the Integrated Zone.

The construction of the "West-to-East Link" facilitates UU's integrated strategy for 2015 and beyond. It will help UU to meet future demand requirements, transferring water in the summer from Cheshire and Merseyside to Manchester to replace the reductions in water source yield from the Lake District and Pennine supplies. It will help maintain security of supply to customers and address the long-term challenges arising from the European Union Habitats and Water Framework Directives (see Section 5.3) and from climate change (see Section 5.4 and Chapter 8). The link will provide an adequately integrated resource zone beyond 2015 and will reduce the risk of loss of supply due to asset failure.

In addition to security of supply, the "West-to-East Link" will enable UU to deliver two further projects that currently present a major challenge, which involve the inspection and maintenance of some of our large diameter trunk mains. Without the link in place, UU would be required to construct duplicate mains, which would subsequently become large redundant assets, or else water supplies would be placed at high risk during internal inspection of the mains. The "West-to-East Link" provides multiple benefits and UU is convinced that it provides a unique opportunity to secure the robustness of the water supply system in the North West of England for the next 100 years.

The Integrated Zone also includes a supply of raw water from the River Dee to Welsh Water and a non-potable supply of raw water from the River Dee to some UU industrial customers in the Wirral. The total quantity of these supplies in 2006/07 was over 70 Ml/d (not included in potable supply volume in Table 4.1 above).

There is a small amount of non-potable water supplied by UU to industrial customers in Warrington. This abstraction is not part of UU's potable water supply system and so is not part of the Integrated Water Resource Zone and is not considered further in the WRMP.

We have a very small bulk supply import from Dee Valley Water Company (less than 0.1 Ml/d) and there are a few very small bulk supply exports to Dee Valley Water and Severn-Trent Water (totalling about 0.01 Ml/d).

4.3 Carlisle Water Resource Zone

The Carlisle Water Resource Zone serves about 106,000 people in the Carlisle local authority area and a small part of Allerdale District. The Carlisle area is served by water abstractions from the River Eden and the River Gelt. There are no non-potable supplies in this zone. There is no transfer of water between the Carlisle Zone and any other zone or any other water company.

4.4 North Eden Water Resource Zone

The North Eden Water Resource Zone serves a population of about 14,000 in the rural, northern part of the Eden District of Cumbria. Most of the zone is supplied from boreholes in the Sherwood Sandstone aquifer whilst the Alston area is supplied from a bulk water supply from Northumbrian Water (normally about 0.6 Ml/d).

There are no non-potable supplies in this zone. There is no transfer of water between the North Eden Zone and any other zone or any other water company, except for the import from Northumbrian Water.

4.5 West Cumbria Water Resource Zone

The West Cumbria Water Resource Zone serves about 152,000 people and is mainly supplied from Ennerdale Water and Crummock Water, which supply the Whitehaven and Workington areas. These are raised natural lakes with level control which provide storage of water for public supply.

Other sources comprise a mix of reservoir, groundwater and stream sources which supply the Wigton, Bassenthwaite and Solway areas. There are connections between the Whitehaven, Workington and Wigton systems which have recently been strengthened to further integrate the water sources and increase the ability to transfer water around the zone.

There is a non-potable water supply from the River Derwent to UU's non-potable customers near Workington. The River Derwent abstraction is not part of UU's potable water supply system and so is not part of the West Cumbria Water Resource Zone and is not considered further in the WRMP. There is no transfer of water between the West Cumbria Zone and any other zone or any other water company.

4.6 The 1995-96 drought

The last time that a hosepipe ban or other drought powers were implemented in North West England was in 1995-96. It was a severe period of drought.

The 1995-96 drought was the most significant drought on record to affect North West England. Between April 1995 and October 1996, the North West was the driest part of Great Britain in relative terms, with only 67% of long-term average rainfall. The Institute of Hydrology estimated the return period for this to be significantly greater than 1 in 200 years (*Hydrological Summary of Great Britain*, October 1996). In the twelve months from April 1995 to March 1996, Pennine areas received less than 50% of average rainfall.

During the drought, reservoirs declined to record low levels, and abstractions from most sources were reduced to well below the previously assessed reliable yields. Several Pennine reservoirs were effectively emptied and could not be used for several months over the winter of 1995-96.

The region also experienced extremely high temperatures and record peak water demand. This high level of demand caused localised problems of low pressure or temporary loss of supply. In most cases, this was the result of demand exceeding the capacities of trunk mains, aqueducts, service reservoirs or local source links.

In order to safeguard essential water supplies, a hosepipe ban was introduced which remained in force over most of the region for 14 months. A drought order to restrict non-essential uses of water was also introduced for a period of 6 months. It was necessary for UU to obtain 19 drought orders and 9 drought permits to enable additional water to be abstracted from reservoirs, lakes and boreholes.

UU implemented a range of actions to increase water availability, reinforce the supply network, and substantially reduce leakage. These measures ensured that essential supplies were maintained to all customers throughout the region. Experience from the 1995-96 drought continues to help shape our water resources and demand strategy, together with the more recent experience from the very dry weather in 2003. In late 2003 UU applied for, and was granted, drought powers to temporarily modify abstraction conditions from Lake Windermere and Ullswater, however the high rainfall at the end of 2003 avoided the need for UU to have to implement any of the drought powers.

4.7 Changes since 1995

4.7.1 Level of service

As described in Section 2.4, we have significantly improved the level of service for our customers in response to their concerns. Since 1999 our target frequency of hosepipe bans has improved from one in every 10 years to no more than once in every 20 years.

There have been no hosepipe bans or other drought-related water restrictions in any part of our region since 1995-96.

4.7.2 Leakage and demand management

We have been undertaking a lot of leakage reduction and other demand management activities, in order to economically minimise the amount of water that needs to be abstracted from the environment. Leakage levels have fallen substantially, a wide range of activities to promote water efficiency have occurred and the number of households that are metered has increased significantly. These are detailed in Chapter 6.

4.7.3 Integrated Resource Zone

As described in Section 4.2, we have installed a major new pipeline between Merseyside and Greater Manchester and are planning to build a further strategic pipeline. These will greatly enhance our ability to transfer water within the zone and in particular to improve the security of supply to Greater Manchester and Merseyside.

In 2002 we constructed a new water supply for the Keswick area from our Thirlmere Reservoir to greatly improve the supply security.

In 1999 UU identified that there were dry weather supply deficits in the Penrith part of the Eden local authority area. Subsequently a new pipeline was laid during 2004 to connect the Penrith area to a supply from the Integrated Zone, whereas the area had previously been a separate supply zone. This enhancement has overcome the risk of water shortages during dry weather in the Penrith area.

In 2003 we completed construction of a new fish pass, fish screen and flow control at Heltondale. We also introduced a “water bank” scheme at Wet Sleddale reservoir with a new flow release regime. These, together with other schemes over the last 15 years, help ensure higher flows in dry weather in the River Lowther catchment, as well as improved protection for fish.

Over the last decade or so, we have undertaken several large projects to refurbish parts of our aqueduct system and have carried out major investment at many water treatment works in the Integrated Zone to improve the quality and security of our water supplies. An example of future work is at our Oswestry water treatment works which treats water supplied to parts of Cheshire and Merseyside. We propose to carry out a major investment programme to improve the treatment so that we can maintain the full capacity of the works during times of poor raw water quality.

UU is currently working with the Environment Agency and Natural England to design improvements to our intakes at Cawdale, Heltondale and Swindale which are indirect catchwaters to Haweswater reservoir. We are also planning improvements to Helvellyn Gill and Mill Gill, indirect catchwaters to Thirlmere Reservoir, as well as at Thirlmere Reservoir itself. The works will provide the capability to release higher prescribed flows to the downstream rivers, release of spate flows, fish screening and fish passage improvements. These structural works were identified by the Environment Agency as being required under the European Union Habitats Directive and are due to be completed by March 2010.

Recently the Environment Agency has informed UU that as a result of their review of abstraction licences to comply with the European Union Habitats Directive they will be

modifying the abstraction licences for Haweswater and Thirlmere reservoirs. This is in order to help protect salmon and other important aquatic species. The changes will reduce the quantity we are able to abstract during dry weather. See Section 5.3 for more details.

4.7.4 Carlisle Resource Zone

UU's 1999 *Water Resources Plan* identified the need for water source enhancement schemes in the Carlisle Water Resource Zone to overcome future water shortages due in part to new development in the Carlisle area. As a result we have increased the supply from the River Eden to provide an additional 9 Ml/d of reliable supply. We worked closely with the Environment Agency, Natural England, Eden Rivers Trust, River Eden and District Fishing Association and other groups during the application for the increase in the abstraction licence and during the scheme design. The scheme was completed in 2004.

In 2002 UU completed construction of a flow control system at our New Water intake, a tributary of the River Gelt, to allow voluntary releases of flow to be made to the river for fisheries benefit. In 2007 UU completed the installation of a new fish screen on our abstraction at New Water to avoid fish being abstracted from the river. We are currently improving the flow control systems at New Water, and also further downstream at Hynam Bridge on the River Gelt, to ensure that future prescribed flow requirements, being proposed by the Environment Agency under the European Union Habitats Directive, can be met. These structural works were identified by the Environment Agency as being required under the European Union Habitats Directive and are due to be completed by March 2010.

Recently the Environment Agency has informed UU that, as a result of their review of abstraction licences to comply with the European Union Habitats Directive, they will be modifying the abstraction licence for the River Gelt. This is in order to help protect salmon and other important aquatic species. The changes will significantly reduce the quantity we are able to abstract during dry weather. See Section 5.3 for more details.

4.7.5 North Eden Resource Zone

In 1999 UU identified water shortages during prolonged dry weather for the Alston part of the Eden local authority area. As a result a new bulk supply of drinking water from Northumbrian Water was constructed in 2004 to serve the Alston area.

In order to improve the quality of the drinking water in the North Eden Zone we have, from 2007, replaced the Dale Springs and Nord Vue groundwater sources with a new groundwater supply at Tarnwood.

The Environment Agency has reviewed the abstraction licences in this catchment as part of the Habitats Directive review of consents and has concluded that no changes are required to any of UU's abstraction licences in the North Eden Zone.

4.7.6 West Cumbria Resource Zone

UU's 1999 *Water Resources Plan* identified the need for water source enhancement schemes in the West Cumbria Water Resource Zone to enable sustainable water abstraction during prolonged dry weather. In consultation with the Environment Agency, Lake District National Park Authority, Friends of the Lake District, National Trust and other organisations we implemented changes in 2001 to the operation of Ennerdale Water to improve supply reliability by 10 Ml/d. In addition over the last 5 years we have constructed reinforcements of the supply network to enable water to be transferred more effectively within the zone. The size of the supply deficit has also reduced due to a large decline in industrial demand for potable water in West Cumbria. As a result of these changes we have eliminated the supply deficit identified in 1999.

UU is currently working with the Environment Agency and Natural England to design a new fish pass and compensation flow control system at Ennerdale Water to improve fish passage and flow control to the downstream River Ehen. UU is also working with the Environment Agency and Natural England to improve the abstraction and prescribed flow control to the downstream river at our Dash Beck river intake. These structural works were identified by the Environment Agency as being required under the European Union Habitats Directive.

UU is also working with the Environment Agency and Natural England to provide lake level control for our abstraction from Overwater Reservoir to protect this Site of Special Scientific Interest.

Recently the Environment Agency has informed UU that as a result of their review of abstraction licences to comply with the European Union Habitats Directive they will be modifying the abstraction licences for Ennerdale Water and Dash Beck. This is in order to help protect salmon and other important aquatic species. The changes will significantly reduce the quantity we are able to abstract during dry weather. See Section 5.3 for more details.

4.7.7 National methodologies

Since the 1995-96 drought the UK water industry has carried out major reviews of the methods and approaches that are used to manage water resources and to assess water supply and demand. This has been supported by many research studies sponsored by UK Water Industry Research Limited, the Environment Agency and other organisations.

UU has adopted the national best practice methods in the management of our water resources and in the preparation of this WRMP. This is explained in detail in the following chapters on water source yields, demand management, demand forecasts, climate change, target headroom, environmental appraisal and option appraisal.

The best practice methods we have used are very similar to those used for our previous (2004) water resources plan. The key methodological changes for this plan are:-

- The explicit assessment of climate change in our supply and demand forecasts (see Chapter 8).

- The preparation of a Strategic Environmental Assessment of our plan (see Chapter 12).

- Increased emphasis on water efficiency measures in response to many new national initiatives, for example the introduction of mandatory targets (Ofwat, 2008), and new best practice documents (in particular Ofwat, 2007; UKWIR, 2006; UKWIR, Defra, EA and Ofwat 2007; and Waterwise, 2008).

- Greater emphasis on the effects of carbon emissions in our appraisal of options.

- Revisions of our water supply, demand and target headroom (i.e. uncertainty analysis) forecasts based on new data and updated studies.

4.8 Future challenges

The main future challenges for maintaining adequate water supply-demand balances are:-

- **Restoring supply-demand balance in response to potential changes in abstraction licences.**
  The Environment Agency is planning to modify the abstraction licence conditions for certain of our water sources as described in Chapter 5. Reviews of other abstraction licences are likely to take place in the future in particular as a result of compliance with the European Union Water Framework Directive. This requires the preparation of River Basin Management Plans in 2009, 2015 and 2021 that will specify the needs to further protect the water environment. These have the potential to significantly reduce the quantity of water that we can reliably abstract from some water sources and result in the need for significant expenditure to enhance our water supply capability and/or reduce demand for water.

- **Adapting to the impacts of climate change.**
  Our plans include our best current estimates of the effects of climate change on water supply and water demand (see Chapter 8). However, there are significant uncertainties about the extent and timing of impacts that will occur. It is expected that climate change will result in prolonged dry periods being more extreme in the future and substantially reduced water availability in our reservoirs. This is likely to significantly reduce the quantity of water that we can reliably abstract from our reservoirs and result in the need for significant expenditure to enhance our water supply capability and/or reduce demand for water.

- **Minimising demand for water.**
  Reducing the amount of water leakage and customer demand for water are of high importance to UU, and have been identified by Defra, the Environment Agency and other organisations (see Chapter 6) as key priorities for the water industry. An important benefit for the UU region is the potential for marked reduction in energy consumption and carbon footprint for UU, by reducing the amount of water we need to pump and treat, and for customers, where it reduces the amount of water they have to heat. Reducing the amount of water that has to be abstracted from the water environment will minimise the extent to which new water sources are

required to replace yield lost due to the impacts of abstraction licence changes and climate change. The cost of achieving reductions in leakage or demand can be very high, as shown in Chapter 11, and must be balanced with the impact on customer water bills.

- **New housing development.**
  The Government is proposing major house building programmes across the country. One of the reasons for needing more houses is that average occupancy in dwellings is reducing with changing social patterns. This has the potential to impact on the demand for water as average per capita consumption is much higher in low occupancy dwellings than in homes with higher occupancy. The WRMP has taken account of the additional water demand expected from the 822,000 new homes that we expect to be built between 2006/07 and 2034/35. Our forecasts have taken account of the revised projections for development in the *North West of England Plan: Regional Spatial Strategy to 2021* (Government Office for the North West, 2008) and the Government's announcements on growth points, which were not available at the time of preparing the original Draft WRMP. We have also incorporated the effects of the economic downturn that has recently become more apparent. More details are provided in Section 7.3.

Chapter 5. Water source yields

This chapter outlines the detailed methods used to assess the yield of our water sources, and presents the key results.

5.1 Source yields

5.1.1 Definitions

There are two important measures of source yields that we use: "deployable output" and "water available for use" (WAFU):-

- **Deployable output** is the maximum quantity of water output from a water source, or group of sources, or of a bulk supply, that can be sustained during a dry year. The output can be constrained by the environment, abstraction licence limits, source water quality, and/or existing water treatment and supply system capacities.

- **Water available for use** is the maximum quantity of water available for supply from a water treatment works, or group of treatment works, or of a bulk supply, that can be sustained during a dry year. It is calculated by deduction from deployable output of outage and planning allowances. Water available for use is compared with distribution input (i.e. water put into supply from our water treatment works and any bulk supply) in Chapter 10 to assess the adequacy of our supply-demand balance.

Deployable output and water available for use are calculated to match our target level of service for the frequency of water restrictions and environmental drought powers (see Section 2.5).

Our preferred minimum level of service applies for all water resource zones. However, for the Cumbrian resource zones, deployable output is insensitive to level of service due to the "flashiness" of the catchments, the relatively low storage volumes available and the short critical periods of the reservoirs (2 to 3 months). UU has calculated deployable output for the Integrated Resource Zone for other level of service standards to demonstrate the sensitivity of yield to level of service (see Section 5.7).

5.1.2 Supply components

The deployable output of our sources is expected to reduce in the future, in particular as a result of:-

- "Sustainability reductions", which result from abstraction licence changes to ensure sustainable abstraction. The Environment Agency has advised us on the abstraction licence changes that we should include in our WRMP. For more details see Section 5.3.

- Climate change, which is expected to result in more extreme dry weather events which will reduce water availability in our water sources in dry years. We have followed the detailed guidance in UKWIR (2006) and EA (2008) to assess the impacts, as described in Sections 5.4 and 8.2.

Our forecasts of deployable output and water available (presented in Section 5.6) for use therefore take these into account:-

Deployable output (forecast)	=	Current deployable output
	-	Sustainability reductions impact
	-	Climate change impact

The components of water source yields are related as follows:-

Water available for use	=	Deployable output	
	-	Non-potable supplies	(to business customers)
	-	Outage allowance	(see Section 5.5)
	-	Raw water exports	(to other water companies)
	+	Raw water imports	(from other water co's)
	-	Process use and losses	(at UU assets)
	-	Bulk supply exports	(to other water companies)
	+	Bulk supply imports	(from other water co's)

5.2 Yield assessment methodology

5.2.1 National best practice

We have used national best practice methods to assess source deployable outputs, outage and water available for use for each water resource zone. Our assessments are in accordance with the following national yield methodologies and guidelines which set out in detail how to evaluate source yields from available historic data:-

- National Rivers Authority (1995) *Surface Water Yield Assessment*

- UKWIR (1995) *Outage Allowances for Water Resources Planning*
- UKWIR (1995) *A Methodology for the Determination of Outputs of Groundwater Sources*
- Environment Agency (1997) *Reassessment of Water Company Yields*
- UKWIR / Environment Agency (2000) *A Unified Methodology for the Determination of Output From Water Sources*
- UKWIR / Environment Agency (2001) *Critical Period Groundwater Yield*
- UKWIR (2006 and 2007) CL04 series of reports *Effects of Climate Change on River Flows and Groundwater Recharge*
- Environment Agency (2007) *Water Resources Planning Guideline*

These methodologies require water companies to determine the deployable output from water resource systems that could be sustained through the worst historic drought conditions and within the constraints of the existing supply system and abstraction licence conditions.

5.2.2 Assessment of yields

Integrated Resource Zone

To assess the combined deployable output of about 200 sources within the Integrated Resource Zone, the bespoke MOSPA™ water resource simulation and optimisation computer model (developed jointly by UU and the EA) was used. It simulates the operation of our water supply system over the 79 year period (1927 to 2005) for which daily reservoir inflow and river flow data are available. Many simulations are carried out to find the optimal run that defines the maximum yield that meets the target level of service for frequency of hosepipe bans. The operation of smaller local sources within the model is governed by control rules which define the quantities which can be sustainably abstracted under different conditions. As the Integrated Zone is highly complex, smaller local sources are grouped together in MOSPA to avoid excessive computation. The modelling of the River Dee includes abstractions from the river by other organisations and our abstraction for non-potable supplies, and takes account of the Environment Agency's operating rules, known as the Dee General Directions.

Cumbrian resource zones

The yields of stream and river sources in Carlisle and West Cumbria have been assessed by examination of flow records and source operation during critical drought periods. In most cases the values of deployable output have been based on source behaviour during the 1995-96 drought period. The deployable outputs of lake and reservoir sources in Carlisle and West Cumbria were derived from simulations using the Aquator™ or MOSPA water resource computer models. All UU water sources in our North Eden Zone are groundwater.

Groundwater sources

The review of groundwater source yields has been completed in accordance with the national methodologies and guidance provided by the Agency. The deployable outputs derived for groundwater sources within the Integrated Resource Zone have been grouped on an area basis and included in the MOSPA model. The simulations therefore include all sources within the zone, both surface water and groundwater.

Groundwater sources provide approximately 15% of UU's deployable output. Most groundwater sources are operated in conjunction with surface water sources within integrated supply systems, and are therefore used intermittently. However, some provide constant supplies to particular local areas and are therefore always in use.

Dead water

At many reservoirs, dead water (the storage at the bottom of a reservoir that cannot be used) had historically been assumed to be 10% of the gross capacity. A detailed review of all dead water values was carried out in parallel with the review of yields in 1997. Where appropriate, changes were made to the dead water values to take account of water quality or technical problems experienced during the 1995/96 drought and other known constraints.

Emergency storage

In accordance with the Environment Agency's methodology, an emergency storage allowance was incorporated into the yield assessment. This allowance provides a reserve storage of water aimed at accommodating the operational uncertainty regarding the duration of a particular drought and particularly to allow for future drought events being more severe than those previously experienced.

The emergency storage allowance adopted for the Integrated Resource Zone is 20 days, which is towards the lower end of the range (15-45 days) suggested in the Agency's guidance. This is due to the very large size of the zone, and the diverse nature and geographical spread of the sources from North Wales, the Pennines and the Lake District. The effects of this diversity were evidenced during the 1995/96 drought and other droughts. The Cumbrian resource zones are much smaller and the main sources are "flashy" with relatively short storage resulting in short critical periods. Here the emergency storage allowance has been set at 30 days. The emergency storage values have been agreed with the Agency.

Other components

We have carried out a detailed assessment of outage allowances for each zone as described in Section 5.5. The other supply components listed in Section 5.1.2, have been derived from flow metering records or surveys of operational water use and loss. We do not expect significant changes in the future.

5.2.3 Sustainable catchment management

Since 2006 UU has been implementing changes to our catchment management practice in our Bowland and Peak District catchments under SCaMP (Sustainable Catchment Management Programme). SCaMP aims to improve the condition of our land as much of the land is designated as Sites of Special Scientific Interest (SSSI). It seeks to deliver government targets for SSSIs, enhance biodiversity and protect/improve raw water quality through catchment management measures, whilst also maintaining viable livings for our tenant farmers. The protection of raw water quality in our catchments ensures that the calculated source yields will not be impacted in the future (for example due to high water colour). UU is undertaking extensive monitoring to understand the hydrological impacts of different land management practices. We hope to extend the SCaMP study to other areas during 2010-15, subject to approval by Ofwat.

5.3 Abstraction licence changes

The Environment Agency is in the process of reviewing the conditions for some of UU's abstraction licences:-

- Water sources that fall within Special Areas of Conservation (SAC) under the European Union Habitats Directive.

- Water sources with national or local environmental drivers, identified under the Agency's Restoring Sustainable Abstraction Programme.

These reviews will result in changes to the abstraction licence conditions in some cases to ensure more sustainable water abstraction and protect the environment at times of low flows in certain watercourses. In such cases the quantity of water that we will be able to abstract in dry weather will be lower in the future than at present. These impacts on our deployable output are known as "sustainability reductions".

The Environment Agency has informed us of those sites where abstraction licence conditions will be modified and the changes that will take place. We have fully included these in our calculations of deployable output. These sustainability reductions are summarised in Table 5.1. We have assumed that the changes will come into effect at 2014/15.

The Environment Agency is continuing with its reviews of our abstraction licences, and so may later identify further proposed changes that we will need to incorporate in our 2014 WRMP. For example, there is a possibility that sustainability reductions could be introduced at Overwater Reservoir or other sites in West Cumbria. In the case of Overwater Reservoir, Natural England is undertaking further work to identify whether a "hands-off" lake level condition should apply.

Table 5.1. Current best estimate of sustainability reductions

Site (zone)	Driver	Issue	Estimated sustainability reduction (Ml/d)
Integrated Zone			
Haweswater intakes	Habitats Directive	Increased prescribed flow in Heltondale Beck, Cawdale Beck and Swindale Beck. Provision of spate flows in Heltondale Beck.	18.6
Thirlmere catchment	Habitats Directive	Increased prescribed flow in Mill Gill and Helvelyn Gill. Provision of spate flows in Mill Gill and Helvelyn Gill. Provision of spatial flows from Thirlmere Reservoir to St John's Beck.	
Rivers Brennand and Whitendale	National (Site of Special Scientific Interest)	Increased prescribed flow in Rivers Brennand and Whitendale	14.3
Carlisle Zone			
River Gelt intakes	Habitats Directive	Increased prescribed flows on New Water and River Gelt.	3.8
North Eden Zone – No sustainability reductions expected			
West Cumbria Zone			
Dash Beck intake	Habitats Directive	Increased prescribed flows on Dash Beck.	0.4
Ennerdale Water	Habitats Directive	Increased compensation flow release from Ennerdale Water to River Ehen.	9.0

No sustainability reductions are proposed for any of our water sources in Wales. The Environment Agency has reviewed the licences for our abstractions in the River Dee and Lake Bala SAC and in the River Severn SAC, and has concluded that no changes are required at the present time that would impact on our deployable output.

In accordance with regulatory guidance from Defra and the Environment Agency, we have not included any allowance for abstraction licence changes that can be expected to occur as a result of the European Union Water Framework Directive. It is possible that substantial further sustainability reductions could occur in the Integrated Zone over the Water Framework Directive implementation period up to 2027, but have not included any effects in our forecasts. We have commented in Chapter 13 on the flexibility of our water resources and demand strategy to respond to a range of possible future changes.

5.4 Climate change

We expect climate change to impact significantly on our future water source yields. We have followed the detailed guidance provided by UKWIR (2006 and 2007) and EA (2008) to assess the impacts, which are summarised in Table 5.2. More details are given in Chapter 8.

Table 5.2. Estimated impact of climate change on deployable output (Ml/d)

	2006/07	2014/15	2024/25	2034/35
Integrated Zone	0	-11.9	-23.4	-28.1
Carlisle Zone	0	-0.1	-0.2	-0.3
North Eden Zone	0	0	0	0
West Cumbria Zone	0	-0.1	-0.2	-0.2

Note:
- Climate change is not expected to impact on the deployable output of the water sources in the North Eden Zone.
- Negative values indicate a reduction in deployable output.

5.5 Outage Allowance

Outage allowances take account of the factors that could reduce the deployable output available in a drought period. The outage allowance calculated for each resource zone is to recognise that, at any point in time, some operational assets will temporarily be unavailable for a variety of factors. Our assessment is based on our experiences of the actual loss of deployable output due to planned and unplanned events in each resource zone over recent years, and an assessment of the risks of unplanned events occurring in the future. We have included the following factors in our calculations:

- Borehole pump failures.
- Short-term water quality problems.
- Seasonal effects on surface water sources, e.g. algae problems, turbidity.
- Plant breakdown at water sources and treatment works.
- Reservoir safety works.

UU has used the best practice methodology *Outage Allowance for Water Resource Planning* (UKWIR, 1995), in line with the Agency's *Water Resources Planning Guideline* (2007), to determine the outage allowance for each of the four water resource zones. This involves using a computer simulation of possible outage scenarios to understand the extent of outage that is likely to occur. The calculated outage allowances have been reassessed using new data that has become available since preparation of the original Draft WRMP (published on 2nd May 2008), and are summarised in Table 5.3.

Table 5.3. Outage allowance for each water resource zone (Ml/d)

	Integrated Zone	Carlisle Zone	North Eden Zone	West Cumbria Zone
Outage allowance	64.8 (79.6)	1.10 (0.98)	0.06 (0.58)	0.60 (0.96)

Note: Values in brackets are those used in the original Draft WRMP.

We have included only those outage events that would impact on water availability. For example, we have excluded plant breakdown that would prevent abstraction from a reservoir for a short duration, as the water would remain in storage and be available for abstraction later. We have also excluded planned outage, such as water treatment works maintenance schemes that could be deferred in the event of a drought and any impact on water availability could be avoided. We have however included planned reservoir safety works as these are statutorily required and we are generally unable to defer such works, and as the duration of reservoir drawdown is usually over 6 months the impact of such outages on water availability can be significant.

We have considered the potential for outage as a result of river flooding causing temporary loss of a water treatment works or key pumping station. In most cases we can continue to supply the water to our customers from other sites until the affected assets are brought back into use. The exceptions either already have flood protection works installed or are not at significant risk of flooding. For these reasons we have not included an allowance for flooding risk at water treatment works or pumping stations. We have in some cases included an allowance for the risk of temporary blockage of an intake resulting from a flood event.

5.6 Supply forecasts

Our forecasts of deployable output and water available for use (WAFU) for each water resource zone are summarised in Tables 5.4 to 5.7. The water availability in our water sources is most critical in years with prolonged hot and dry summers. Therefore the deployable output and WAFU values are calculated for a dry year in the case of the Integrated and North Eden Zones. The Carlisle and West Cumbria zones are vulnerable to short period drought events because of the lower volumes of water storage available. The critical periods for the sources in these zones are between 2 and 3 months. The deployable output and WAFU values are calculated for the critical period.

Table 5.4. Water supply forecasts for Integrated Zone (Ml/d)

	2006/07	2009/10	2014/15	2024/25	2034/35
Baseline deployable output	2147.5	2119.7	2119.7	2119.7	2119.7
Benefit of West-to-East Link from 2012/13	0	0	16.6	16.6	16.6
Sustainability reductions impact from 2014/15	0	0	-32.9	-32.9	-32.9
Climate change impact	0	-3.4	-11.9	-23.4	-28.1
Forecast deployable output	**2147.5**	**2116.3**	**2091.5**	**2080.0**	**2075.3**
Maximum non-potable and raw water supplies	-99.6	-89.6	-89.6	-89.6	-89.6
Process use and losses	-60.8	-57.2	-57.2	-57.2	-57.2
Outage allowance	-55.3	-64.8	-64.8	-64.8	-64.8
Net capacity of bulk potable supplies	-0.1	-0.1	-0.1	-0.1	-0.1
Water available for use (WAFU)	**1931.7**	**1904.6**	**1879.8**	**1868.4**	**1863.6**

Notes for Tables 5.4 to 5.7:

- Values may not sum exactly due to rounding.
- Deployable output and WAFU are key measures of reliable supply capacity as explained in Section 5.1
- The 2006/07 values for each item are those which have been previously officially reported and are based on our 2004 yield review. The 2009/10 values have been derived from our 2008 yield review, which incorporates some changes to water sources and improved modelling methods.
- An export of water has a negative impact on WAFU whereas an import has a positive effect. In the case of Table 5.6 the capacity of the Northumbrian import has a positive effect on the calculation of WAFU.

Table 5.5. Water supply forecasts for Carlisle Zone (Ml/d)

	2006/07	2009/10	2014/15	2024/25	2034/35
Baseline deployable output	39.1	38.0	38.0	38.0	38.0
Sustainability reductions	0	0	-3.8	-3.8	-3.8
Climate change	0	0	-0.1	-0.2	-0.3
Forecast deployable output	**39.1**	**38.0**	**34.1**	**34.0**	**33.9**
Maximum non-potable and raw water supplies	0	0	0	0	0
Process use and losses	-0.4	-0.5	-0.5	-0.5	-0.5
Outage allowance	-1.0	-1.1	-1.1	-1.1	-1.1
Net capacity of bulk potable supplies	0	0	0	0	0
Water available for use (WAFU)	**37.7**	**36.4**	**32.5**	**32.4**	**32.4**

Table 5.6. Water supply forecasts for North Eden Zone (Ml/d)

	2006/07	2009/10	2014/15	2024/25	2034/35
Baseline deployable output	9.01	9.49	9.49	9.49	9.49
Sustainability reductions	0	0	0	0	0
Climate change	0	0	0	0	0
Forecast deployable output	**9.01**	**9.49**	**9.49**	**9.49**	**9.49**
Maximum non-potable and raw water supplies	0	0	0	0	0
Process use and losses	-0.27	-0.13	-0.13	-0.13	-0.13
Outage allowance	-0.58	-0.06	-0.06	-0.06	-0.06
Net capacity of bulk potable supplies	1.00 (import)	1.00 (import)	1.00 (import)	1.00 (import)	1.00 (import)
Water available for use (WAFU)	**9.16**	**10.30**	**10.30**	**10.30**	**10.30**

Table 5.7. Water supply forecasts for West Cumbria Zone (Ml/d)

	2006/07	2009/10	2014/15	2024/25	2034/35
Baseline deployable output	62.9	60.5	60.5	60.5	60.5
Sustainability reductions	0	0	-9.4	-9.4	-9.4
Climate change	0	0.0	-0.1	-0.2	-0.2
Forecast deployable output	**62.9**	**60.5**	**52.0**	**51.9**	**51.9**
Maximum non-potable and raw water supplies	0	0	0	0	0
Process use and losses	2.8	-2.1	-2.1	-2.1	-2.1
Outage allowance	1.2	-0.6	-0.6	-0.6	-0.6
Net capacity of bulk potable supplies	0	0	0	0	0
Water available for use (WAFU)	**58.9**	**57.8**	**48.4**	**48.3**	**48.2**

5.7 Alternative levels of service

The last drought in North West England was in 1995/96, which included a 14-month period of hosepipe bans. At that time the security of supply service level allowed for hosepipe bans once in every 10 years. Customers expressed concern about the frequency of hosepipe restrictions and over 90% of customers expressed a preference for an improvement in the level of service. This provided strong support for UU to undertake investment to achieve an improved level of service of hosepipe restrictions of once in every 20 years. This improved level of service was achieved by 2004/05.

The higher level of service was supported by the results from the 2004 Price Review national and regional market research, which showed that water reliability is a high priority with customers. At that time the majority of customers supported maintaining our current levels of service. The adopted standard was supported by the Environment Agency as representing an appropriate balance between customer and stakeholder expectations, expenditure requirements and environmental sustainability.

Our preferred level of service includes a hosepipe ban frequency of no more than once in 20 years. However, we have investigated a range of potential alternative service levels and associated deployable output values. The results are summarised in Table 5.8. It demonstrates the large scale of water supply enhancement and/or demand reduction actions that would be required to achieve less frequent hosepipe bans. For example, enhancements totalling 117 Ml/d would be required to improve the hosepipe ban frequency to once in 30 years.

Table 5.8. Water supply-demand requirements to achieve alternative levels of service

Level of service scenario	Hosepipe ban frequency	Supply-demand implications
Current level of service Deployable output required at 2009/10 to achieve hosepipe ban frequency of 1 in 20 years. (UU's preferred minimum level of service).	1 in 20 years	2172 Ml/d (deployable output)
Reduction alternative Water supply-demand reductions (by ceasing use of water sources) that would be required to deteriorate the level of service	1 in 10 years	-44 Ml/d (reduction)
Enhancement alternatives Water supply-demand enhancements (by increasing supply or reducing demand) that would be required to improve the level of service to:	1 in 30 years 1 in 40 years 1 in 80 years	117Ml/d (enhancement) 209Ml/d (enhancement) 243Ml/d (enhancement)

During 2007 we carried out further research of customer views in preparation for the 2009 Price Review. Our detailed **willingness-to-pay studies** asked our customers to express the extent to which they would be willing (or otherwise) to see their water bills increase in order that increases in level of service could be obtained. We obtained the views of 2,000 household customers and 500 non-household customers. Customers showed that they highly valued a secure water supply and most were willing to pay higher bills if the frequency of water restrictions was reduced from the current level. However, this was a lower priority than some other service improvements that they require, such as improving river quality. The increase in water bills that customers are willing to pay to improve the frequency of hosepipe ban water restrictions from once in 20 years to a level of once in 30 years is insufficient to achieve that service improvement.

The results from our "willingness-to-pay" study for water supply level of service are summarised in Table 5.9. This table shows that:-

- UU could save £44m by relaxing the security of supply level of service to a 1 in 10 year hosepipe ban level. Customers have said that they would be willing to pay £538m to maintain the existing 1 in 20 year service level rather than return to a 1 in 10 years. In other words customers would need to see savings of £538m on their bills before they would tolerate a reduction in their security of supply.

- Customers are willing to pay as much as £268m to improve their security of supply level of service to a 1 in 30 year hosepipe ban level. But this is appreciably less than the £306m expenditure that would be required to achieve this.

Table 5.9. Total customer willingness to pay and costs of implementation

Service level (hosepipe ban frequency in years)	1 in 10	1 in 30
Required WAFU (Ml/d)	-44	+117
Total willingness to pay (£'m) (provisional assessment)	-538	268
Estimated additional NPV of achieving new service level (£'m)	-44	306
Cost / Benefit of change in service levels (£'m)	**-495**	**-38**

These findings strongly support maintaining the existing hosepipe ban frequency of no more than once in 20 years and demonstrate there would be strong opposition to adopting more frequent restrictions. Therefore, UU considers that its preferred minimum level of service represents the best balance between customer expectations for supply reliability and the scale of water resource enhancements that would be necessary to provide a higher standard of service. Customers have strongly indicated that more frequent water restrictions would be unacceptable and the provision of less frequent restrictions would increase water bills more than customers are willing to pay according to our customer surveys.

Chapter 6. Demand management

This chapter describes the actions undertaken (to 2006/07) and planned by UU to minimise the demand for water through leakage reduction, promotion of water efficiency, and increased customer metering.

6.1 Importance of demand management

Actions carried out by UU and other water companies to manage the amount of demand for water are of three main types:-

- Leakage reduction (from UU water supply assets and customer supply pipes) (see Section 6.2);
- Promotion of water efficiency (Section 6.3); and
- Increased customer metering (Section 6.4).

UU recognises the important contribution of demand management actions in helping to achieve or maintain an adequate supply-demand balance in each of its resource zones. Also UU has highlighted in its *Strategic Direction Statement* (UU, 2007) the need to adapt to meet the challenge of climate change by helping our customers manage their use of water more efficiently, and tackle leakage from our own network.

The key aims of UU's demand management strategy are as follows:-

- To adapt to meet the challenges of climate change. As well as the benefits of reduced water abstraction, saving water can make a material difference to the carbon footprint of water activities. It reduces the energy needed for our water supplies but more significantly the associated carbon footprint of households. For example, energy use by a home to heat water for a shower is over 100 times the energy consumed by UU in delivering that water to the home.
- To maximise the economic utilisation of demand management to assist in achieving and maintaining adequate supply-demand balances in our water resource zones.
- To target water demand management activities in those resource zones where supply-demand deficits exist or are anticipated to occur in the near future.
- To comply with regulatory and statutory obligations. These include: meeting the targets set by Ofwat for the volume of total leakage; complying with our statutory duty to promote water efficiency by our customers and Ofwat's targets for water efficiency activity; and extending household metering in accordance with the powers and limitations set out in the *Water Industry Act 1999*.

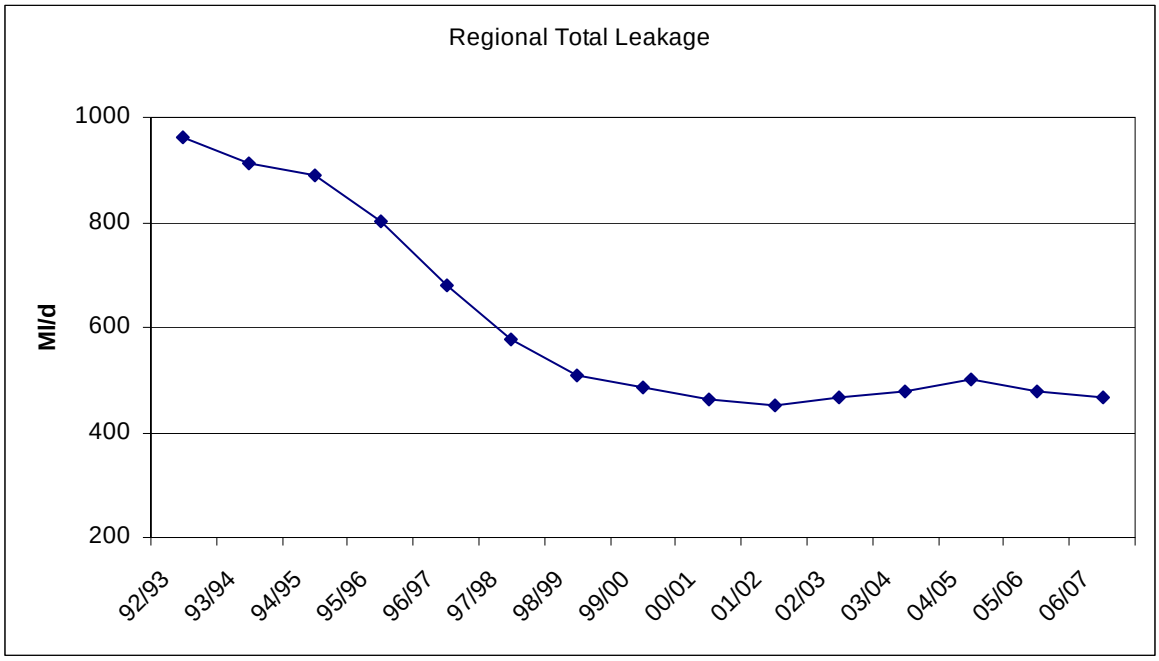
- To prepare and carry out action plans which are consistent with industry best practice.

6.2 Leakage reduction plan

6.2.1 Leakage reduction activities

UU has significantly reduced leakage over the last 15 years, more than halving leakage from 960 Ml/d in 1992/93 to 468 Ml/d at 2006/07 (462 Ml/d at 2007/08), as illustrated in Figure 6.1. This has been achieved through a wide range of operational and capital investment interventions designed to achieve the leakage targets set by Ofwat. Our expenditure on leakage reduction during 2006/07, for example, was around £29 million.

Figure 6.1. Total Leakage Trend



This has been achieved by a combination of the following important activities:-

- **Employing best industry practice**
  We have followed national best practice and have kept up to date with developments as they have occurred over the years. The main best practice methodologies for determining the optimal leakage strategy is "*Best Practice Principles in the Economic Level of Leakage Calculation*" (Ofwat, EA and Defra, 2002). In addition, Ofwat has recently published reports (Ofwat 2007), as part of detailed reviews of some aspects of the best practice methodology.

- **Extensive District Meter Area (DMA) coverage**
  District meter areas are formed by dividing the network into manageable units that enable flows and pressures to be continuously monitored, so that we can use the minimum night-flows to calculate leakage levels. Since 1995 we have installed

2,360 DMAs, so that 99% of properties in our region are covered by continuous monitoring. The average DMA size is 1,311 properties, which is within the best practice range of between 900 and 2,000 properties.

- **Widespread pressure management**
  Managing pressures is a proven method of reducing leakage. Controlling pressures reduces background leakage and limits the water lost from existing leaks. Over the last decade we have implemented a major pressure reduction programme across the region. A significant proportion (59%) of our region is pressure controlled through pressure management valves or trunk mains reduction. We have installed data loggers and telemetry devices to record the pressure at the critical monitoring point within each DMA.

  Our pressure management programme is based on reducing average zonal night pressures within district meter areas such that the pressure at the critical monitoring point within the DMA is no less than 20 to 25m head. As a result the regional average night-time pressure has reduced due to our actions from 42m head in 1998 to 36.8m head in March 2007. In addition advances in technology allow older pressure management valves to be modified by fitting flow-modulated control units or time-control. The most cost-effective pressure reduction schemes have been implemented and new opportunities are limited, but we continue to investigate the feasibility of further pressure reduction options.

- **Good quality leakage data and information systems**
  We have a sophisticated leakage management information system known as WRIMS. It is used throughout UU to analyse data and monitor leakage performance. WRIMS holds asset information, flow and pressure data and reports leakage on a weekly basis. The system is primarily used to direct leakage reduction activities and to report leakage trends.

  Leakage is measured at a variety of regional and sub-regional levels which enable us to focus leakage effort effectively and to understand the various components of the water balance. Analysis is undertaken for: regional level; water resource zone level; 4 business areas; 34 demand monitoring zones; 2,360 DMAs; 3,982 discrete pressure areas; 740 “tiles” upstream of DMAs and 10 aqueduct systems.

  Recent deployment of remote telemetry loggers has significantly improved leakage and pressure monitoring. The WRIMS system now analyses the 15-minute flows and pressures in each DMA and discrete pressure area on a daily basis. This system is used for rapid targeting of DMAs showing a sudden rise in night-flow. Leakage reporting is conducted weekly.

- **Efficient leakage detection using latest technologies**
  We employ a large number of trained leakage detection personnel (currently around 190 full-time equivalent across the region) who are equipped with the best available range of leakage detection equipment. This is essential for locating underground leaks that cannot be seen and also finding the precise location of leaks that can be seen above-ground.

We are continually reviewing and implementing new technologies wherever there is scope to improve our efficiency. For example in recent years we have widely used acoustic noise loggers to complement standard techniques such as step testing and sounding.

During the past two years we have invested in over 6,000 remote telemetry devices for reading DMA meters and pressure monitors. The devices record data every 15-minutes and send the readings daily to the UU computer system via mobile phone networks. Significant changes are picked up by a daily change report in our WRIMS system. This has significant benefits in terms of faster detection of leaks and by freeing up time for leakage detection that was previously spent reading meters.

We provide a free *Leakline* telephone service for customers to report leaks. The service is actively promoted through telephone directory entries, information leaflets, UU's envelopes, customer billing information and signs advertising the service on our vans. We estimate that in 2006/07, customers reported around 64% of the leaks repaired.

UU have recently completed studies into the natural rate of rise in leakage and the policy minimum (background leakage) across the region. We are using the results to target active leakage control and as one factor in the targeting of infrastructure maintenance expenditure.

- **Reduced repair times**
  Any leak that is reported to us by a customer or found by our leakage detection teams is repaired as promptly as we can. Our objective is for the average repair time for all leaks to be within 5 days. Reducing the repair time below this level has a detrimental effect on the ability of our network repair partners to effectively plan their workload and comply with the statutory streetworks noticing requirements.

- **Mains replacement and refurbishment**
  The major element of the UU mains refurbishment programme is for the purpose of improving drinking water quality; the preferred method of refurbishment is replacement with polyethylene pipe. We also have a relatively small poor condition mains programme. Identification of poor condition mains is carried out by analysis of burst frequency, and focuses investment on improving serviceability. It is a small programme because of the generally very high cost for the quantity of leakage saved compared with other leakage reduction measures.

- **Providing free supply pipe repairs for domestic customers**
  Supply pipes are the part of the service pipe that is the responsibility of the customer as they own the pipe. The monitoring of minimum night flows ensures that leaks on customer pipes are detected as effectively as leaks on our own network. Supply pipe leaks are also brought to the attention of the UU through billing enquiries.

  In 1996 we were the first company to introduce a region-wide free repair service for household customers in recognition that the quantity of supply pipe leakage can be considerable. A total of 100,248 supply pipes have been repaired or replaced free of charge since that time. Although the scheme has cleared out a backlog of

existing leaks and is no longer cost beneficial, we continue to operate the scheme in accordance with regulatory and customer expectations.

- **Leakage detection and repair service for commercial/industrial customers**
  In 2003/04, UU launched a service branded as "Total Pipework Solutions", offering water and wastewater solutions to industrial and commercial consumers, via partnering agreements with selected suppliers. A major part of the service is commercial leak detection and repair, but we also refurbish and rehabilitate customers' private networks as well as offering more diverse services, such as sub-surface radar scanning to update customers' service mapping data. We also have a "Flow Watch" service that enables customers to gain on-line access to their meter data and receive alerts using SMS texting technology.

6.2.2 Baseline leakage levels

The current and planned levels of leakage in each of our water resource zones is summarised in Table 6.1. These are our baseline values, which assume that we will meet the Ofwat targets but exclude our enhanced leakage reduction programme described in Chapter 13.

Table 6.1. Total leakage levels (Ml/d)

	Actual total leakage 2006/07	Baseline total leakage from 2008/09 onwards
Carlisle Zone	4.9	4.8
Integrated Zone	442.4	441.9
North Eden Zone	2.4	2.0
West Cumbria Zone	18.5	15.5
Region	468.2	464.2
Ofwat target for UU region	470	465

Note: The baseline leakage values for 2008/09 onwards are the same as derived for the original Draft WRMP.

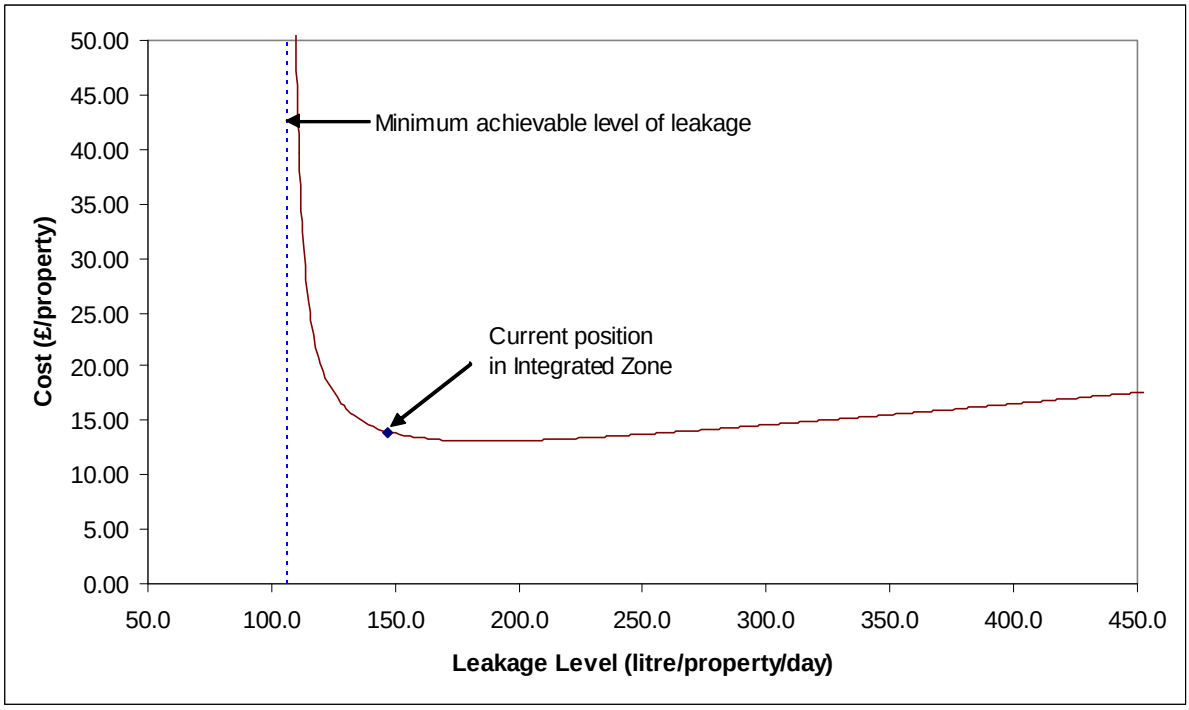
These leakage volumes appear high, but should be considered alongside the following information about the nature of leakage.

A substantial quantity of the leakage that is occurring is "background leakage" which is due to seepage from the water distribution network. There are over 40,000 km of water pipes conveying drinking water and a series of connections to each of the over 3 million customers in the region. Each pipe joint and each connection point is a point of inherent weakness which is prone to leakage. As a result much of the leakage is due to small amounts of seepage occurring at a large number of locations across the very large network. These small leaks are very difficult to find, and if we could easily find them they would be costly to repair in comparison with the water saved.

Larger leaks comprise those which are visible, and can thereby be readily observed by customers or UU personnel, and also many that are invisible because the water stays underground and does not come up to the surface. In such cases we use our leak detection personnel and equipment to try to find them as quickly as possible.

As we have a relatively old pipe network, with many pipes over 100 years old, new leaks are continually breaking out and so a sustained leak detection and repair effort is needed just to maintain current leakage levels. Higher costs are involved to reduce leakage further. This is illustrated by Figure 6.2 which demonstrates how the costs increase rapidly as leakage levels reduce. It also shows the way in which we are approaching the minimum achievable leakage levels using currently available leakage detection and repair techniques. Leakage levels below the "minimum achievable" can be achieved only by other measures such as mains replacement, which is currently assessed as very expensive (see Chapter 11).

Figure 6.2. Leakage cost curve for the Integrated Zone



The volume of supply pipe leakage from customers' pipes depends on the average volume per supply pipe and the number of customers. The estimated average volumes per supply pipe have been derived by specialist consultants in accordance with national best practice. The average volumes are low compared with national norms as a result of our free supply pipe leak repair policy, and so we do not currently expect any significant change in average per property supply pipe leakage levels to be achievable in the future. Therefore, the total volume of supply pipe leakage is forecast to rise by 19% from 66 Ml/d in 2006/07 to 78 Ml/d in 2034/35 due to the increasing number of connections, but this is less than the 21% expected increase in the number of household and non-household properties served.

6.2.3 Future leakage reductions

Further leakage reduction and innovation is an important element of our water resources and demand strategy to maintain adequate water supply reliability and reduce carbon dioxide emissions, as described in Chapter 13.

In 2007 Ofwat completed their Leakage Methodology Review to provide updated guidance to water companies on how to assess the current and future economic level of leakage (ELL). The Ofwat guidance included *Providing best practice guidance on the inclusion of externalities in the ELL calculation* (Ofwat, 2007) which introduced the concept of "sustainable economic level of leakage" (SELL). The assessment of SELL includes social, environmental and carbon costs and benefits, which are known as "externalities", and the Ofwat guidance explained how these should be incorporated into the overall cost of leakage control. We have followed this approach in our appraisal.

The guidance considers two groups of activities:-

- Those relating to the effects of changes in abstraction, treatment and distribution as a result of leakage reduction. Examples of these include environmental effects of changes in river flows and carbon costs associated with pumping and chemical production.

- Those resulting directly from leakage control activities such as detection, repair and asset renewals. Included in this group are the effects of traffic congestion, increases in vehicle movements and carbon costs of pipe manufacture.

UU has followed this guidance and considered a comprehensive range of social, environmental and carbon issues in our leakage appraisal to determine the SELL. This has shown that current levels of leakage are considerably below Sustainable Economic Leakage Levels in all water resource zones.

Leakage profiles have not changed as a result of the new guidance. This is because our existing process for comparing all supply-demand options already considered an extensive range of social, environmental and carbon costs and benefits.

6.3 Water efficiency plan

6.3.1 Water efficiency activities

UU takes an active role in promoting the efficient use of water by all types of household and non-household customers. We have implemented a wide range of measures, carried out trials of innovative techniques and undertaken many publicity and advisory activities. The following paragraphs summarise UU's water efficiency policies and activities in respect of each of the ten good practice headings identified in *Water Efficiency Initiatives - Good Practice Register* (Ofwat, 2007).

- **Cistern displacement devices**
  We have distributed over 550,000 cistern devices free of charge to household customers since 1997/98. We now distribute the "Save-a-flush" water saving

cistern device, which we promote as a "customer-fit" option; simple-to-follow instructions are included on the front of each device. Demand for "Save-a-flush" remains high. During 2006/07 we distributed some 54,000 cistern devices to domestic customers at numerous local events (e.g. garden shows) and in response to customer requests. We also gave away over 15,000 "Save-a-flush" cistern devices to non-household customers in 2006/07.

- **Household water audits**
  Home audits offer an opportunity to both educate customers with water efficiency messages and provide them with devices to help them save water at home. 152,000 "*Water Savers*" home audit packs have been distributed by UU since 2005. The pack includes a "*Guide to Using Water Wisely"* leaflet (which includes advice and tips on how to save water in the home and garden, and advice on preventing bursts and wasting water through leakage), a cistern displacement device, a water butt promotion leaflet, and water savers leaflet for children. These packs help a customer understand how they can save water at home, and provide them with a simple to install cistern displacement device.

  We have also trialled "visit and fix" home audits, where a UU sponsored plumber visits a customer's home, offers water savings tips, fits water saving devices, and provides the customer with a "*Water Savers*" pack. During the visit the plumber records what water using devices the customer has, what their water using behaviours are, fits a water efficient showerhead and converts the toilet to dual-flush (if appropriate). They also fix any small leaks they can. UU undertook this approach in over 400 homes in Warrington during 2007.

- **Commercial water audits**
  UU regularly visits major industrial, commercial and institutional customers, and has contact with many smaller customers. As part of these visits we promote water conservation and the related services provided by UU, which include a Water Audit Service. In total 800 water audits have been undertaken at non-household properties since 1997/98.

  We have worked closely with local industrial and commercial customers on water and wastewater minimisation projects. In addition, we have carried out water efficiency audits to advise on the potential for water savings at the premises of many other organisations.

  We provide water savings advice and self-audit packs, free of charge, to institutional customers on request. In addition we were actively involved in the development of the www.waterintheschool.co.uk website, which explains to children how to monitor their school's water use and then identify ways of reducing consumption. This included the development of a CD-based information pack for schools that teach pupils about water conservation through the use of interactive games and exercises.

- **Customer education / awareness**
  UU provides water conservation information in a range of information packs including: "water savers" packs, "*A Guide to Using Water Wisely*" leaflets, "*All About Water Meters*" leaflets, "*Extra Care*" magazine, "*Waterwise in the*

Workplace" leaflets, and a special water conservation information pack for schools.

The company hosts visits to our Environmental Education Centre classrooms for over 10,000 pupils and students from across the region each year, which include information about water conservation.

We provide continued communications campaigns to encourage customers to use water wisely via our annual billing leaflet, local press releases and other UU literature. We have also held a stand at the Southport Flower Show to promote water efficiency with visitors.

For commercial customers UU provides seminars on water conservation measures. We have developed a large model toilet for display at local authority and commercial premises to promote cistern devices and water efficiency information. This has been used at major venues and environmental-themed events across the region.

- **Other water efficiency initiatives**
  We maintain partnerships with external bodies to promote water conservation, including local councils, local environmental groups, the Environment Agency and water efficient product manufacturers. We have also actively supported local groups and organisations on a range of water conservation initiatives.

  The "*All About Your Water Meter*" leaflets include details on how customers can check for a supply pipe leak on their property if they have a meter at their boundary. We also offer a 24 hour leakline for customers to ring if they spot a leak on our system.

  A special promotion of water efficiency was provided for 14,000 farms, parks and gardens in 2007. This comprised of a tailored water efficiency leaflet being sent to the owner/ caretaker of the property. Response to the leaflets indicated a strong interest in water efficiency from this group of customers.

- **Metering**
  As detailed in Section 6.4, UU provides a free meter option scheme, and compulsorily meters new and unmeasured non-households (where appropriate). We have actively promoted the scheme with our customers.

  We have developed a pack called "*A Simple Guide to Your Water Meter"* which is left with household customers after a meter is installed. The pack contains water saving information, a cistern device and promotion of subsidised water butts.

- **Water butts / composters / trigger hoses**
  UU offers subsidised water butts to all domestic customers in our region. The water butts are promoted on the UU website, in the "*Water Savers Pack*", and "*A Simple Guide to Your Water Meter*" leaflets. UU have also organised recycling road-shows with Local Authorities across the region where water butts and composters were sold at a discount price. Since 1997/98 over 8,000 water butts

have been sold or given away through these promotions and over 1000 trigger hose fittings have been given away.

- **Toilet retrofit**
  In 2007 UU conducted over 400 "visit and fix" home audits using qualified plumbers. Amongst other activities, the plumbers fitted "EcoBeta" dual flush conversion devices. These devices are an effective method of converting a single flush toilet into a dual flush appliance, potentially saving an average of 20 litres per property per day. In total around 200 devices were fitted.

- **Research and development**
  UU has completed a major research study with Liverpool John Moores University to identify how to make showers more water and energy efficient (UU/LJMU, 2007). We identified products, such as aerated showerheads, that use less water than normal showers but are also acceptable to customers. The results of this study were widely publicised within the industry and have prompted the inclusion of a large scale showerhead distribution programme by UU for 2010-15. The study has attracted widespread interest and is being used to help develop national policies for showers.

  A household "visit and fix" study during 2007/08 examined the effectiveness of visiting domestic properties and fitting water saving devices. This project is similar to studies undertaken by other water companies, but the UU study has at a reduced cost. In total just over 400 homes in Warrington were visited in 2007. The results have been used to help inform the Waterwise water efficiency evidence base (Waterwise, 2008).

  We have recently completed a small scale trial offer of water saving showerheads to investigate the viability, cost, and benefit of offering efficient showerheads through the post, at no charge to the customer. The results (UU, 2008) indicate that this approach is likely to be sufficiently popular with customers to make it a viable approach for larger-scale distribution of water efficient showerheads.

  Between 1997 and 1999 we carried out the major Solway Water Conservation Programme in West Cumbria, in close collaboration with the Environment Agency. The project implemented a comprehensive range of water conservation measures for non-household and household customers across a population of some 22,000 people. Results from this programme have helped shape our demand management activities.

  UU has recently carried out a customer opinion survey on water supply-demand issues. The survey included questions on customers' awareness and opinion towards water efficiency. The results of this study will help us target future water efficiency messages and promotions.

- **Supply pipe repair / replacement**
  UU provides a range of services to help combat supply pipe leakage. We offer to repair a supply pipe leak once a year free of charge for all customers, provided we can reach the leak without risking damage to customers' property. This promotion is advertised on the website and in various leaflets. In total UU has repaired or

replaced over 100,000 supply pipes free of charge. We also provide a 24 hour contact number that customers can phone to report a leak.

6.3.2 Baseline water efficiency

UU is committed to continuing the promotion of efficient use of water by its customers, and to continue to follow national best practice. Enhanced water efficiency is, we believe, an important part of ensuring sustainable water abstraction and reducing carbon dioxide emissions due to activities by UU and our customers.

The introduction of mandatory water efficiency targets by our economic regulator (*Water efficiency targets 2010-11 to 2014-15* (Ofwat, 2008)) provide us with a clear framework for targeting both the nature and volume of activity that we will be undertaking. As a result the company plans to substantially increase its water efficiency programme from 2010.

The new targets provide for three areas of water efficiency activity:

- An annual target to save an estimated one litre of water per property per day through water efficiency activity, during the period 2010-11 to 2014-15. The target saving for UU is 2.95 Ml/d each year.

- A requirement to provide information to consumers on how to use water more wisely.

- A requirement that each company actively helps to improve the evidence base for water efficiency.

As a result of this the water efficiency measures adopted by UU will continue to be targeted on those activities that are most beneficial, with intensive programmes in areas with supply-demand deficiencies. Therefore our **baseline water efficiency programme** will increase in size, but will consist of a similar range of activities as previously (see Section 6.3.1), in particular:-

- Free water savings packs and cistern displacement devices for all newly metered households (new for 2010-15).

- Free water audit packs for key institutional customers (new for 2010-15).

- Providing free cistern displacement devices and "*Water Savers"* packs on request.

- Providing water butts and other water saving devices at discounted prices or free of charge (enhanced for 2010-15).

- Offer supply pipe repair and replacement schemes.

- Providing educational material through schools and on the company website, and promote the benefits of water efficiency at large public events (enhanced for 2010-15).

- Promoting the free meter option to domestic customers on our website and through the billing leaflet.

- Work with key stakeholders to raise the public awareness of water efficiency (enhanced for 2010-15).

This new programme will enable us to achieve the new water efficiency targets. The savings will be realised by both household and non-household customers.

In addition the large element of educational activity described in this baseline programme will meet Ofwat's stipulation that water companies "…*provide information to consumers on how to use water more wisely*". UU will continue to promote water efficiency more rigorously across the whole customer base through improvements to the company website, improved leaflets, increased messaging through bills, and explicitly linking water use with carbon emissions in company literature.

The benefits of this baseline level of activity are accounted for in our baseline demand forecasts.

6.3.3 Enhanced water efficiency programmes

Enhanced water efficiency is, we believe, a crucial part of ensuring sustainable water abstraction and reducing carbon dioxide emissions due to activities by UU and our customers.

We are planning a water efficiency research programme in 2010-15, in addition to activities described above, as part of our water resources and demand strategy described later in Section 13.5.

6.4 Customer metering plan

6.4.1 Effect of metering and tariffs on water demand

It is widely recognised that metered customers use less water than unmetered customers, and that the use of appropriate tariffs can help to encourage more water saving. The most authoritative assessment of the effects of metering and tariffs in the UK has been undertaken by Professor Herrington on behalf of UKWIR in *Critical Review of Relevant Research concerning the Effects of Charging and Collection Methods on Water Demand, Different Customer Groups and Debt* (UKWIR, 2005). Professor Herrington concluded that average demand reductions are typically in the 10% to 15% range for compulsory metering and 9% to 21% for optional metering, and that use of more complex tariffs in other countries further reduces demand.

We have assumed that metering reduces water consumption by households in the UU region by 8.3% in a normal weather year, based on a detailed study of UU customers (National Economic Research Associates, 2003). This is slightly below the expectations reported by Professor Herrington which were based mainly on studies in southern England where discretionary water use, for example on garden watering, is much higher than in North West England.

Metering of water use by customers has a wide range of potential benefits, as indicated for example by the text box below.

Examples of the wider benefits of metering (prepared by the Environment Agency):

- The demand management effect of paying by volume will have a benefit re reduced energy bills in the home.
- The demand management effect of paying by volume will have a carbon benefit. Our work to date makes clear that this is likely to be substantial with a real value to society.
- Reviews of metering have consistently concluded that metering provides the 'fairest' way to pay for water.
- The 'rateable value' system of charging can not continue indefinitely, it is already some 30 years out of date. If not metering then an alternative form of non volumetric charging mechanism needs to be defined and implemented with all the costs associated with such a system. Wide scale metering would remove the need for such investment and therefore has a value/benefit.
- Affordability. If metering progresses passively the cross subsidy between measured and unmeasured charges will become enhanced meaning that those who remain on unmeasured charges will become increasingly penalised financially. An active transition to wide scale metering would allow for a more equitable charging regime.
- Tariffs. Metering is a prerequisite for variable tariffs. Tariffs have two benefits/values: they enable enhancement of demand management savings using price elasticity; and they can enable mitigation of affordability. In particular rising block tariffs have the potential to allow for everyone to have basic water requirements at the most affordable cost.
- Network Management/Operation and Leakage: Wide scale metering will enable better network management and operation which will include network leakage management. The ability to measure and record total consumption will remove the existing uncertainly within networks. Most companies simply do not know the water flows through its network beyond bulk meters such as DMA's boundaries.
- Supply Pipe Leakage: Metering, particularly at the property boundary, has clear benefits and value for supply pipe leakage with reduction in both awareness times and repair times.
- Water Resource Management and Demand Forecasting: Wide scale metering will enable a clear understanding of demand and consumption patterns with significant benefits for demand forecasting, water resource planning and drought demand management.
- Climate Change resilience: Wide scale metering represents a hub for sustainable water demand management which is our principal adaptive behaviour to the risk and uncertainties of climate change. Reducing our overall demands for water will increase our resilience to climate change impacts and has a value to society and a benefit in offsetting the need for other costly climate change adaptation investments in the future.
- Climate Change mitigation: Not only is metering shown to be a lower carbon option than all new resource options but the evidence indicates that it results in a net reduction in the life cycle costs of water related carbon. This reduction has important benefits in the context of national and international carbon reduction targets.

- Metering is an incremental and flexible water resource option, particularly when used in conjunction with variable tariffs. In an uncertain future incremental and flexible water resource solutions have an important value in terms of an alternative to the need for long-term fixed solutions.
- Smart meters can provide a range of additional benefits related to: Additional tariff opportunities; Automatic meter reading can reduce operating costs and carbon costs; and Opportunities for interoperability with energy meters for customer info, tariffs, smart in home screens and competition.
- Customer information: Metering enables enhanced customer information for education and choice.

6.4.2 Metering policy

UU's current metering policy is to:-

- Meter all new household properties.
- Provide a free meter option scheme for household customers, and actively promote the scheme on our website and in our billing leaflet.
- We do not compulsorily meter unmeasured household customers except occasionally if a house is split into flats.
- Meter all new non-households.
- Meter existing unmeasured non-households where practical.
- Other metering policies have been considered, but have not justified implementation to date.

As a result, water meters have been installed and are used as the basis for water charges at 621,000 homes (i.e. 21% of our 2.94 million household customers) and 182,000 non-households (i.e. 87% of our 0.21 million non-household customers).

We are not currently planning any changes to our metering policy. However, UU's *Strategic Direction Statement* (see Chapter 3) highlights the need to adapt to meet the challenges of climate change and ensure a more sustainable water resource position. It identifies the need to accelerate meter penetration, initially through voluntary initiatives, alongside a national commitment to metering in all homes (wherever practical) no later than 2035.

We anticipate that in the longer term it will become a statutory requirement to meter all homes wherever practical (metering is not feasible in some homes because of complex pipe arrangements). However, in line with specific guidance from Ofwat and the Environment Agency we have excluded compulsory metering from our main plan, although we have considered (see Chapter 13) how it could impact on the strategy in the longer term. We have no current plans to implement any compulsory household metering programmes. Indeed, as the UU region is classified as "low water stress" by the

Environment Agency (EA, 2007), UU is not permitted to implement compulsory metering except in certain cases permitted by the Water Industry Act 1999.

We are permitted, for example, to compulsorily meter household customers on change of occupancy of the home, or homes that use high water using appliances, such as garden sprinklers or high flow-rate showers. We have no plans to compulsorily meter such customers as this is uneconomic in the UU region (see Chapter 11), and compulsory metering would be unpopular with customers and very difficult to implement in a fair way without penalising honest customers.

6.4.3 Tariff policy

UU's tariff policy is to set tariff structures that are easily understood by customers, are broadly cost reflective and comply with the regulatory licence conditions. Our current policies can be summarised as follows:-

- Unmeasured households: a standing charge and rateable value charges for water and sewerage services.

- Measured households: a combination of standing charges, a fixed charge and volumetric charges for water and sewerage services. There is a single volumetric charge for water services and a single volumetric charge for sewerage services.

- Special provisions exist for households with vulnerable status: a fixed charge is applied for water and sewerage services based on the average household charge.

- Unmeasured non-households: a standing charge and rateable value charges for water and sewerage services.

- Measured non-households: a standing charge, a fixed charge and a single volumetric charge apply for each category of non-household customer.

- More complex tariff structures have been considered but have not justified implementation to date. Some options cannot be considered because of our statutory requirement that our tariffs must avoid preference or undue discrimination to any group of customers

One of the key difficulties in being able to successfully and fairly implement more sophisticated tariffs (such as rising block or seasonal tariffs), which could achieve greater water savings, is the limited water volume data that can be collected from conventional types of water meter. We recognise excellent advantages in the use of "smart meters" which record the volumes used in specified time periods and with automated meter read (using radio technology for example) so that the meter volumes can be obtained more easily and more frequently. The key elements of our plan are:-

- Install automated meter read technology in most newly metered properties and where meters are being replaced, from April 2010.

- During 2010-15 we plan to carry out studies of the best way to use new meter technologies and to consider alternative tariff structures to encourage greater water efficiency.

- During 2010-15 we plan to investigate the use of "smart meters" that give more information about patterns in water use than normal meters, and how the data can be used through new tariffs to influence customer behaviour in the way that water is consumed. The tariffs that will be investigated include rising block (i.e. higher volumetric charges as the consumption rate increases) and seasonal tariffs (i.e. charging a higher volumetric tariff in summer months and a reduced tariff in winter months). The implications for vulnerable customers will be investigated and we will explore the potential for developing social tariffs that assist affordability for customers with low incomes.

- Investigations will also take place into the application of infrastructure charges to establish if any changes could be made to encourage developers to consider water efficiency in their approach to property building.

- Implement new tariff structures by 2015.

6.4.4 Numbers of metered properties

Table 6.3 and Figure 6.2 show that the number of metered households is increasing steadily year by year. Household meter penetration has increased from 13% at 2002/03 to 21% at 2006/07 and we anticipate reaching 60% by 2035.

The increases in meter numbers are due to:-

- Metering of all new homes. We expect a further 822,000 new homes to be built in the region by 2035 (see Section 7.3 for more details).

- Take-up of the free meter option. Over 250,000 households have opted to be metered to date. We expect a further 708,000 households to voluntarily opt to be metered by 2034/35.

  This is feasible as about 1 million unmeasured household customers could reduce their water bill by opting to be metered. In 2008/09 we expect to install over 53,000 free meters as a result of a significantly increased number of applications, which we think is due to a combination of new bill format and the "credit-crunch". We expect that the economic downturn will result in high numbers of customers continuing to opt. The free meter option is publicised on our website and in our billing information. If it becomes necessary we will consider carrying out targeted publicity programmes, but do not plan general further promotion of the scheme as it is not currently an economic approach to maintaining the supply-demand balance (as shown in Appendix 7).

  The projections for continued take-up of the free meter option are consistent with UU's *Strategic Direction Statement* (see Chapter 3), which highlights the need to adapt to meet the challenges of climate change and ensure a more sustainable water resource position. We expect that universal household metering will be

required in the long-term and it makes sense to make good progress to that position through voluntary means.

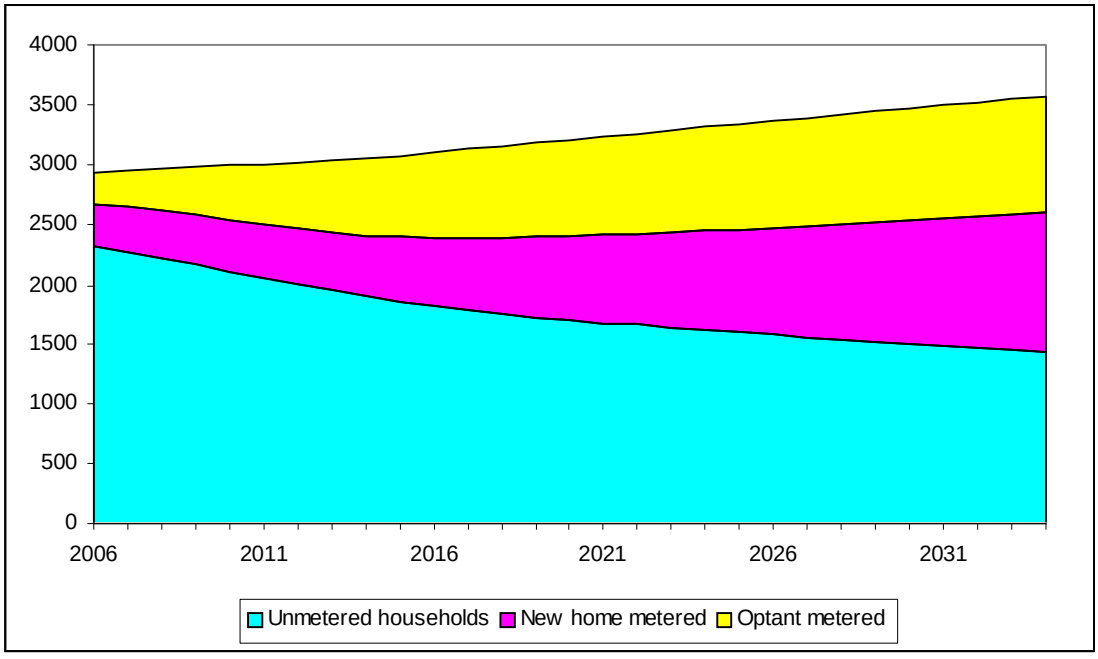
Table 6.3. Summary of forecast numbers of metered households ('000)

	Number at 2002/03 (year average)	Number at 2006/07 (year average)	Forecast at 2014/15 (year average)	Forecast at 2024/25 (year average)	Forecast at 2034/35 (year average)	Total increase 2006/07 to 2034/35
New home metered	260	355	501	838	1177	822
Meter optants	107	262	646	863	970	708
Compulsory metered	4	4	4	4	4	0
All metered	371	621	1151	1706	2152	**1531**
Unmeasured homes	2505	2315	1905	1612	1429	-886
Total households	2876	2936	3056	3318	3581	645
% houses metered	**13**	**21**	**38**	**51**	**60**	**-**

Notes:

- Values may not sum exactly due to rounding.
- The forecasts include for allowance of demolition of homes at a rate of about 7,000 per year. Therefore the growth in total households (645,000 by 2034/35) is less than the growth in new homes (822,000).
- About 4,000 houses that owned garden sprinklers were compulsorily metered during the 1995/96 drought, but this programme was discontinued as it was seen as a "tax" on honest customers who informed us that they owned a garden sprinkler and is not an economic supply-demand measure.

Figure 6.2. Forecast changes in household types ('000)



Chapter 7. Demand forecasts

This chapter describes how we calculate our "baseline" demand forecasts and presents summary tables of demand data.

Our "final planning" demand forecasts that incorporate the effects of our proposed future demand reduction programmes are presented in Chapter 13.

7.1 Water demands

7.1.1 Definition of baseline demand

UU has carried out very detailed studies to determine "baseline" water demand forecasts for each water resource zone for each year to 2034/35.

Baseline demand forecasts include our current demand management policies (as described in Chapter 6), but exclude the effects of any additional demand management measures identified by the option appraisal (Chapter 11) as part of the best value approach for resolving any supply-demand deficits. The effects of such measures are included in the "final planning" demand forecasts presented in Chapter 13. This approach is in full accordance with the Environment Agency's guidance (EA, 2008).

7.1.2 Demand components

The total volume of water abstracted from the environment is known as "raw water abstracted". In order to understand the demand for water and how raw water abstracted is likely to change in the future we assess each of the individual demand components, which can be considered as three main groups:-

- "Raw water" components arise between the point of abstraction and the point of input into the distribution system.

- "Potable water bulk supply" imports or exports with other water companies. These are accounted for in the calculation of distribution input, but also have to be itemised separately in order to correctly account for raw water abstracted.

- "Distribution input" is the amount of water entering the distribution system at the point of treated water production. It is a very important measure because its calculation is based on the intensive water metering at our water treatment works, and we have to report distribution input components in great detail to Ofwat in our annual June Return reports.

Table 7.1 summarises the components. The later parts of this chapter explain our approach for calculating the baseline forecasts for these components.

Table 7.1. Demand components 2006/07

Component	Regional total volume in 2006/07 (Ml/d)
Raw water exported (to other water companies) and non-potable supplies (to various UU industrial customers)	72
Raw water imported (from other water companies)	0
Process use and losses	64
Total raw water	**136**
Potable water bulk supplies (i.e. exports to other companies minus imports from other companies)	**- 1**
Metered household consumption	156
Unmetered household consumption	775
Metered non-household consumption	441
Unmetered non-household consumption	14
Other water use	44
Total leakage	468
Total distribution input	**1898**
Total raw water abstracted (i.e. comprising raw water, potable water bulk supplies and distribution input)	**2033**

Notes:

- Values have been taken from UU's 2007 June Return report to Ofwat. They are presented here to nearest whole number.
- Other water use = distribution system operational use by UU (e.g. cleaning of service reservoirs and water mains) and unbilled water use (e.g. fire fighting, highway washing, use at UU sites, and illegal use)

7.2 Demand forecasting methodology

Best practice methods have been used by UU in the preparation of the population and water demand component values in accordance with the national best practice documents. In particular:-

- All key base data and forecast data have been derived using the best sources of information available in accordance with the best practice methods in *Demand Forecasting Methodology* (UKWIR/NRA, 1995).

- All methods used are consistent with the Environment Agency's *Water Resources Planning Guideline* (EA, 2008) and Ofwat's guidance for preparing business plans (Ofwat, 2007).

- All population and household data and projections have been derived from official statistics and calculated in accordance with the Environment Agency's *Methods of Estimating Population and Household Projections* (EA, 2007). Our customer billing system has been used to apportion billed properties and population to individual water resource zones.

- The calculation of current water consumption by metered households and non-households is based on the meter readings on our customer billing system. This is in accordance with *Demand Forecasting Methodology* (UKWIR/NRA, 1995).

- Water consumption at unmeasured households is continuously monitored using water meters on selected streets and districts across the region. The monitoring and calculation of consumption rates is in accordance with *Best Practice for Unmeasured Per Capita Consumption Monitors* (UKWIR, 1999).

- The implementation of the newly introduced mandatory water efficiency targets (Ofwat, 2008) has been incorporated in our forecasts of household and non-household water demand.

- Forecasts of metered and unmeasured household demand have been based on a detailed micro-components analyses in accordance with *Forecasting Water Demand Components* (UKWIR/EA, 1997). In this approach, household water demand is broken down into its constituent parts (for example toilet flushing, bath use, clothes washing and garden watering), and assessments are made of the likely changes in ownership and usage of each type of appliance through time.

- The effect of metering on household demand has been derived by National Economic Research Associates (NERA, 2003) in accordance with *A Framework Methodology for Estimating the Impact of Household Metering on Consumption* (UKWIR, 2003).

- Forecasts of non-household water demand have been based on a detailed econometric model in accordance with *Forecasting Water Demand Components* (UKWIR/EA, 1997). The model was developed by Cambridge Econometrics (2003) who prepared the national methodology.

- The calculation of leakage levels is fully consistent with *Demand Forecasting Methodology* (UKWIR/NRA, 1995), *June Return Reporting Requirements* (Ofwat, 2007) and best practice for supply pipe leakage assessment (UKWIR, 2005). Leakage levels are monitored using the continuous flow measurement in each of the 2360 district meter areas that cover all customers across the region – the minimum night-flow in each district is used to derive the total leakage. The leakage appraisal has been undertaken using *Future Approaches to Leakage Target Setting for Water Companies in England and Wales* (Ofwat/EA/Defra, 2002) and *Providing best practice guidance on the inclusion of externalities in the ELL calculation* (Ofwat, 2007).

- The volume of supply pipe leakage from customer supply pipes have been based on the best practice methodology *Towards Best Practice for the Assessment of*

Supply Pipe Leakage (UKWIR, 2005).

- Reconciliation of the water balance for 2006/07 for each resource zone has been undertaken in accordance with *Demand Forecasting Methodology* (UKWIR/NRA, 1995) and *June Return Reporting Requirements* (Ofwat, 2007).

- The impact of climate change on water demand has been assessed in accordance with the EA's *Water Resources Planning Guideline* (EA, 2008) by using the information in *CCDeW: Climate Change and the Demand for Water* (Defra, 2003). More details are given in Chapter 8.

- The estimated impact of the "credit-crunch" and economic downturn on the projections for house-building and water demand by households and non-households have been incorporated in our demand forecasts, as described in Section 7.3.

7.3 Key data

A number of assumptions have necessarily been made in preparing the baseline demand forecasts in line with national methodologies and discussions with the Agency. In each case, the best sources of available data have been used to ensure a reliable and robust assessment.

The key data used for derivation of the baseline demand forecasts can be summarised as follows.

7.3.1 Base year data

All data used for 2006/07 and 2007/08 are fully consistent with the data reported to Ofwat and Environment Agency in UU's 2007 and 2008 June Return regulatory reporting submissions. We have used 2007/08 as our base-year to derive forecasts for future years.

7.3.2 Baseline demand management

Our baseline demand forecasts assume continued achievement of the baseline leakage levels in Table 6.1. Further leakage reduction actions needed as part of our water resources and demand strategy are set out in Chapter 13.

The "base service" component of the newly introduced mandatory water efficiency targets specifies that "each water company should have an annual target of saving one litre of water per billed property per day through approved water efficiency activity" (Ofwat, 2008). In the case of UU this equates to a target saving of 2.95 Ml/d each year, and we are required to carry out activities that should achieve these savings. We have not yet defined the base service programme in detail, but in line with the Ofwat guidance we expect it to comprise a combination of measures as described in Section 6.3.2.

We have also used the recently published water efficiency evidence base (Waterwise, 2008) to help inform the most suitable activities. There will be a significant decay in the

water savings as customers remove or replace devices over time, as indicated by Waterwise.

Our forecasts assume implementation of our current metering policies, which include metering of all new households and non-households, and continued provision of a free meter option scheme for households. We have used an econometric opting model developed for the water industry (UKWIR, 2003) to estimate that there will be 708,000 meter between 2006/07 and 2034/35. See Chapter 6 for further details of our metering programme. In accordance with advice from Ofwat and the Environment Agency, we have not assumed any compulsory metering of unmetered homes although we anticipate that widespread compulsory household metering will become a statutory requirement in the longer term.

We estimate the average sustained effect of household metering on demand for water is a reduction of 8.3% in a normal weather year. This has been derived from a detailed study of water consumption by UU customers before and after opting to be metered. The data analysis was undertaken for UU by National Economic Research Associates (NERA, 2003). The water savings in a dry year would be higher due to greater discretionary use of water, for example garden watering, in dry weather.

The water savings that are included in our baseline demand management plan include:-

- Maintaining leakage levels at current levels.

- 9 Ml/d water saving by 2014/15 from our base service water efficiency programme in line with Ofwat's water efficiency targets, rising to 12 Ml/d by 2034/35. (These forecasts include the decay in savings that result from customers removing or replacing devices over time).

- 10 Ml/d demand reduction by 2014/15 households who opt to be metered, rising to 23 Ml/d by 2034/35.

7.3.3 Population and households

The population in North West England supplied with water by UU is expected to increase by 13% from the 2006/07 level of 6.81 million to 7.70 million by 2034/35. This is in accordance with the latest information published by the Office for National Statistics (ONS, 2008). The number of households served by UU is expected to increase by 22% from the 2006/07 level of 2.94 million to 3.58 million by 2034/35, as discussed below. The forecasts are summarised in Table 7.2.

Table 7.2. Population and households served by UU in each resource zone ('000)

Resource zone	Population ('000)		Households ('000)	
	2006/07	2034/35	2006/07	2034/35
Integrated Zone	6535	7394	2812	3422
Carlisle Zone	106	124	50	66
North Eden Zone	14	17	6	9
West Cumbria Zone	152	166	68	84
UU Region	**6807**	**7701**	**2936**	**3581**

Our housing forecast has taken account of the economic downturn and "credit-crunch", the severity of which has recently become more apparent, on the house-building programme. We have assumed that the number of new homes built in 2009/10 will be half the current level (in line with statements by the National House-building Council), and that the numbers will gradually return to recent historic levels by 2014/15.

Our longer term forecasts, for 2015/16 to 2034/35 have been assessed by taking account of various official regional forecasts including:-

- In July 2008 the Department for Communities and Local Government announced support for the six "growth point" proposals in the North West (Greater Manchester, Carlisle, Central Lancashire/Blackpool, West Cheshire, Halton/St Helens/Warrington and Mersey Heartlands) for an additional 29,448 dwellings, above Regional Spatial Strategy levels, by 2016/17 (DCLG, 2008).

- The region's *Regional Spatial Strategy to 2021* (GONW, 2008) was published in October 2008, which plans for a growth in households by an average of 23,111 per annum between 2003 and 2021.

- The North West Regional Assembly has advised us of a variety of regional housing forecasts, ranging up to 35,666 per annum. One of the forecasts recommended to us was the National Housing and Planning Advice Unit prediction of an average increase in homes of 26,600 per annum between 2003 and 2026.

- However, it is apparent that the severe economic downturn is having a significant impact of house-building, which will result in significant delays in achieving any of the regional projections. Our approach has been to assume (a) reduced house-building until 2014/15 as described above; and (b) assume that the National Housing and Planning Advice Unit forecast for 2026 is delayed by 5 years until 2031. The key numbers are summarised in Table 7.3 below. We have discussed this approach with Environment Agency staff who have indicated that it is reasonable in light of the exceptional economic circumstances.

Table 7.3. Comparison of policy-based housing projections for the North West Region ('000)

Basis of forecast	2003 (actual)	2007	2016 (forecast)	2021 (forecast)	2026 (forecast)	2031 (forecast)
Regional Spatial Strategy (23,111 p.a. from 2003)	2874	2966 (forecast)	3174	3290	N/A	N/A
National Housing and Planning Advice Unit (26,600 p.a. from 2003)	2874	2980 (forecast)	3220	3353	3486	N/A
UU forecast	2874	2945 (actual)	3093	3224	3355	3486

Note: UU's water supply area is slightly different to the North West Region, and so the housing forecasts used in the WRMP are slightly different to those shown above.

Average household occupancy has been steadily declining in recent decades, and we expect it to reduce from the 2006/07 level of 2.32 to 2.15 (including empty homes) by the year 2034/35, in accordance with the projections used for population and households. Based on our recent survey of 3500 customers, we estimate the average occupancy of occupied unmeasured houses, new houses and meter optant houses at 2006/07 to be 2.44, 2.62 and 1.70, respectively.

7.3.4 Household demand

Forecast per capita consumption rates for metered and unmetered household customers have been derived from detailed micro-component analysis. Current ownership of water-using appliances has been derived from our detailed survey of 3500 customers. The volume per use and frequency of use of such appliances has been derived from a detailed appliance monitoring study by the Water Research Centre (2005). Forecasts of ownership of water using appliances have been derived from a combination of published data and other authoritative sources, including the future trends suggested in the Environment Agency report *A Scenario Approach to Water Demand Forecasting* (EA, 2001). In particular, we expect that all new toilets, washing machines and dishwashers will become more water efficient, but that ownership and use of showers and lawn sprinklers will increase. The results are summarised in Table 7.4. We have included the effects of our base service water efficiency programme in these forecasts.

Our forecast average per capita consumption rate in a normal year at 2030 is 129 litres per person day, which is lower than the Government's *Future Water* aspirational ambition of achieving an average of 130 litres per person per day by 2030 (Defra, 2008). We anticipate that widespread compulsory metering will become a statutory requirement in the longer term and this will drive the average consumption rate even lower.

From April 2007, all new homes receiving Government funding, which is a small proportion of total new housing build, must be built to a minimum of Code level 3 of the UK's *Code for Sustainable Homes (*DCLG, 2006), achieving a level of 105 litres per person per day internal use. Also, from Spring 2009 (when Part G of the Building Regulations comes into force, as specified in *Homes for the Future* (DCLG, 2007)), all new homes will be required to comply with a water use standard of no more than 125 litres per person per day. Our forecasts are fully consistent with these new requirements as

the average water consumption rate for new homes is currently about 113 litres per person day and is forecast to remain close to that level.

Table 7.4. Baseline regional average per capita consumption (litres per person-day)

Component	Unmeasured households		Metered households		All households (Weighted average)	
	2006/07	2029/30	2006/07	2029/30	2006/07	2029/30
Toilet flushing	38.3	23.9	35.1	20.2	37.7	21.9
Bath use	25.8	21.5	12.5	13.4	23.2	17.0
Shower use	17.3	32.5	17.6	32.8	17.4	32.6
Hand basin	10.0	10.0	9.1	9.2	9.8	9.5
Clothes washing	19.4	16.8	17.6	14.7	19.1	15.7
Dish washing	10.4	8.6	10.5	7.8	10.4	8.1
Garden use	3.0	4.5	2.3	3.1	2.9	3.7
Car washing	1.2	1.7	0.8	1.1	1.1	1.3
Miscellaneous use	18.1	23.2	16.3	14.9	17.7	18.6
Total use in a normal year	**143.5**	**142.7**	**121.7**	**117.3**	**139.3**	**128.6**
Total use in a dry year	**154.1**	**159.8**	**129.6**	**129.4**	**149.4**	**143.0**

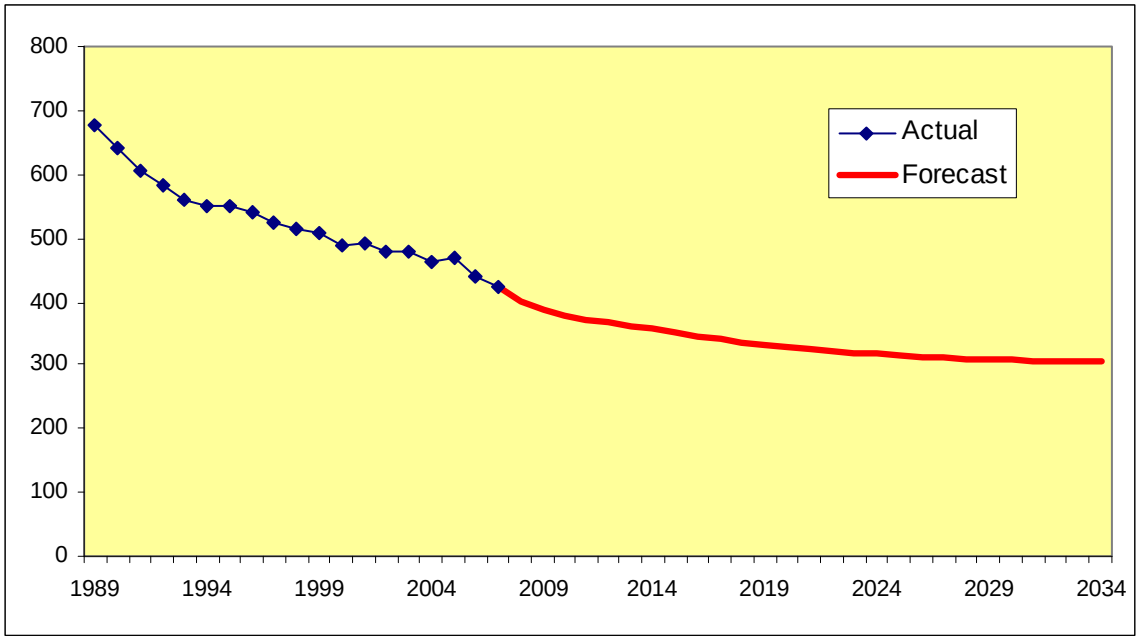
Note: Values may not sum exactly due to rounding

7.3.5 Non-household demand

Non-household consumption of potable water across the UU region has reduced substantially in recent decades, as shown in Figure 7.1. We forecast that non-household water demand will fall by just over 30% between 2006/07 and 2034/35. This is based on the results from a recent detailed econometric modelling study of trends in water consumption in North West England. We have included the estimated effects of the current economic downturn on the consumption levels. Separate forecasts were prepared for different industrial sectors, as shown in Table 7.5.

Although the economy of North West England has grown substantially over the last 30 years, water use by non-households has persistently declined. Our econometric model assumes continued economic growth in the region (after the next few years) but that the strong trend for reducing water use will also continue. The continuing decline in non-household water demand is as a result of continuing water efficiency measures and reduction in water-intensive industry in North West England, although there will be local variations. UU will continue to ensure that adequate water supplies will be available to meet customer requirements and that our plan presents no barrier to the region's economic growth or housing development.

Figure 7.1. Trend in non-household water demand (Ml/d)



7.3.6 Weather and climate change effects on demand

The sufficiency of the water supply and demand balance is most critical in years with a prolonged hot and dry summer. In these conditions, water availability is reduced and higher than usual demands occur, particularly due to increased watering of gardens. In accordance with the EA's *Water Resources Planning Guideline* (EA, 2008), assessment has therefore been made of the "dry year annual average unrestricted daily demand" for each resource zone for comparison with reliable water supply availability (WAFU, see Section 5.1).

The extent of extra water consumption during prolonged hot, dry weather has been calculated from the water demand patterns experienced during the 1995/96 drought. Our evaluation concluded that the marked elevations in demand during the summer of 1995 (before introduction of the hosepipe ban) were consistent with a quadrupling of normal annual average water use for garden watering, together with assumed small increases in shower use and clothes washing.

The Carlisle and West Cumbria resource zones are vulnerable to short period drought events because of the lower volumes of storage available. In these cases, the "critical periods" of our water sources are between 2 and 3 months. Forecasts of "critical period average daily demand" have been prepared for these zones in accordance with the *Water Resources Planning Guideline* (EA, 2008) and using the *Peak Water Demand Forecasting Methodology* (UKWIR, 2005).

Table 7.5. Baseline regional non-household water demand (Ml/d)

Component	2006/07	2014/15	2024/25	2034/35
Agriculture, horticulture, forestry and fishing	37.4	26.1	20.9	19.2
Extraction of minerals and energy producing minerals	1.0	0.9	0.7	0.7
Food and drink (manufacture)	50.4	39.6	30.5	26.7
Textile, fur and leather (manufacture)	3.3	2.3	1.6	1.3
Other manufacturing	10.5	7.8	6.7	6.9
Paper (manufacture)	8.0	5.7	4.5	4.1
Fuel refining	2.3	2.3	1.7	1.4
Chemicals, rubbers, plastics and man-made materials (manufacture)	64.8	47.7	40.3	39.3
Non-metallic minerals (manufacture)	7.5	5.4	4.2	3.9
Basic metals, fabricated metal products and machinery (manufacture)	7.1	5.3	4.3	4.1
Transportation and manufacture of of transport equipment	16.8	11.7	9.8	9.8
Electricity, gas and water supplies	11.5	7.3	6.1	5.9
Construction	3.3	2.0	1.7	1.6
Wholesale and retail	27.8	23.3	21.8	20.6
Hotels, bars and restaurants	50.4	47.8	50.7	55.5
Other services	85.6	68.5	61.4	55.4
Education and health	54.2	51.5	49.1	48.7
Total metered non-household consumption	441.7	355.3	316.0	305.1
Unmetered non-household consumption	14.0	8.3	5.0	1.5
Total dry year non-household water consumption	**455.7**	**363.6**	**321.0**	**306.6**

Note: Water used for irrigation on arable land is almost entirely raw water not supplied by UU, and so although arable farming is expected to grow substantially we do not expect it to result in significant increased use of potable water for agriculture. The agricultural use of drinking water is for diary farming and its use is expected to continue to reduce with implementation of further water recycling and other efficiency measures.

We have used the report *CCDeW: Climate Change and the Demand for Water* (Defra, 2003) to estimate the potential effects of climate change on water demand. The estimated impacts are summarised in Table 7.6 and more details are given in Chapter 8.

Table 7.6. Estimated impact of climate change on dry weather demand (Ml/d)

	2009/10	2014/15	2024/25	2034/35
Integrated Zone	2.3	8.1	16.3	20.3
Carlisle Zone	0.04	0.1	0.3	0.4
North Eden Zone	0.01	0.02	0.04	0.05
West Cumbria Zone	0.06	0.2	0.4	0.5

7.4 Baseline demand forecasts

The methods and assumptions described above have been used to prepare baseline demand forecasts for each water resource zone, as summarised in Tables 7.7 and 7.8.

The components of the regional dry year demand forecast through the planning period to 2034/35 are illustrated in Figure 7.2. It shows the way in which we expect household demand and non-household demand to reduce, and the anticipated transfer of a large number of households from unmeasured to metered.

Figure 7.2. Components of regional dry year demand forecasts including climate change (Ml/d)

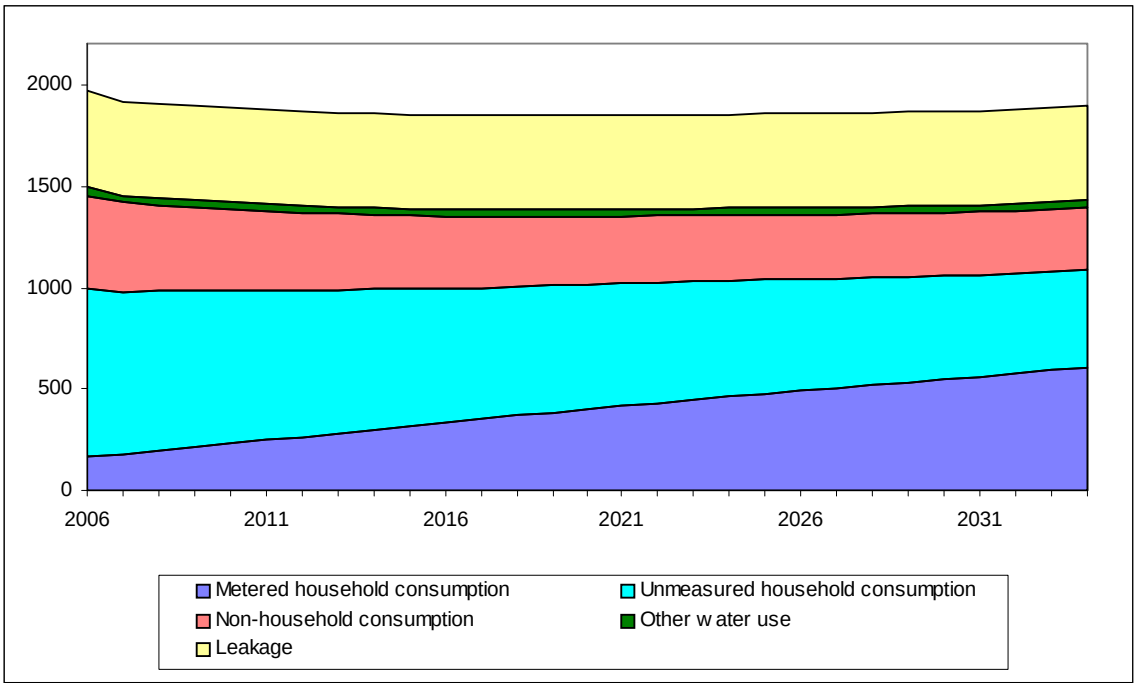


Table 7.7. Baseline dry year demand forecast for resource zones including climate change (Ml/d)

Item	Integrated Zone		Carlisle Zone	
	2006/07	2034/35	2006/07	2034/35
Metered households consumption	159.3	580.5	2.9	10.0
Unmetered households consumption	799.5	467.0	11.8	7.1
Metered non-households consumption	417.1	287.9	9.3	5.8
Unmetered non-households consumption	13.3	1.5	0.2	0.0
Other water use	42.2	32.6	0.7	0.6
Total leakage (baseline)	442.4	439.2	4.9	4.8
Total dry year demand	1873.8	1808.7	29.8	28.4
Item	**North Eden Zone**		**West Cumbria Zone**	
	2006/07	**2034/35**	**2006/07**	**2034/35**
Metered households consumption	0.4	1.3	3.0	10.4
Unmetered households consumption	1.4	0.8	18.9	12.9
Metered non-households consumption	2.1	1.2	13.2	10.1
Unmetered non-households consumption	0.0	0.0	0.4	0.0
Other water use	0.1	0.1	1.1	0.8
Total leakage (baseline)	2.4	2.0	18.5	15.5
Total dry year demand	6.5	5.5	55.1	49.8

Table 7.8. Baseline critical period demand forecast for Carlisle and West Cumbria resource zones including climate change (Ml/d)

Item	Carlisle Zone		West Cumbria Zone	
	2006/07	2034/35	2006/07	2034/35
Metered households consumption	3.1	11.4	3.3	12.4
Unmetered households consumption	12.9	8.2	21.5	15.8
Metered non-households consumption	9.3	5.8	13.2	10.1
Unmetered non-households consumption	0.2	0.0	0.4	0.0
Other water use	0.7	0.6	1.1	0.8
Total leakage (baseline)	4.9	4.8	18.5	15.5
Total critical period demand	31.2	30.9	57.9	54.6

Note to Tables 7.7 and 7.8: Values may not sum exactly due to rounding

The anticipated increase in households of 645,000 by 2034/35 (net of demolitions) will put an upward pressure on water use, as well as the expected growth in water use for garden watering and personal washing. However, we are forecasting that demand will generally reduce due primarily to the expected effects of:-

- Growth in customer metering. Our studies have shown that customers in North West England reduce their water use by an average of 8.3% as a result of being metered.
- The growing use of low-flush-volume toilets and other water efficient appliances.
- Our base service water efficiency programme.
- Forecast reductions in measured non-household demand resulting from macro-economic factors and water efficiency.

Chapter 8. Climate change

This chapter describes how climate change is expected to impact on future water supply and demand and what actions UU is taking to minimise emission of greenhouse gases.

8.1 Climate change predictions

The most recent climate change scenarios for the UK, often known as "UKCIP02", were published by the UK Climate Impacts Programme (UKCIP, 2002) and have the following headline conclusions:-

- UK climate will become warmer (summer and winter).
- Winters will become wetter and summers may become drier.
- Heavy winter precipitation will become more frequent, but snowfall amounts will decrease.

These findings have been confirmed by the recent UKWIR "CL04" studies (UKWIR, 2006 and 2007).

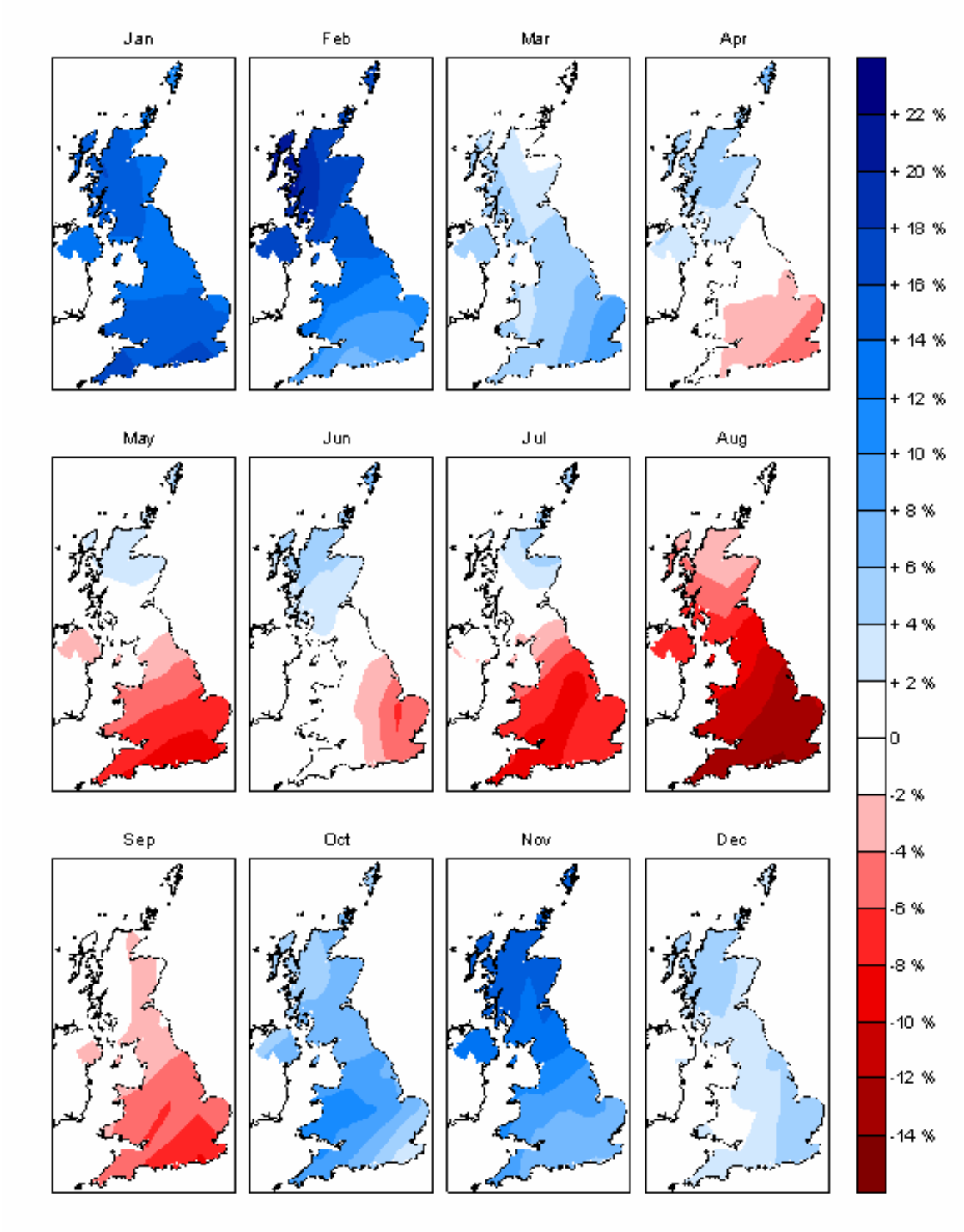
Behind these conclusions are uncertainties inherent in the modelling of climate change, including timescales, extent of change and the likelihood of any particular scenario occurring. There is also a natural variability in climate that may mask or accentuate human-induced climate change. However, it is now generally accepted that climate change is happening. Of particular importance is the potential change to extreme events that impact on water source yields and the maintaining of levels of service. North West England is in the mid-range of the latest UK predictions, showing neither the extremes of drier and warmer weather in the south of England or the wetter, less warm predictions for Scotland.

The UK Climate Impact Programme published new climate projections "UKCP09" in June 2009, which give an enhanced UK assessment of climate change. These were too late for this WRMP, but we will work with UKWIR and the Environment Agency to use the findings to review our calculations of climate change impact.

8.2 Impact on source yields

The UKWIR "CL04" series of reports *Effect of Climate Change on River Flows and Groundwater Recharge* represents the most authoritative research on the impacts of climate change on water source yields. The 2003 report identified potential changes to rainfall (see Figure 8.1), flows and recharge based on the "UKCIP02" climate change scenarios (UKCIP, 2002), for a range of climate change scenarios. Subsequent UKWIR reports (UKWIR, 2006 and 2007) prepared in collaboration with the Environment Agency have studied the effects in more detail and have derived practical methods for incorporating impact in the estimates of future deployable output.

Figure 8.1. Average changes in monthly precipitation for the 2020s compared to the 1961-1990 period based on the "UKWIR06" scenarios (from *Effect of Climate Change on River Flows and Groundwater Recharge*, UKWIR, 2006)



Environment Agency guidance requires water companies to use these methods to derive "wet", "mid" and "dry" estimates. UU has therefore carried out detailed hydrological modelling to estimate the effect of the wet", "mid" and "dry" scenarios on water source deployable output during the 2020's for each resource zone. The estimated impacts at 2025 are presented in Table 8.1. The impacts for other years, from 2007/08 to 2034/35, are calculated by interpolation in accordance with the Agency's guidance.

Table 8.1. Estimated impact on deployable output due to climate change at 2025 (Ml/d)

	Integrated Resource Zone	Carlisle Resource Zone	North Eden Resource Zone	West Cumbria Resource Zone	Region
Lower estimate (Ml/d) ("Wet" climate scenario)	112	0.9	0	4.9	118
Lower estimate as % of WAFU	5%	3%	0%	-10%	-
Central estimate (Ml/d) ("Mid" climate scenario)	**-24**	**-0.2**	**0**	**-0.2**	**-24**
Central estimate as % of WAFU	-1%	-1%	0%	-0.4%	-
Upper estimate (Ml/d) ("Dry" climate scenario)	-420	-1.4	0	-7.4	-428
Upper estimate as % of WAFU	-23%	-4%	0%	-15%	-

Notes:

- Values may not sum exactly due to rounding
- A negative value represents an reduction in water available in our water sources.
- Climate change is not expected to impact on the deployable output of the water sources in North Eden.

The range of effects across the resource zones is due mainly to the way in which climate change will primarily impact water availability in our reservoir and lake water sources, which form a large proportion of the water source capacity of our Integrated and West Cumbria zones.

We are concerned there remain significant uncertainties surrounding climate change predictions and the secondary impacts on deployable output. We do, however, recognise the important need to take account of climate change in our plans and this is endorsed by the guidance from Defra (2008), Ofwat (2007) and EA (2008).

The central estimated impacts have been included in our water supply forecasts (see Chapter 5). The uncertainty in potential impacts on water availability, as represented by the lower and upper impacts derived from applying the UKWIR methodology, has been included in our detailed uncertainty analysis to calculate "target headroom" values, as described in Chapter 9.

8.3 Impact on demand

Water demand is affected by weather conditions: in particular water use for garden watering and other uses increases significantly in hot and dry weather. The recent major research project by Oxford University for Defra *CCDeW: Climate Change and the Demand for Water* (Defra, 2003) provides the best available estimates of the impact of climate change on future demands for water. It presents indicative predictions, for a variety of scenarios, of the potential impact of climate change in North West England on key components of household and non-household water demands.

UU has used the "CCDeW" data to estimate the impact on water demand for each zone as summarised in Table 8.2. The central regional estimated impact of 17.5 Ml/d represents 0.9% of regional dry weather distribution input at 2025.

Table 8.2. Estimated increase in dry weather water demand due to climate change at 2025 (Ml/d)

	Integrated Resource Zone	Carlisle Resource Zone	North Eden Resource Zone	West Cumbria Resource Zone	Region
Lower estimate	14.4	0.3	0.04	0.4	15.1
Central estimate	16.7	0.3	0.05	0.4	17.5
Upper estimate	19.9	0.4	0.06	0.5	20.9

The central estimated impacts have been included in our baseline dry weather demand forecasts. The uncertainty in potential impacts on water demand, as represented by the lower and upper impacts derived from the "CCDeW" findings, has been included in our detailed uncertainty analysis to calculate "target headroom" values, as described in Chapter 9.

8.4 Mitigation actions by United Utilities

UU is concerned about the risks posed by climate change to the general environment and is taking action as a "good neighbour" to help mitigate climate change by reducing greenhouse gas emissions that result from our activities. Our actions were summarised in UU's *Strategic Direction Statement* (UU, 2007), as presented in the following text box.

UU actions to mitigate climate change
(extract from UU's Strategic Direction Statement)

We intend to move our business to a more sustainable and efficient basis of operation. The main elements will be:

Playing our part in mitigating climate change:

- We have an existing commitment to cut greenhouse gas emissions by more than a quarter in the short term (8 per cent from carbon reduction and 18 per cent from green energy contracts).
- By 2035 we aim to halve emissions from their current level.
- We expect this will require us to operate our wastewater operations in an energy neutral manner.
- Reduced pumping in our water network as a result of lower demand and reduced leakage will play its part.

We will exploit technological developments and innovative approaches:

- We intend a significant expansion in automation and control of our network and processes – benefiting the environment through improved compliance and optimising processes so as to reduce their energy and chemical requirements.
- We see significant scope for innovation across a broad front, improving energy recovery in wastewater, trialling new metering technology and the pricing structures they facilitate, and exploiting low impact land management practices on catchment land.

To improve our efficiency and meet our broader environmental goals, the way we manage water and wastewater services will alter

- We intend to reduce the number of water treatment facilities we operate to improve efficiency and quality.
- Conversely, wastewater operations may become more local with greater reliance on low impact, local treatment techniques, management of stormwaters at source and localised energy recovery.

Mitigating climate change

In 2006/7 we used one-third of one per cent of the UK's electricity. This and other sources meant greenhouse gases equivalent to almost half a million tonnes of CO2 entered the atmosphere as a result of our operations, a figure that has doubled in the last fifteen years from the major investments we have made to improve services and the water environment.

We have already publicly declared our intention to reduce that figure by 8 per cent when account is taken of the upwards pressures we face on our level of emissions. But this is just the first stage. We want to play our part in meeting the UK's longer-term target of a 60 per cent reduction in CO2 emissions by 2050, compared to the level in 1990.

For UU the main way in which we can reduce our emission is by using the methane gas available in sewage sludge to generate electricity. In addition, we can improve the efficiency with which we use energy in the first place throughout our operations, from offices to transport to treatment sites.

By 2035 we aim to have halved emissions from the current level. For our wastewater activities this is likely to mean that they will have become close to energy neutral as we extract as much as possible of the available energy from sewage sludge and exploit lower intensity treatment methods.

Our water activities seem certain to continue to require significant quantities of energy for pumping. We may be able to source more of that energy from renewable sources, from wind turbines sited on our facilities, for example, and from capturing the energy in water as it flows under gravity through our supply system. Reduced water demand will also make a significant contribution.

Chapter 9. Target headroom

This chapter describes how we have identified uncertainties that affect the supply-demand balance and prepared forecasts of target headroom allowances.

9.1 Role of target headroom

Target headroom is an essential component of water resources planning to ensure that appropriate measures are taken to safeguard customers from the many uncertainties associated with forecasting demand and the assessment of water available for use over the planning horizon. These include political, social, environmental, climate change and technical factors outside of UU's control that may significantly influence components of the supply-demand balance. The need for sufficient headroom has been recognised by Government Ministers (Defra, 2004) who require water companies "*to plan to have sufficient headroom and use appropriate methodologies and guidance to achieve this*".

9.2 Target headroom methodology

We have applied the most recent national best practice methodology *An Improved Method for Assessing Headroom* (UKWIR, 2002) to determine target headroom values for each of our water resource zones for the planning period to 2034/35.

The methodology involves identifying and quantifying the potential effects on the supply-demand balance of the following issues:-

Supply-side issues:
S1. Vulnerable surface water licences }
S2. Vulnerable groundwater licences } Not used (see below)
S3. Time limited licences }
S4. Bulk transfers
S5. Gradual pollution causing a reduction in abstraction
S6. Accuracy of supply-side data
S7. Single source dominance and critical periods (not used, see below)
S8. Uncertainty of climate change on yield
S9. Uncertainty in deployable output of supply-side solutions

Demand-side issues:
D1. Accuracy of sub-component data
D2. Demand forecast variation
D3. Uncertainty of climate change on demand
D4. Uncertainty in benefit of demand-side solutions

The elements of uncertainty associated with each of the issues S4 to D4 has been considered for each of the four water resource zones. In accordance with the *Water Resources Planning Guideline* (EA, 2008) we have made no allowance for S1, S2 or S3

type uncertainties. We have found that the S6 component was under-estimated in our 2004 target headroom assessment of the uncertainty associated with water supply data and so have corrected it for this WRMP – this is due to an incorrect assessment in 2004 and not a deterioration in actual data quality. There is inherent uncertainty in supply-side data including historic rainfall and run-off measurements collected over many decades, and the relationships derived for the calculation of water source yield. We have not included S7 as this component is not part of the latest target headroom methodology.

The Environment Agency's "Restoring Sustainable Abstraction" programme and implementation over the next 20 years of the European Union Water Framework Directive will result in the abstraction licences for many of our water sources being reviewed. In consequence it is likely that various abstraction licences will be modified to ensure more sustainable water abstraction. This could have a significant impact on our supply-demand balances and results in significant uncertainty about the future deployable output of our water resource zones. UU is disappointed that we are not permitted by the Agency's guidelines to include this important uncertainty in categories S1 and S2 of our target headroom assessment.

9.3 Headroom risk

In accordance with the EA's *Water Resources Planning Guideline*, UU has applied a varying level of headroom risk over the planning horizon, with a higher level of risk in future years than at present. The risk profile through the planning horizon adopted by UU has been chosen to ensure an appropriate balance between taking adequate measures to safeguard the reliability of supply to customers and the avoidance of unnecessary costs.

In our original Draft WRMP (published in May 2008) the climate change uncertainty components (S8 and D3) had a very large impact on the target headroom values for the Integrated Zone. We had carefully followed best practice in their assessment – it is the wide range of predictions from the different global climate models we are required to use that leads to the large uncertainty. But Ofwat suggested in their consultation response that UU consider reducing the effect in order to avoid major expenditure (and impact on customer bills) arising directly from the large uncertainty in the climate change predictions. In discussion with the Environment Agency, UU has decided to apply a different risk profile for climate change to that applied for other uncertainty components.

The adopted risk profiles are summarised in Table 9.1. In the case of the **non-climate change uncertainties**, as 2009/10 is very near to the present time, it is appropriate to accept only a low risk that the identified uncertainty issues would result in a supply deficit. We have therefore applied a 5% risk by using the 95 percentile headroom values for the period up to 2009/10. In the case of 2034/35, which is much more distant in the planning horizon, we have the opportunity over the coming years to modify our plans to adapt to changing circumstances. So it is appropriate that a higher risk should be allowed for in later years: we have applied an increasing risk profile, rising to 30% risk at 2034/35.

In the case of the **climate change uncertainties**, we have chosen to apply a 50%ile risk throughout the planning period for the purpose of this WRMP. In the future, when the understanding of climate change effects has improved, we plan to revert to using the same risk profile as for non-climate change issues. The UK Climate Impact Programme

published new climate projections "UKCP09" in June 2009, which give an enhanced UK assessment of climate change. These were too late for this WRMP, but we will work with UKWIR and the Environment Agency to use the findings to review our calculations of the uncertainty in climate change impacts.

Table 9.1. Summary of risk profile used to derive target headroom values

	2009/10	2014/15	2019/20	2024/25	2034/35
Non-climate change uncertainties					
Risk of understating the supply-demand balance	5%	15%	25%	30%	30%
Headroom uncertainty percentile value	95 percentile	85 percentile	75 percentile	70 percentile	70 percentile
Climate change uncertainties					
Risk of understating the supply-demand balance	50%	50%	50%	50%	50%
Headroom uncertainty percentile value	50 percentile	50 percentile	50 percentile	50 percentile	50 percentile

9.4 Target headroom values

The calculated target headroom values required between water available for use and demand are summarised in Table 9.2. The 2006/07 values for target headroom are those calculated in 2003 for our *2004 Water Resources Plan* (UU, 2007). The future values have been calculated by our 2007 target headroom assessment.

The calculated target headroom value for the Integrated Resource Zone is low at 2009/10 at only 2.8% of reliable supply (WAFU). Target headroom increases to 4.2% of WAFU at 2014/15 and 6.9% of WAFU at 2034/35, increasing primarily due to the increasing uncertainties in climate change impacts on the water sources and water demand.

In the case of the Carlisle, North Eden and West Cumbria zones the target headroom values are low, at less than 5% of reliable supply (WAFU). The headroom values tend to fluctuate through time, with upward pressures due to increasing uncertainties and downward pressures in line with the increasing risk profile. The increase in headroom for the North Eden Zone at 2024/25 is due to potential uncertainty about the continuation of the bulk supply import from Northumbrian Water.

The contribution to target headroom values due to uncertainty of climate change impact on water source yields and water demand is shown in Table 9.3. It is significant only in the case of the Integrated Zone, because of the large number of reservoirs that are part of the supply system for that zone.

Table 9.2. Target headroom values (Ml/d)

Zone	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Integrated Zone						
Target Headroom	**41.4**	**53.4**	**79.3**	**99.0**	**106.0**	**129.5**
As % of WAFU	2.1%	2.8%	4.2%	5.3%	5.7%	6.9%
Carlisle Zone						
Target Headroom	**1.0**	**0.6**	**0.8**	**0.6**	**0.5**	**0.7**
As % of WAFU	2.7%	1.5%	2.4%	1.9%	1.6%	2.0%
North Eden Zone						
Target Headroom	**0.55**	**0.43**	**0.17**	**0.12**	**0.15**	**0.24**
As % of WAFU	6.0%	4.2%	1.7%	1.2%	1.5%	2.3%
West Cumbria Zone						
Target Headroom	**1.4**	**1.9**	**1.8**	**1.6**	**1.4**	**1.5**
As % of WAFU	2.4%	3.3%	3.8%	3.3%	2.8%	3.0%

Note:
- WAFU = Water available for use (see Section 5.1).
- The 2006/07 values were derived by our 2004 target headroom assessment; the future values have been calculated by our new assessment.

Table 9.3. Contribution of climate change to the target headroom values (M/d)

Zone	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Integrated Zone	0	10.3 (0)	35.5 (53.9)	60.9 (117.3)	70.9 (133.5)	84.9 (155.8)
Carlisle Zone	0	<0.1 (0)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)
North Eden Zone	0	<0.1 (0)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)
West Cumbria Zone	0	0.1 (0)	0.3 (<0.1)	0.5 (0.4)	0.5 (0.3)	0.6 (0.5)

Note: Values in brackets are the climate change contributions included in the original Draft WRMP.

In order to prepare a robust WRMP, we need to take account of the key risks that will impact on our supply-demand balances, and have a strategy in place to deal with them. It is important, therefore, that uncertainties in water resources planning are incorporated into the calculation of headroom to ensure that the potential impacts on supply-demand balances are recognised and managed. UU considers that the calculated headroom values represent a reasonable allowance to account for future uncertainties outside of its control.

Chapter 10. Initial supply-demand balance

This chapter sets out the initial supply-demand balance of each water resource zone, before taking account of enhancements identified as part of our water resources and demand strategy presented in Chapter 13.

10.1 Supply-demand balance concept

The water supply-demand balance for a water resource zone can be summarised by the following equation:-

Supply-demand balance	**=**	**Water available for use**
	minus	**Dry weather demand**
	minus	**Target headroom**

Where:

- Water available for use is the amount of water that can be reliably supplied from our water sources during prolonged dry weather (see Chapter 5 for details).
- Dry weather demand is the total customer demand for water and leakage during prolonged dry weather (see Chapter 7 for details).
- Target headroom is the calculated allowance for uncertainties that are outside the control of the water company (see Chapter 9 for details).

As described in Section 1.3, if the supply-demand balance in a water resource zone is positive, then we have adequate water supply capacity to meet forecast water demand in that zone and achieve our target level of service.

If, however, the supply-demand balance is negative for any future years, then we need to carry out a combination of supply enhancement and/or demand reduction measures in that zone to maintain an adequate supply-demand balance. Otherwise hosepipe bans or other drought powers are likely to be required more frequently than desired by our customers and other stakeholders.

10.2 Initial supply-demand balances

Initial "baseline" supply-demand balances are summarised in Table 10.1. Each balance indicates the difference between water available for use and baseline demand forecasts including target headroom. The effects of climate change on our calculations of baseline water available for use, dry weather demand and target headroom are summarised in Table 10.2.

Our baseline demand forecasts include the effects of the following (as described in Chapter 6):-

- Continuation of existing leakage control policies to maintain regional total leakage below 465 Ml/d.
- Continuation of existing water efficiency activities.
- Continue to meter all new properties.
- Continuation of the free meter option scheme.
- Continue with existing tariff structures for water bills.

Figures 10.1 to 10.4 illustrate the initial supply-demand balance for each water resource zone. These initial supply-demand balances are based on baseline demand forecasts and so do not include any additional policies for demand management. Options for further demand management measures (including leakage reduction) are considered as part of the option appraisal described in Chapter 13.

Table 10.1. Initial supply-demand balances 2006/07 to 2034/35 (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Integrated Zone						
Water source yield	1931.7	1904.6	1879.8	1871.3	1868.4	1863.6
Dry weather demand	1873.8	1800.7	1770.6	1765.4	1769.5	1808.7
Target headroom	41.4	53.4	79.3	99.0	106.0	129.5
Supply-demand balance	**16.6**	**50.6**	**30.0**	**6.9**	**-7.1 (deficit)**	**-74.6 (deficit)**
Carlisle Zone						
Water source yield	37.7	36.4	32.5	32.4	32.4	32.4
Dry weather demand	31.2	30.1	30.1	29.8	29.9	30.9
Target headroom	1.0	0.6	0.8	0.6	0.5	0.7
Supply-demand balance	**5.4**	**5.8**	**1.6**	**2.1**	**2.0**	**0.8**
North Eden Zone						
Water source yield	9.2	10.3	10.3	10.3	10.3	10.3
Dry weather demand	6.5	5.6	5.5	5.4	5.4	5.5
Target headroom	0.6	0.4	0.2	0.1	0.2	0.2
Supply-demand balance	**2.1**	**4.3**	**4.7**	**4.8**	**4.7**	**4.6**
West Cumbria Zone						
Water source yield	58.9	57.8	48.4	48.3	48.3	48.2
Dry weather demand	57.9	55.0	54.8	53.8	53.6	54.6
Target headroom	1.4	1.9	1.8	1.6	1.4	1.5
Supply-demand balance	**-0.4 (deficit)**	**1.0**	**-8.3 (deficit)**	**-7.1 (deficit)**	**-6.7 (deficit)**	**-7.8 (deficit)**

Notes:

- Values may not sum exactly due to rounding.
- The water source yields reported here are what is officially known as "Water Available For Use" (WAFU).
- Dry weather demand forecast = Dry year annual average distribution input for the Integrated and North Eden resource zones, and Critical Period average distribution input in the case of the Carlisle and West Cumbria resource zones.

Table 10.2. Estimated impact of climate change on water source yields, dry weather demand and target headroom

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Integrated Zone						
Water source yield reduction	0	3.4	11.9	20.4	23.4	28.1
Dry weather demand increase	0	2.3	8.1	14.7	16.3	20.3
Target headroom increase	0	10.3	35.5	60.9	70.9	84.9
Total impact	**0**	**16.0**	**55.5**	**96.0**	**110.6**	**133.3**
Carlisle Zone						
Water source yield reduction	0	0	0.1	0.2	0.2	0.3
Dry weather demand increase	0	0.0	0.1	0.3	0.3	0.4
Target headroom increase	0	0.0	0.0	0.0	0.0	0.0
Total impact	**0**	**<0.1**	**0.2**	**0.5**	**0.5**	**0.7**
North Eden Zone						
Water source yield reduction	0	0	0	0	0	0
Dry weather demand increase	0	0.01	0.02	0.04	0.04	0.05
Target headroom increase	0	0.0	0.0	0.0	0.0	0.0
Total impact	**0**	**0.01**	**0.02**	**0.04**	**0.04**	**0.05**
West Cumbria Zone						
Water source yield reduction	0	0.0	0.1	0.2	0.2	0.2
Dry weather demand increase	0	0.1	0.2	0.4	0.4	0.5
Target headroom increase	0	0.1	0.3	0.5	0.5	0.6
Total impact	**0**	**0.2**	**0.6**	**1.1**	**1.1**	**1.3**

Note: Values may not sum exactly due to rounding.

Figure 10.1. Initial supply-demand balance for Integrated Zone (Ml/d)

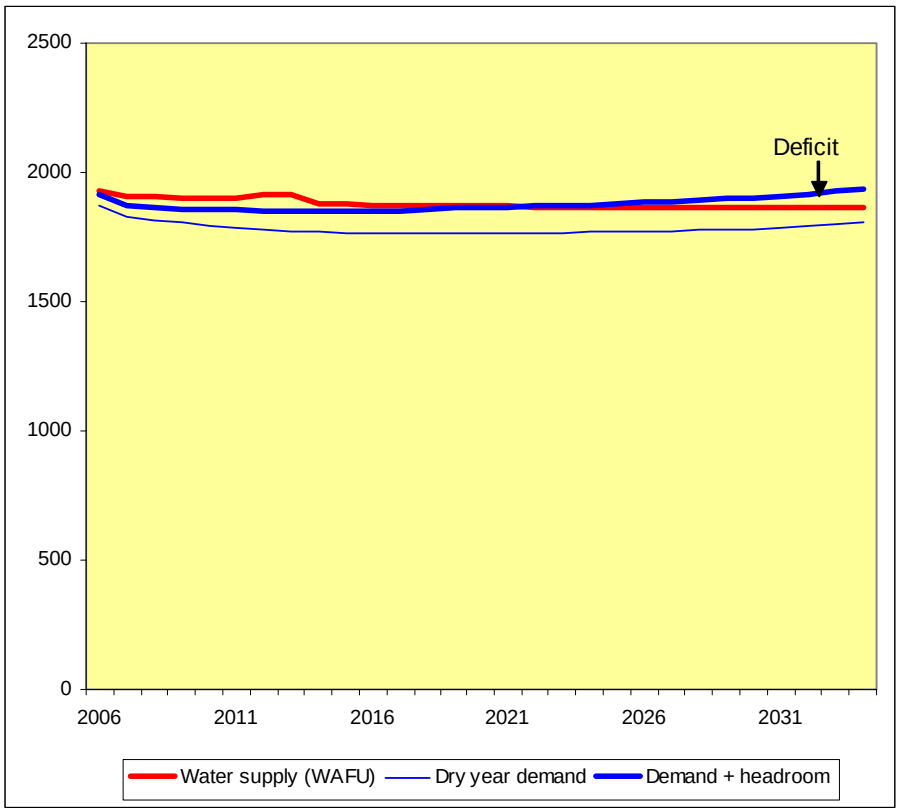


Figure 10.2. Initial supply-demand balance for Carlisle Zone (Ml/d)

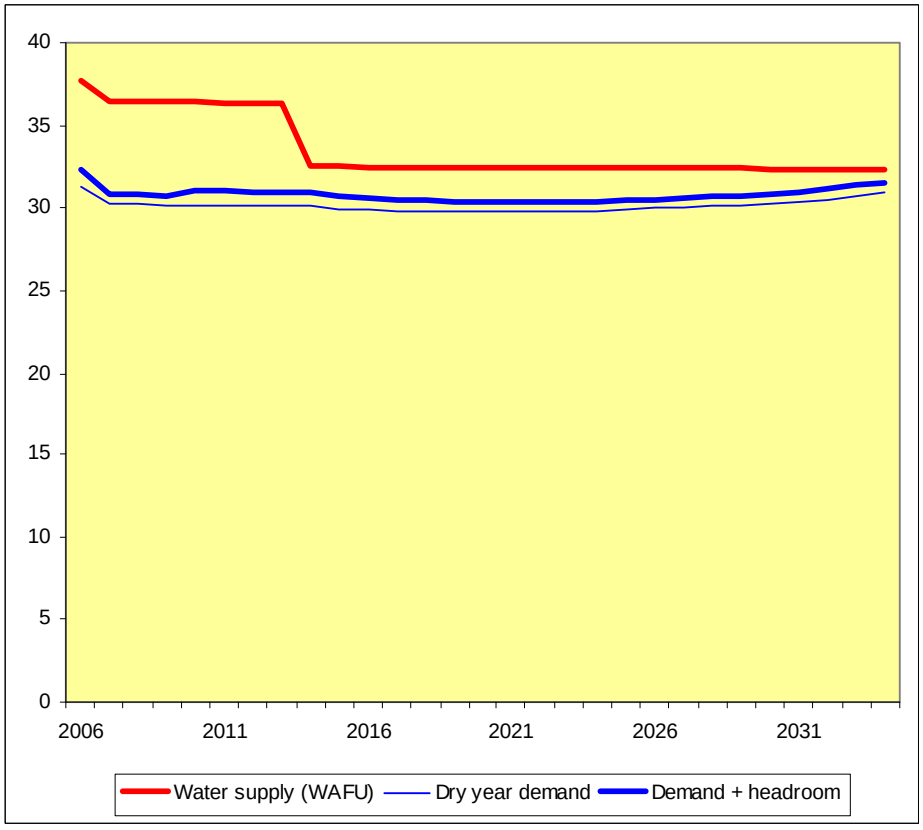


Figure 10.3. Initial supply-demand balance for North Eden Zone (Ml/d)

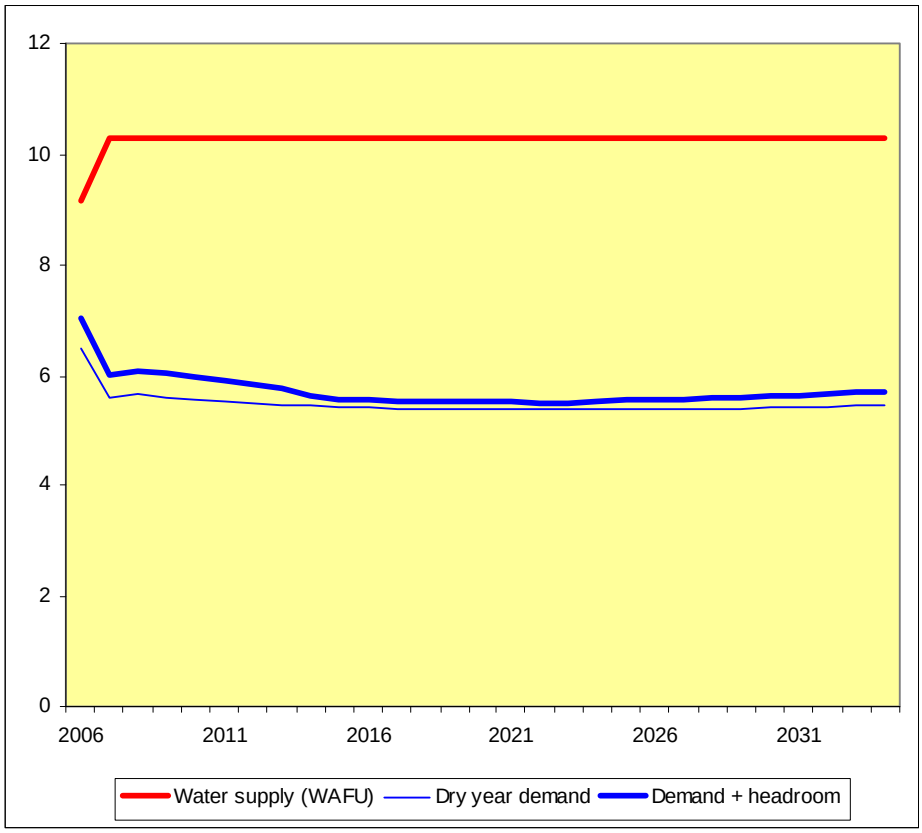
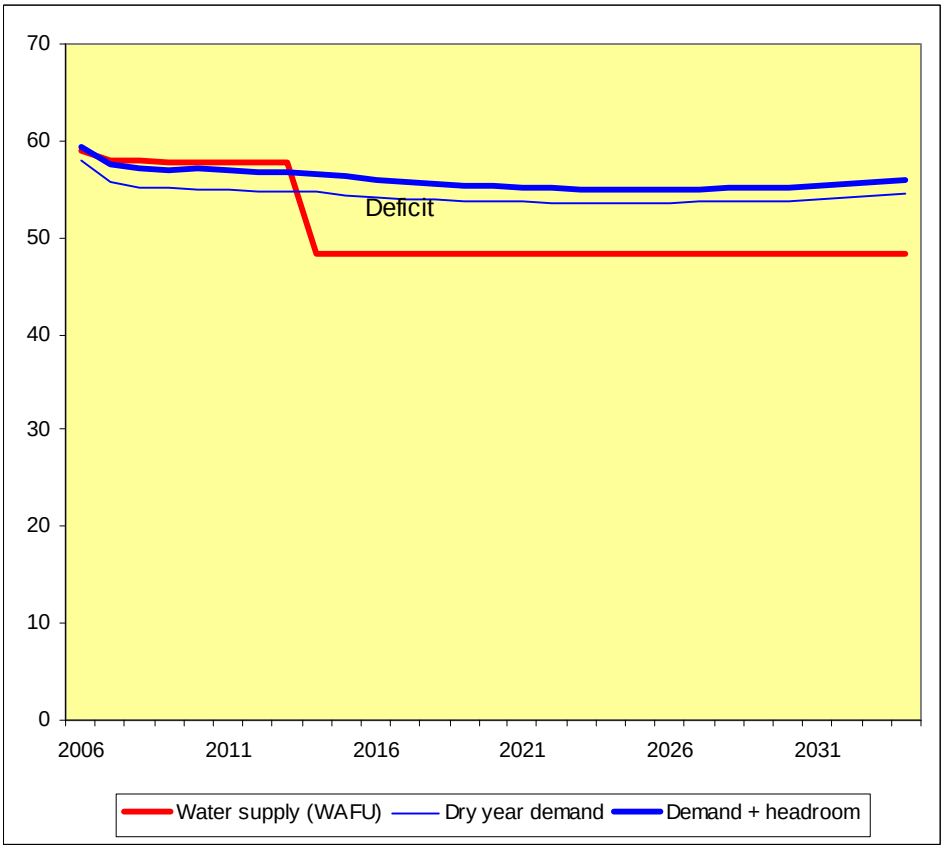


Figure 10.4. Initial supply-demand balance for West Cumbria Zone (Ml/d)



10.3 Implications

The implications of the supply, demand and target headroom forecasts for each resource zone are summarised below.

- **Integrated Resource Zone**
  The Integrated Zone serves over 95% of our customers. The water available for use in this zone is expected to reduce by 24.8 Ml/d between 2009/10 and 2014/15. There will be an increase in 2012/13 of 16.6 Ml/d due to the introduction of the West-to-East Link main. Water availability will then reduce markedly by 2014/15, mainly due to the anticipated 32.9 Ml/d sustainability reductions arising from the proposed abstraction licence changes for our Haweswater and Thirlmere reservoirs and rivers Brennand and Whitendale. There is a need for increasing target headroom over time because of greater uncertainty about potential impacts on our supply and demand forecasts in the longer term.

  A small supply deficit is forecast to occur by 2022/23, and the deficit is expected to increase through the remainder of the planning horizon. A programme of supply-demand solutions will be required from 2022/23 to maintain adequate water supply reliability in the Integrated Zone.

  The original Draft WRMP (published in May 2008) predicted that a deficit of 41.2 Ml/d would occur in 2014/15. We are now presenting a surplus of 30.0 Ml/d at 2014/15 because of the following key changes:-

  - We have substantially reduced (by 87 Ml/d at 2034/35) the allowance for climate change uncertainty in our assessment of target headroom in line with Ofwat's consultation response on the Draft WRMP, and in discussion with the Environment Agency. The effects of climate change remain very uncertain, because of the wide range of predictions from the various global climate models we are required to use, however we accept that it is not appropriate to fully include this uncertainty in our assessment until the scientific knowledge has progressed further. We expect the UK Climate Impact Programme to publish their latest climate projections"UKCP09" in 2009, which will give an enhanced UK assessment of climate change. (See Sections 9.3 and 9.4)

  - We have calculated the benefit of the West-to-East Link main to the water source yield of the Integrated Zone as 16.6 Ml/d, and have included it in our assessment as requested by the Environment Agency. (See Section 5.6)

  - We have reduced our outage allowance by 14.8 Ml/d, due to reassessment using new information, as part of our water source yield calculations. (See Section 5.5)

  - We have included the effect of implementing the recently published mandatory water efficiency targets, which we expect to achieve a 9.1 Ml/d reduction in water use by our customers by 2014/15. (See Section 6.3)

- We have also included the estimated effects on water demand of the severe economic downturn, which we expect to reduce house-building rates and water use by non-households over the next few years. (See Section 7.3)

- **Carlisle Resource Zone**
  A significant reduction in water available for use will occur in 2014/15 as a result of the 3.8 Ml/d sustainability reduction due to the planned changes to our abstraction licence for the River Gelt. However, as a result of the enhancement of the River Eden supply to Carlisle in 2004, water available for use is expected to be adequate to meet forecast demands. No supply deficits are forecast in the Carlisle Zone throughout the planning period. However, Carlisle is a growth-point area and major development is taking place in the next few years that will require the provision of a mains reinforcement scheme to maintain adequate supplies to the development area.

- **North Eden Resource Zone**
  No supply deficits are forecast in the North Eden Zone throughout the planning period. The increase in water availability in 2007 results from the new Tarnwood groundwater source that has recently been commissioned to replace the Nord Vue and Dale Springs sources.

- **West Cumbria Resource Zone**
  A significant reduction in water available for use is expected to occur in 2014/15 as a result of the 9.4 Ml/d sustainability reductions, due to the planned changes to our abstraction licences for Ennerdale Water and Dash Beck (Chapter 5). The expected reductions in non-household demand and leakage will help to minimise the supply deficit that will occur from 2014/15. However, supply-demand solutions will be required to provide 8.3 Ml/d water availability benefit by 2014/15 to maintain adequate water supply reliability in West Cumbria.

  The original Draft WRMP predicted that a deficit of 4.1 Ml/d would occur in 2014/15. We have now identified a deficit of 8.3 Ml/d at 2014/15. A key reason for the increase in deficit is revisions to the sustainability reductions. The Environment Agency has now completed their review of the abstraction licence changes needed at Ennerdale Water and Dash Beck to comply with the EU Habitats Directive. The reduction in the water source yield at Ennerdale Water is 9.4 Ml/d instead of the 8.6 Ml/d previously.

  The supply-demand balance has also been impacted by other changes. The Environment Agency asked us to assess the water source yield of West Cumbria using a combined model instead of separate models for sub-zones, as this would be more accurate, and this has reduced the yield of the zone by 4.0 Ml/d. We have modified our water demand forecasts to take account of the base service water efficiency targets and the economic downturn, and we have reduced the allowance for climate change uncertainty in our target headroom assessment.

Chapter 11. Options

This chapter describes the potential options we have investigated to resolve the forecast supply-demand deficits in the Integrated and West Cumbria water resource zones. The findings are used in Chapter 13 to derive our water resources and demand strategy.

11.1 Need for supply-demand options

Detailed studies have been carried out to identify expected future changes in water supply and demand, as described in preceding chapters. Supply-demand deficits are predicted in our Integrated and West Cumbria water resource zones from 2014/15, as shown in Table 10.1.

Therefore, in order to maintain our preferred level of service (see Section 2.4) we need to undertake actions to increase supply and/or reduce demand in these two zones. If we do not carry out such actions the frequency of water restrictions, such as hosepipe bans, and of environmental drought powers will increase. This would be contrary to the expectations of our customers, the Environment Agency, Ofwat and the Consumer Council for Water.

11.2 Option appraisal methodology

We have followed national best practice to identify and appraise potential supply-demand options.

The main, over-arching methodology is detailed in *Economics of Balancing Supply and Demand* (EBSD [2]) (UKWIR/EA, 2002). The EBSD report sets out a structured approach for identifying, assessing and comparing the alternative options to balance supply and demand throughout the planning period (to 2034/35). The Environment Agency's *Water Resources Planning Guideline* (EA, 2008) expects companies to apply EBSD. We have followed the EBSD methods.

A new requirement to carry out a strategic environmental assessment of the plans in our WRMP has come into force, in accordance with the European Union Strategic Environmental Assessment Directive. The summary of our strategic environmental assessment is presented at Chapter 12. The assessment was carried out in accordance with the guidance issued by the then Office of the Deputy Prime Minister (ODPM, 2005) and UKWIR (2006).

There are several important supporting methodologies which describe specific aspects of the option appraisal process, in particular:-

[2] EBSD = Economics of Balancing Supply and Demand, the name of an important national best practice method.

- *Benefits Assessment Guidance and Valuation for Water Resources and Water Quality Schemes* (EA, 2003) gives guidance on the assessment of the environmental and social costs or benefits associated with each option.

- *A Framework for Valuing the Options for Managing Water Demand* (UKWIR, Defra, EA and Ofwat, 2007) provides details of the best methods for using available evidence on the costs and benefits of possible demand management measures.

- *Providing Best Practice Guidance on the Inclusion of Externalities in the Economic Level of Leakage Calculation* (Ofwat, 2007) describes how to value the environmental and social costs or benefits of leakage reduction options.

Our approach for option appraisal, in accordance with EBSD, strategic environmental assessment and the other methodologies, is set out in this document as follows:-

- Deriving initial supply-demand balances – see preceding Chapters.

- Identifying "unconstrained options" – see Section 11.3.

- Identifying "feasible options" and their costs and benefits – see Sections 11.4 and 11.5.

- Environmental appraisal (applying strategic environmental assessment) – see Chapter 12.

- Deriving a water resources and demand strategy, taking account of the environmental appraisal and customer preferences, as well as costs – see Chapter 13.

Our approach is explained further in Appendix 6, and an outline description of each feasible option is provided in Appendix 7.

11.3 Unconstrained options

The EBSD report provides details of a wide range of different types of option that should be considered, which can be grouped into the four main EBSD categories as follows:-

Distribution management options:

- Customer supply pipe leakage reduction
- Leakage reduction
- Leak detection
- Pressure reduction programmes
- Advanced replacement of infrastructure for leakage
- Distribution capacity expansion
- Diagnostic studies

Customer demand management options:

- Compulsory metering
- Meter installation policy change
- Metering of sewage flow
- Introduction of special fees
- Changes to existing measured tariffs
- Introduction of special tariffs for specific users
- Targeted water conservation information
- Advice and information on direct abstraction and irrigation techniques
- Advice and information on leakage detection and fixing techniques
- Water saving devices
- Recycling and reuse
- Other water efficiency measures (we have reviewed Ofwat's Good Practice Register in considering these)

Production management options:

- Improved leakage detection and reduction on raw water mains
- Recycling of backwash water at water treatment works

Resource management options:

- Direct river abstraction
- New reservoir storage
- Reservoir raising
- Groundwater wells (boreholes)
- Infiltration galleries
- Artificial storage and recovery wells
- Aquifer recharge
- Desalination
- Reclaimed water
- Bulk and raw water transfers
- Tankering of water
- Sophisticated conjunctive management

UU has carefully considered a wide range of possibilities for each of these types of option. The feasibility of these "unconstrained option sets" has been examined to screen out those options that are infeasible, in accordance with the four EBSD criteria:-

- Screen 1 – Does the option address the problem ?
- Screen 2 – Does the option avoid breaching any unalterable constraints ?
- Screen 3 – Is the option promotable ?
- Screen 4 – Is the risk of the option failing acceptable ?

This resulted in the identification of the feasible options for the Integrated Zone and West Cumbria Zone described in Section 11.4.

11.4 Feasible options

The feasible options for the Integrated and West Cumbria zones are summarised in Tables 11.1 to 11.4. An outline description of each feasible option is presented in Appendix 7.

11.4.1 Feasible options

Each feasible option has been examined in detail to assess:

- Potential benefit to water available for use or savings in demand;
- Implementation and operational financial costs;
- Savings in operational costs associated with demand reduction;
- Environmental and social costs and benefits;
- Sustainability of benefits – for example the water savings from many water efficiency options decay as customers replace or remove devices over time.
- Lead-times and strategic implementation; and
- Average incremental social costs (AISC [3]).

The environmental and social costs and benefits of each feasible option have been calculated from a detailed study using best available cost-benefit valuations. The valuations were undertaken by following the detailed methods in *Benefits Assessment Guidance and Valuation for Water Resources and Water Quality Schemes* (EA, 2003). The environmental and social issues evaluated include a wide range of issues, as appropriate for each particular option, such as:-

- Environmental impacts of water supply schemes, during construction and/or during scheme operation, on: biodiversity and non-use values (including impacts on aquatic flora and fauna), informal recreation activities such as walking, cycling or birdwatching; in-stream recreational activities such as boating, canoeing or rowing; other water abstractors; heritage, archaeology and landscape.

- Social impacts of water supply schemes, during construction and/or during scheme operation, due to noise, dust, odour, or time delays to people's journeys as a result of road closures to lay or repair pipelines.

- Increases or reductions in carbon emissions that could result from: abstraction, treatment and distribution of water; fuel consumption of vehicles used in construction, leakage management, or installation of water meters or water efficiency devices; energy use at work sites; emissions from road traffic as a result of diversions or disruptions; embodied carbon in materials used; or changes in water use (and thus changes in energy use) within the home. The effects on carbon emissions have been costed using the Government's shadow price of carbon dioxide (currently £25.4 per tonne carbon dioxide at 2007 prices).

The environmental and social costs and benefits were combined with the financial costs (AIC [3]) to derive the AISC value for each option in accordance with EBSD. AISC is a

[3] AIC = average incremental cost, a key measure of the financial cost of an option.
AISC = Average incremental social cost, a key measure of the overall financial, environmental and social cost of an option.

measure of the overall unit cost of an option and is usually expressed in terms of pence per cubic metre of water (p/m^3). It provides a simple, initial ranking of supply-demand options of different types.

Figures 11.1 and 11.2 show, for each zone, the relative ranking of the "output-based" AISC of each leakage reduction, water efficiency, metering and supply enhancement option according to their overall total environmental, social and financial costs, and the quantity of water that each option can deliver. We have also calculated "utilisation-based" AISC values which relate the costs of each option to the volume of water used, as shown at the end of Appendix 7.

Figures 11.1 and 11.2 also show the potential water volume benefit for each option. For example, the "Pressure reduction stage 1" option for the Integrated Zone (Figure 11.1 and Table 11.1) has a very low unit of 3.7 pence per cubic metre of water and is the most economic leakage reduction option for this zone, but the volume of water saving that it would achieve is relatively small at 1.0 Ml/d.

The AISC values indicate the relative unit costs of the various options but, as explained in the EBSD report, the least-cost solution depends on the optimal schedule of options over time that best satisfy the profile of any supply-demand deficits. Consequently, the most economic plan may not necessarily directly reflect the AISC ranking. In accordance with the EBSD report, a least-cost planning approach using mathematical programming has been applied to derive an optimal schedule of solutions to achieve a supply-demand balance in each water resource zone as discussed in Sections 11.5 and 11.6.

11.4.2 Changes since Draft WRMP

We have made changes to some options since publication of the Draft WRMP on 2nd May 2008, in particular:-

- We have taken account of consultee comments about the feasibility of options or identification of new options.
- We have used the recently produced national water efficiency evidence base to revise the water efficiency options (see below).
- We have reviewed the scope, cost and environmental/social effects of water source and other options to take account of new information.

In autumn 2008 the national water efficiency evidence base was published (Waterwise, 2008), which UU studies contributed to (see Section 6.3). Waterwise used the available evidence to examine five potential generalised scenarios for implementing water efficiency:-

- **Scenario 1. Toilet flush retrofit devices into homes managed by a housing association** – UU's option WE005c is based on this scenario
- **Scenario 2. Retrofit of a basket of water efficiency measures within a single water resource zone** – UU's option WE005a is based on this scenario.

- **Scenario 3. Showerhead retrofit in partnership with an energy supply company** –UU's option WE008 is similar to this scenario, although the method of showerhead deliver and installation has been altered to make the option more economic.

- **Scenario 4. Showerheads retrofit in partnership with a local energy advice centre** – This is similar to Scenario 3, but Waterwise found that it was generally much less efficient; therefore we have not pursued this scenario further.

- **Scenario 5**. **Retrofit of cistern displacement device while undertaking other water company activities** – UU's option WE005b is based on this scenario; however we have modified this option to better align with similar activities proposed as part of the UU baseline water efficiency programme.

Table 11.1. Feasible demand-side options for Integrated Zone

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m3)
Mains replacement (phase 1) (INT 1001) To reduce leakage by replacing mains in areas of high leakage.	1	49.83	2.07	51.9
Mains replacement (phase 2) (INT 1002) To reduce leakage by replacing mains in areas of high leakage.	1	77.67	5.8	83.48
Mains replacement (phase 3) (INT 1003) To reduce leakage by replacing mains in areas of high leakage.	1	105.4	8.01	113.41
Leakage detection and repair (phase 1) (INT 1004) To detect more leaks by employing more detection personnel.	10	28.4	0.31	28.7
Leakage detection and repair (phase 2) (INT 1005) To detect more leaks by employing more detection personnel.	10	33.95	0.34	34.3
Leakage detection and repair (phase 3) (INT 1006) To detect more leaks by employing more detection personnel.	10	41.94	0.39	42.33
Leakage detection and repair (phase 4) (INT 1007) To detect more leaks by employing more detection personnel.	10	53.1	0.45	53.55
Leakage detection and repair (phase 5) (INT 1008) To detect more leaks by employing more detection personnel.	10	69.5	0.53	70.03
Pressure reduction (phase 1) (INT 1009) To reduce leakage by additional pressure management.	1	4.47	-0.03	4.44
Pressure reduction (phase 2) (INT 1010) To reduce leakage by additional pressure management.	0.5	37.23	0.18	37.41
Pressure reduction (phase 3) (INT 1011) To reduce leakage by additional pressure management	0.3	240.17	1.46	241.63
Meter on change of ownership (WE 001) To compulsorily meter 119,900 homes on change of occupier.	3.97	173.63	-17.46	156.17

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m3)
Meter high water users (WE 002) To compulsorily meter 24,000 homes with high water using appliances.	1.22	125.88	-12.26	113.62
Meter non-households (WE 003) To compulsorily meter 14,400 non-households – these have not been previously metered due to difficult pipe layout.	0.85	377.31	-19.08	358.23
Enhanced water savers pack (WE 004a) To issue enhanced self-audit packs to 19,200 customers a year, to encourage water saving actions.	1.46	74.43	-2.03	72.4
Domestic "visit and fix" - dedicated visit (WE 005a) To visit 24,000 volunteer homes to implement water saving measures	1.35	162.08	4.24	166.32
Domestic 'visit and fix' - meter fitting add on (WE005b) To offer newly metered customers (approx 44,100 per annum in 2010-15) an extended water savers audit as part of the Free Meter Option offer.	2.55	68.82	-26.93	41.89
Domestic 'visit and fix' - partner visit (WE 005c) Partner with a housing association to convert 9,600 eligible toilets a year into dual flush using retrofit devices.	0.46	254.63	0.11	254.74
Community audits (WE 006) To provide 190 free water audits for schools and other public institutions a year.	0.41	99.05	0.16	99.21
Subsidised water butts (WE 007) To provide 9,600 customers with a water butt at a discounted price each year.	0.19	475.56	920.62	1396.18
Free water efficient showerheads (WE 008) To provide 9,600 household customers with a free showerhead each year.	1.99	42.85	-40.24	2.61
Rainwater harvesting retrofit (WE 011) To retro-fit a rainwater collection, filtering and recycle system at 48 volunteer homes a year. For use in WC flushing and garden watering.	0.09	1267.26	73.82	1341.08
Promotion of the Free Meter Option (WE 012) The active promotion of the domestic customer Free Meter Option to increase meter take-up by an average 9,600 p.a.	0.96	299.12	-10.44	288.68
Water Efficiency Research - Integrated Zone (WE 100) This option represents anticipated Water Savings from the Water Efficiency research programme during 2010-15 in the Integrated resource zone	0.09	243.38	0	243.38
Other feasible options A range of other demand-side options were identified but not investigated in detail as they were clearly not as efficient as the options listed above. For example the use of greywater recycling (i.e.) the use of bath and shower water for toilet flushing or garden watering) was discarded because of the very high installation and maintenance costs, the very high energy requirements and the potential health risks.				

Notes to Tables 11.1 to 11.4:

- AIC = average incremental cost, a key measure of the financial cost of an option.
- AISC = average incremental social cost of an option. This also includes the environmental and social costs.
- WAFU benefit = For Water Efficiency options WAFU benefit is the maximum benefit over 25 years

Table 11.2. Feasible supply-side options for Integrated Zone

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/m^3)	AISC (p/m3)
Huntington WTW upgrade (INT 003) To increase the capacity of Huntington WTW. The abstraction would be within the existing consented limits.	30	41.27	9.62	50.9
River Ribble abstraction (INT 006) To provide new abstraction and infrastructure to convey raw water to an existing reservoir near Bolton.	17	78.74	11.88	90.62
Manchester Ship Canal (INT 009b) To provide a new abstraction and infrastructure to convey the water via a new potable water treatment works for supply to Trafford Park.	10	87.75	3.38	91.13
Mid-Cheshire groundwater (INT 051) To reinstate use of mid-Cheshire boreholes, involving borehole refurbishment and new pipeline and water treatment works.	5	46.42	0.15	46.57
Widnes groundwater (INT 052) To reinstate use of boreholes near Widnes, involving borehole refurbishment and new pipelines.	22.7	23.48	0.47	23.95
Southport groundwater (INT 054) To reinstate use of boreholes in North Merseyside, involving borehole refurbishment and new pipelines and water treatment works, for supply to Southport area.	22.5	30.6	0.59	31.19
Ribble Valley groundwater (INT 067) To provide a groundwater supply, involving new boreholes and pipelines to convey water to Blackburn.	3.1	62.05	0.07	62.12
North Warrington groundwater (INT 072a) To reinstate use of boreholes north of Warrington, involving refurbishment of borehole and pipelines.	3.0	87.03	0.31	87.34
Warrington groundwater A (INT 073a) To reinstate use of boreholes near Warrington, involving refurbishment of borehole and pipelines.	3.5	61.24	0.59	61.83
Warrington groundwater B (INT 073b) To reinstate use of boreholes near Warrington, involving refurbishment of borehole and pipelines.	3.4	70.3	0.61	70.9
Oldham groundwater (INT 101) To convey minewater, via new pumping station and new pipeline, to a reservoir near Oldham.	2.5	28.52	1.08	29.6
Desalination from Mersey Estuary (INT 079) To provide a new abstraction, desalination plant and pipeline, to provide a new potable water supply to part of Merseyside.	20	49	75.14	124.14
Raw water transfer from Kielder Water (INT 105) To provide new abstraction, pumping stations and pipeline to convey raw water to South Cumbria for treatment.	50	79.49	38.56	118.05
Other feasible options A large number of other feasible river abstraction, reservoir raising, groundwater, desalination or raw water transfer options were also identified. These were not investigated in detail as they were clearly unpromotable or not as efficient or practical as the options listed above.				

Table 11.3. Feasible demand-side options for West Cumbria Zone

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m3)
Mains replacement (phase 1) (WC 1001) To reduce leakage by replacing mains in areas of high leakage.	0.11	225.92	45.01	270.93
Leakage detection and repair (phase 1) (WC 1005) To detect more leaks by employing more detection personnel.	1	29.31	-0.05	29.26
Leakage detection and repair (phase 2) (WC 1006) To detect more leaks by employing more detection personnel.	1	45.23	-0.01	45.22
Leakage detection and repair (phase 3) (WC 1007) To detect more leaks by employing more detection personnel.	1	79.32	0.05	79.37
Leakage detection and repair (phase 4) (WC 1010) To detect more leaks by employing more detection personnel.	1	176.18	0.22	176.4
Pressure reduction (phase 1) (WC 1008) To reduce leakage by additional pressure management.	0.05	29.65	-0.06	29.59
Pressure reduction (phase 2) (WC 1009) To reduce leakage by additional pressure management.	0.03	297.74	1.86	299.6
Meter on change of ownership (WE 001) To compulsorily meter 2,300 households on change of occupancy.	0.08	173.63	-17.46	156.17
Meter high water users (WE 002) To compulsorily meter 500 homes with high water using appliances.	0.02	125.88	-12.26	113.62
Meter non-households (WE 003) To compulsorily meter 300 non-households – these have not been previously metered because of the difficult pipe layout.	0.02	377.31	-19.08	358.23
Enhanced water savers pack (WE 004a) To issue enhanced self-audit packs to 400 customers a year, to encourage water saving actions.	0.03	74.43	-2.03	72.4
Domestic "visit and fix" - dedicated visit (WE 005a) To visit 500 volunteer homes to implement water saving measures	0.03	162.08	4.24	166.32
Domestic 'visit and fix' - meter fitting add on (WE 005b) To offer newly metered customers (approx. 900 per annum in 2010-15) an extended water savers audit as part of the FMO offer.	0.05	68.82	-26.93	41.89
Domestic 'visit and fix' - partner visit (WE 005c) Partner with a housing association to convert 200 eligible toilets a year into dual flush using retrofit devices.	0.01	254.63	0.11	254.74
Community audits (WE 006) To provide 4 free water audits for schools and other public institutions a year.	0.01	99.05	0.16	99.21
Subsidised water butts (WE 007) To provide 200 customers with a water butt at a discounted price each year.	0.004	475.56	920.62	1396.18

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m3)
Free water efficient showerheads (WE 008) To provide 200 household customers with a free showerhead each year.	0.04	42.85	-40.24	2.61
Rainwater harvesting retrofit (WE 011) To retro-fit a rainwater collection, filtering and recycle system at 1 volunteer homes a year. For use in WC flushing and garden watering.	0.002	1267.26	73.82	1341.08
Promotion of the Free Meter Option (WE 012) The active promotion of the domestic customer Free Meter Option to increase meter take-up by an average 200 properties a year	0.02	299.12	-10.44	288.68
Water Efficiency Research - West Cumbria (WE 101) This option represents anticipated Water Savings from the Water Efficiency research programme during 2010-15 in the West Cumbria resource zone	0.24	167.82	0	167.82
Other feasible options A range of other demand-side options were identified but not investigated in detail as they were clearly not as efficient as the options listed above. For example the use of greywater recycling (i.e.) the use of bath and shower water for toilet flushing or garden watering) was discarded because of the very high installation and maintenance costs, the very high energy requirements and the potential health risks.				

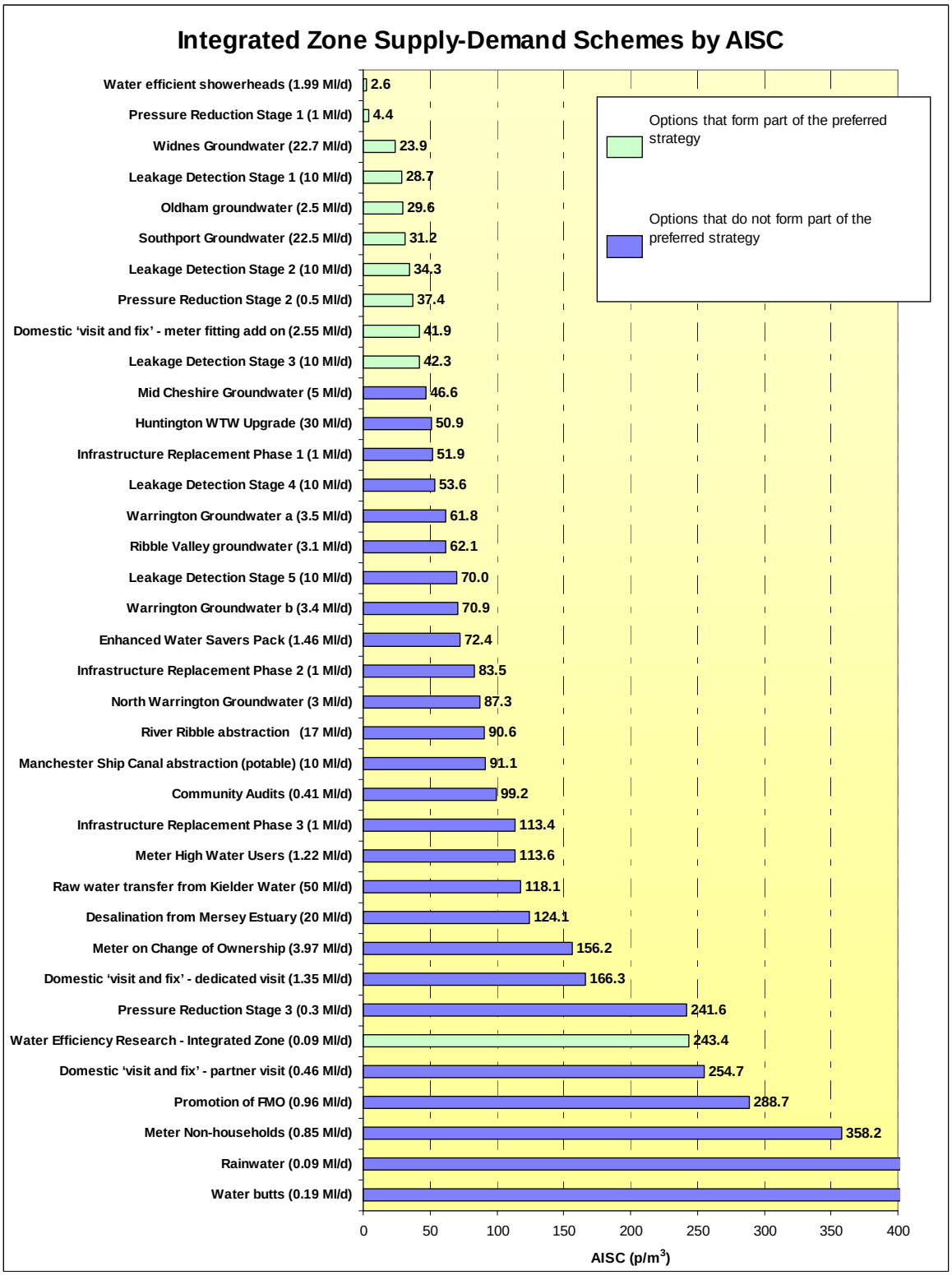
Table 11.4. Feasible supply-side options for West Cumbria Zone

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m3)
River Derwent abstraction (WC002) To construct new water treatment works and pipelines to convey and treat water from River Derwent, within existing abstraction licence limits.	3	125.55	20.26	145.81
South Egremont groundwater (4.6 Ml/d) & Hayborough reinforcement (WC 006b) To construct new boreholes near Egremont, and lay pipelines to convey 4.6Ml/d water to treated water reservoirs, and reinforce mains at Hayborough.	4.6	84.45	7.55	92
South Egremont groundwater (6.4 Ml/d) & Hayborough reinforcement (WC 006c) To construct new boreholes near Egremont, and lay pipelines to convey 6.4 Ml/d water to treated water reservoirs, and reinforce mains at Hayborough.	6.4	63.3	5.7	69
Roughton Gill Mine Adit (WC 007) To reinstate a mine adit near Caldbeck	1.4	39.58	0.39	39.97
Waverton groundwater (WC 008a) To construct new borehole and pipeline to convey water to a water treatment works.	0.7	113.69	7.92	121.61
Thursby groundwater (WC 008b) To construct new borehole and pipeline to convey water to a water treatment works.	1	159.55	6.44	165.99
Raw water from third party (WC015) To construct a new water treatment works and pipelines to convey and treat raw water for supply to West Cumbria.	9.1	84.57	18.86	103.43
Compensation flows (WC 014) To add automatic controls at Crummock Water, reducing overall compensation flow within abstraction licence limits.	1.5	19.95	6.9	26.85
Other feasible options Several other feasible water supply options were also identified, including transfer from Thirlmere reservoir, reinstatement of unused reservoirs, and use of other river, groundwater or minewater sources. These were not investigated in detail as they were clearly not as efficient or practical as the options listed above.				

Note:

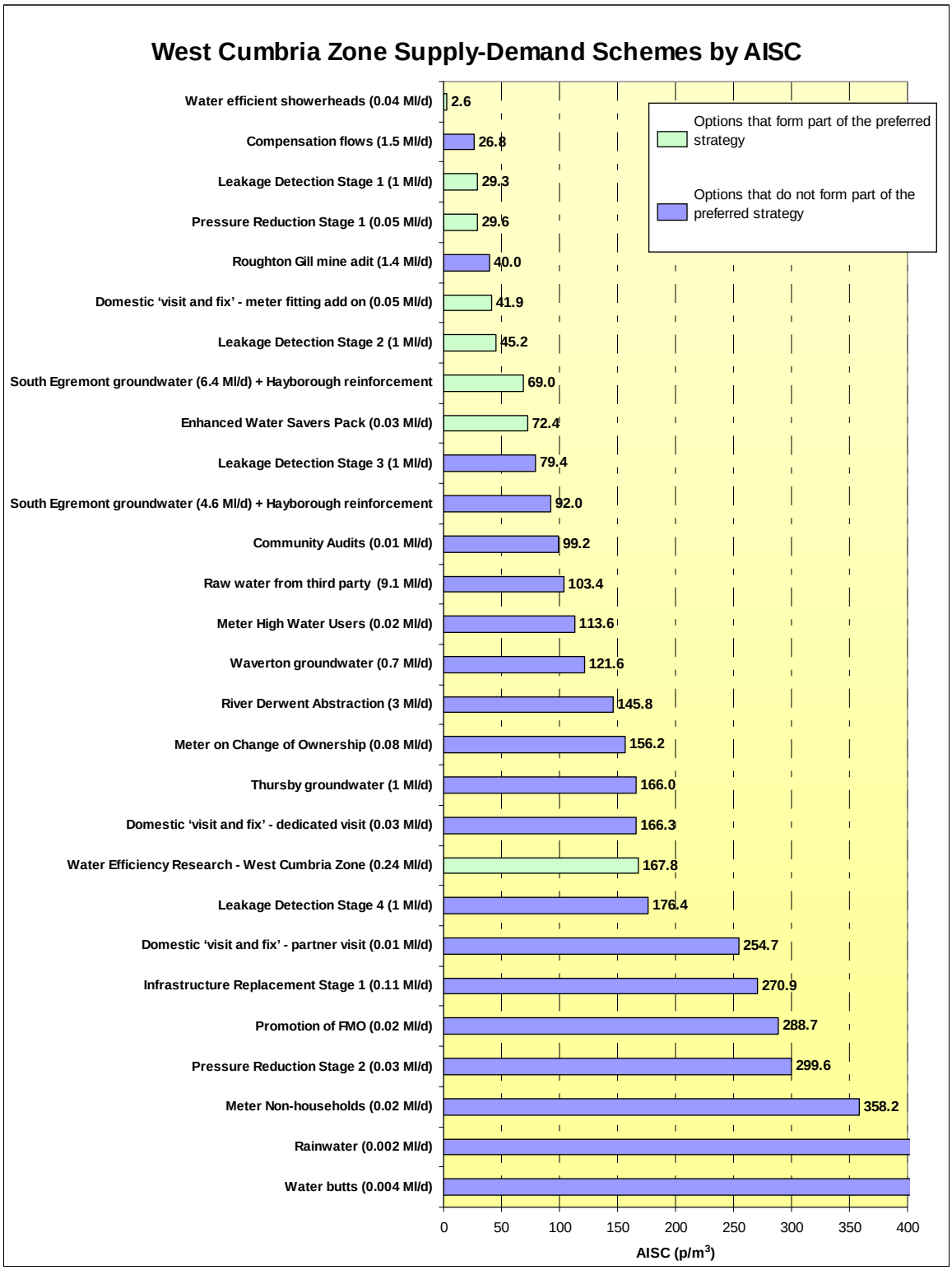
- We have considered two alternative capacities, 4.6 Ml/d and 6.4 Ml/d, for the "**South Egremont groundwater and Hayborough mains reinforcement"** options. They are given their full titles in this Table and in Figure 11.2, but elsewhere in the document are referred to by a shorter name as "**South Egremont groundwater**", which is the main part of the scheme.

Figure 11.1. Ranking of options for the Integrated Zone according to average incremental social cost (pence per cubic metre of water)



Notes: The average incremental social cost (AISC) of an option includes environmental and social effects as well as financial costs.
WAFU benefit = For Water Efficiency options WAFU benefit is the maximum benefit over 25 years

Figure 11.2. Ranking of options for the West Cumbria Zone according to average incremental social cost (pence per cubic metre of water)



Notes: The average incremental social cost (AISC) of an option includes environmental and social effects as well as financial costs.
WAFU benefit = For Water Efficiency options WAFU benefit is the maximum benefit over 25 years

11.5 Comparison of options: Integrated Zone

The options for the Integrated Zone exclude a new reservoir at Borrowbeck in the Lune valley or raising dams, for example at Haweswater or Stocks reservoirs, as the construction of such schemes in North West England is unlikely to be promotable. The consultation responses to our original Draft WRMP indicated that they would be strongly opposed by environmental and local interest groups, and are unlikely to be approved by statutory bodies unless there was overwhelming evidence that there was no feasible alternative. UU has no plans or requirements for such a scheme.

We have identified the **most economic combination of options in Table 11.5**. We assumed that water efficiency research (WE100) would be undertaken during 2010-15, although it has high cost per unit volume of water saved, because of its importance to help identify more cost-effective measures for implementation in the future. It is therefore included in the schedule in Table 11.5, together with the solutions derived by using mathematical programming optimisation. The solution consists of supply enhancement schemes, water efficiency and leakage reduction. It represents the lowest cost (including environmental and social costs as well as financial costs) combination of options.

The environmental appraisal (Chapter 12) considers the environmental issues more widely than through the economic calculation. It confirms that there is no significant overall adverse impact with this solution combination. We have not considered alternative combinations as no schemes are proposed before 2022/23 and we recognise that significant changes will take place in the coming years, in particular implementation of the EU Water Framework Directive, which will impact on our plans when we prepare our 2014 and 2019 WRMPs. Therefore, for this WRMP we have evaluated just the most economic solution in deriving our water resources and demand strategy, as presented in Chapter 13.

11.6 Comparison of options: West Cumbria Zone

In the case of West Cumbria, the least-cost combination of options to provide the 8.3 Ml/d of water supply benefit required would comprise: South Egremont groundwater (6.4 Ml/d); compensation flow control at Crummock Water (1.5 Ml/d) and 0.4 Ml/d of leakage reduction. However, as discussed below, our environmental appraisal has led us to prefer a slightly more costly (in financial terms), but more sustainable, combination of options, which involves more leakage reduction and water efficiency instead of the compensation flow control option.

Table 11.5. Most economic combination of options for Integrated Zone (Ml/d benefit to supply-demand balance)

Option	2014/15	2019/20	2024/25	2029/30	2034/35
Deficit requiring solutions	**none**	**none**	**7.1**	**32.3**	**74.6**
Water efficiency research (WE 100)	<0.1	<0.1	<0.1	<0.1	<0.1
Free water efficient showerheads (WE 008)	0	0	0	1.0	1.5
Domestic 'visit and fix' - meter fitting add on (WE 005b)	0	0	0	0	2.5
Water efficiency total	**<0.1**	**<0.1**	**<0.1**	**1.0**	**4.0**
Leakage reduction by pressure reduction Stages 1 and 2 (INT 1009 & INT 1010)	0	0	0	0	1.5
Leakage detection Stage 1 (INT 1004)	0	0	7.1	8.6	10
Leakage detection Stage 2 (INT 1005)	0	0	0	0	10
Leakage detection Stage 3 (INT 1006)	0	0	0	0	1.3
Leakage reduction total	**0**	**0**	**7.1**	**8.6**	**22.8**
Widnes groundwater (INT 052)	0	0	0	22.7	22.7
Southport groundwater (INT 054)	0	0	0	0	22.5
Oldham groundwater (INT 101)	0	0	0	0	2.5
Supply enhancement total	**0**	**0**	**0**	**22.7**	**47.7**
Total benefit to supply-demand balance (Ml/d)	**<0.1**	**<0.1**	**7.1**	**32.3**	**74.6**

Notes to Table 11.5:

- Values may not sum exactly due to rounding.
- There are no deficits before 2022/23.
- The year of maximum deficit is 2034/35.
- The benefit of the water efficiency programmes are assumed to decay as customers would remove or replace the devices over time.

We have identified three potential combinations of solutions for West Cumbria (as summarised in Table 11.6):-

- **Least-cost combination of options**
  This potential solution consists of the South Egremont groundwater (6.4 Ml/d) and compensation flow control at Crummock Water (1.5 Ml/d) supply enhancement schemes, together with a small amount (0.4 Ml/d) of leakage reduction. It has been derived by using mathematical programming optimisation and represents the lowest cost (including environmental and social costs as well as financial costs) combination of options. The Net Present Value of the total financial, environmental and social costs to implement these options is **£33.0 million**.

- **Preferred combination of options**
  This potential solution comprises the South Egremont groundwater scheme (6.4 Ml/d) and a larger amount (1.9 Ml/d) of water efficiency and leakage reduction. This combination of options is preferred, although it has slightly higher financial costs, because it is more environmentally sustainable. This is supported by our environmental appraisal and the strongly expressed preference by customers, the Environment Agency and other stakeholders that leakage reduction or other demand management options should form a significant part of the overall solution. The water efficiency research project has been included, although it has relatively high cost per unit volume of water, because of its importance to help identify more cost-effective measures for implementation in the future. The Net Present Value of the total financial, environmental and social costs to implement these options is **£34.3 million**.

- **Alternative combination of options**
  Our discussions with the Environment Agency and Natural England, and our option appraisal have led us to conclude that there is no practical alternative to implementing a South Egremont groundwater scheme to overcome a significant part of the predicted supply-demand deficits. No combination of options that excludes South Egremont groundwater can provide enough water to meet the supply-demand deficit without significant increase in cost and/or environmental impact. The most realistic alternative to the "least-cost" or "preferred" combinations therefore comprises a reduced South Egremont groundwater option (4.6 Ml/d) and the compensation flow control at Crummock Water (1.5 Ml/d), together with 2.2 Ml/d of leakage reduction and water efficiency. The Net Present Value of the total financial, environmental and social costs to implement this option is **£36.4 million**.

The summary of the economic analysis is shown in Table 11.7.

The environmental appraisal (Chapter 12) considers the environmental issues more widely than through the economic calculation. It found no significant adverse impact with any of these combinations for West Cumbria, but identified that the "preferred combination" has less environmental concerns. Several consultees who commented on the original Draft WRMP requested that water efficiency and leakage reduction measures should be included alongside source enhancement in West Cumbria. The Environment Agency has informed us that they would be reluctant to consider a new abstraction licence unless we can show that we have included all economic demand-side options. The review of consents for the River Derwent Special Area of Conservation has not yet been completed, and so there is

uncertainty about whether any changes will be made to the abstraction licence for Crummock Water that could impact on the feasibility of the compensation flow control scheme. For these reasons, our proposed solution for West Cumbria comprises economic water efficiency and leakage reduction measures together with the 6.4 Ml/d South Egremont groundwater scheme.

Table 11.6. Summary of the alternative combinations of options for West Cumbria Zone (Ml/d benefit to supply-demand balance at 2014/15)

	Least-cost combination	Preferred combination	Alternative combination
Leakage reduction	0.4	1.6	1.9
Water efficiency		0.3	0.3
South Egremont groundwater	6.4	6.4	4.6
Crummock compensation flow control	1.5		1.5
Total benefit to maintain supply-demand balance at 2014/15	**8.3**	**8.3**	**8.3**

Table 11.7. Net Present Value (NPV) comparison of solutions for the West Cumbria Zone (£m)

	NPV of capital costs	NPV of operational costs	NPV of social and environmental costs	Total NPV
Least-cost combination	25.0	4.8	3.2	**33.0**
Preferred combination	24.1	7.9	2.3	**34.3**
Alternative combination	24.9	8.6	2.9	**36.4**

We have discussed the options available for West Cumbria in detail with the Environment Agency. There are uncertainties associated with each scheme, and the Agency is particularly concerned at the potential impact of some of the source enhancement options on flows in local watercourses. We have carried out environmental assessment desk-studies to investigate potential issues and this has helped to inform our discussions with the Agency, our environmental appraisal and our selection of the preferred combination of options. Although the South Egremont boreholes would be located in the River Ehen catchment they would be downstream of the River Ehen Special Area of Conservation. Abstraction from the boreholes would have a small percentage impact on the flows in the lower River Ehen. But this will be mitigated by the additional water flows released from Ennerdale Water into the upper River Ehen as a result of the abstraction licence changes proposed by the Environment Agency for Ennerdale Water. We will need to carry out further discussions with Natural England and the Environment Agency, and further environmental assessments and borehole testing in order to confirm the suitability of the scheme and the best location for the boreholes. The findings from our work to date indicate that the South Egremont groundwater scheme is the most environmentally preferred source enhancement solution for West Cumbria and, in our view, there is a high probability that the further studies will confirm its suitability.

Chapter 12. Environmental appraisal

This chapter has been derived from the strategic environmental assessment of the WRMP prepared for UU by environmental consultants Entec UK Limited. Strategic environmental assessment is a process that enables identification and assessment of any potentially significant effects associated with a plan.

A copy of the full Environmental Report *Strategic Environmental Assessment of UU's Draft Water Resources Management Plan* (Entec, 2008) and the subsequent *Addendum to the Strategic Environment Assessment Environment Report* (Entec, 2009) are available in electronic form at http://www.unitedutilities.com/WaterResourcesPlan.htm

12.1 Strategic environmental assessment

UU's WRMP identifies the most economic combinations of options in two of their water resource zones, the Integrated and West Cumbria zones, while the Carlisle and North Eden zones are expected to have sufficient supplies to meet demand over the next 25 years.

The process for identifying the most economic combinations of options included consideration of the potential environmental and social costs. In addition, a Strategic Environmental Assessment has also been undertaken. Strategic Environmental Assessment is a statutory process that allows United Utilities to identify and assess the potentially significant environmental effects associated with the implementation of the plan, and, where appropriate, how negative impacts might be mitigated and positive impacts enhanced. The findings of the Strategic Environmental Assessment have been used to check whether the most economic combination of options identified through the standard industry processes are the best from an environmental and social point of view, and whether there are any opportunities to improve their impacts. The findings of the Strategic Environmental Assessment were consistent with other work undertaken by United Utilities, and concurred with the information used in their decision making process. In addition, it has highlighted opportunities to mitigate some of the potential negative and enhance the potential positive impacts of the options as they are taken forward.

12.2 Characterisation of United Utilities' supply area

It is important that any plan, including the WRMP, takes into account the heritage, biodiversity, designated landscapes, and the other key sustainability issues for the region. This includes the need to protect and enhance sites for nature conservation, areas of natural beauty, and cultural heritage sites. Plans will also need to take account of the need to enhance employment opportunities, reduce levels of income deprivation, and provide facilities to meet the needs of local communities. The potential impacts on environmental quality, particularly the contribution to further improvements in air and water quality, and the need for reductions in resource use, transport, and waste, are also important. Based on an analysis of recent relevant information, the key sustainability issues in the region have been identified and are summarised in Table 12.1.

Table 12.1. Summary of the key sustainability issues identified in the Strategic Environmental Assessment

Topics	The key sustainability issues arising from the baseline assessment
Biodiversity	• The need to protect or enhance the region's biodiversity, particularly protected sites designated for nature conservation. • The need to continue to improve the condition of priority habitats to support increases in wildlife, biodiversity and important protected species in the region.
Population and human health	• The need to ensure continued improvements in levels of health across the region, particularly in urban areas. • The need to ensure a balance between different aspects of the built and natural environment that will help to provide opportunities for tourists and local residents. • The need to reduce outward migration, and attract investment to the region to raise employment and levels of income. This is particularly important in Merseyside, but also other key towns in Lancashire and Manchester. • The need to ensure sufficient infrastructure to ensure the gradually rising population does not have a negative impact upon the provision of educational, health and other essential service provision.
Soil, geology and land use	• The need to sustainably manage and/or improve the quality of agricultural land in the region. • The need to make use of previously developed land in urban areas, and to reduce the prevalence of derelict land in the region. • The need to protect the natural beauty of the regions national parks and areas of natural beauty, and encourage the considerate growth of native woodland and forest in the region.
Water	• The need to further improve the quality of the regions river, estuarine and coastal water quality, particularly the biological quality of rivers. • The need to ensure the quality of still waters is maintained or improved. • The need to ensure the continued risk of flooding is mitigated effectively.
Air and climate	• The need to continue to reduce air pollutant and greenhouse emissions arising from industrial processes. • The need to reduce the use of the car, and to reduce localised air pollution and greenhouse gas emissions arising from transport. • The need to take into account and where possible mitigate for the potential effects of climate change.
Material assets and resource use	• The need to reduce the total amount of waste produced in the region, from all sources, and to reduce the proportion of this waste sent to landfill. • The need to reduce overall energy consumption and encourage energy efficiency, particularly energy used for transport and domestic use. • The need to reduce the total amount of water resource used in the region both by managing demand and addressing leakage issues.
Archaeology and cultural heritage	• The need to protect or enhance sites of archaeological importance and cultural heritage interest, taking into account the different types of cultural heritage that occur in rural and urban areas.
Landscape and visual amenity	• The need to protect and improve the natural beauty of the region's national parks, coastline and other areas of natural beauty, and encourage the growth of woodland and forest in the region.

12.3 The approach to assessing the potential impacts of the WRMP

12.3.1 Strategic environmental assessment

The Strategic Environmental Assessment considers the potential impacts of the options that could be included in the WRMP. Each of the feasible options considered by UU and the combinations of options included in the WRMP was assessed against nine objectives that cover the scope of issues identified for inclusion in the Strategic Environmental Assessment. These objectives were developed by considering the sustainability issues identified during the review of baseline information (and summarised in Table 12.1) and the relationship of the WRMP with other relevant plans and programmes, each with their own objectives.

The nine objectives against which each of the options have been assessed are as follows:

1. Economy and employment: To enhance the economic performance of the area and improve the social consequences of economic opportunity;

2. Health: To maintain and improve health and encourage healthy lifestyles;

3. Community wellbeing: To enhance the quality of life in local communities;

4. Landscape and cultural heritage: To protect and enhance natural, built and historic assets for both people and wildlife;

5. Use of water: To encourage efficient water use;

6. Use of other resources, including waste: To encourage the responsible management of natural resources and waste;

7. Water: To protect and improve inland and coastal waters;

8. Energy and climate: To reduce energy use and its impacts, and limit the potential consequences of climate change; and

9. Wildlife and biodiversity: To avoid damage to, and improve, biodiversity.

Under each of these objectives, a series of questions helped to identify the types of issues that need to be considered.

12.3.2 Habitats Regulations Assessment

We have undertaken a Habitats Regulations Assessment of our WRMP, as described below.

The legal advice provided to UU and other water companies identifies that the Habitats Regulations (Conservation (Natural Habitats &c.) Regulations 1994) do not apply to water resources management plans as they are not land use plans. However, UU recognises the importance of protecting habitats designated under the EU Habitats Directive. Therefore

we has met with Natural England and the Countryside Council for Wales to identify what would need to be included in the Environment Report to apply Habitats Regulations Assessment to the WRMP. It was agreed that, in order to fulfil the requirements of a Habitats Regulations Assessment of the WRMP, UU should issue an Addendum to the Environment Report, which should include the following additional information:-

- Statements for each option about the potential significant effects on EU Habitats Directive sites.

- For those schemes that are likely to take place by 2014/15, clear identification of whether an Appropriate Assessment is expected to be required and identification of mitigation opportunities.

- Identification of what the alternative plan would be if consents were not granted.

- For schemes that are not being progressed by 2015, identify why it is not favoured and whether an Appropriate Assessment is likely to be required if the scheme were to be progressed.

These issues are fully addressed in the *Addendum to the Strategic Environmental Assessment Environment Report* (Entec, 2009). We have thereby complied with the requirements of Natural England and Countryside Council for Wales to undertake a Habitats Regulations Assessment of the WRMP.

The only scheme proposed to be implemented by 2014/15 that could impact on a Habitats Directive site is the South Egremont groundwater scheme, which would serve the West Cumbria Water Resource Zone. It involves abstraction of up to 8 Ml/d from the aquifer near to the River Ehen (the water source yield benefit has been assessed as 6.4 Ml/d). The abstraction would not impact on flows in the reaches of the River Ehen that are designated as a Special Area of Conservation but may have a small impact on the flows in the lower River Ehen through which migratory salmon would need to pass. The flow reductions would be mitigated by the additional flow releases from Ennerdale Water into the upper River Ehen as a result of the proposed changes to UU's licence for abstraction from Ennerdale Water. UU is in discussion with Natural England and the Environment Agency, and this has identified that an Appropriate Assessment or other type of environmental assessment is likely to be required to determine whether the scheme could have adverse impact and to identify any further mitigation measures.

During 2008 the Environment Agency and UU have carefully examined a wide range of source enhancement options for West Cumbria, including those listed in Table 11.4. There are limited opportunities available that could provide an adequate quantity of water as many of the watercourses in West Cumbria are in Special Areas of Conservation, the Lake District National Park or other environmentally sensitive locations. Our discussions with the Environment Agency and Natural England have led UU to conclude that the South Egremont groundwater option is the most environmentally preferred water source enhancement option for West Cumbria. There are significant environmental concerns, and high cost impacts, associated with alternative options that could deliver a comparable water source yield, for example: raw water transfer from a third party would involve abstraction (within existing consent limits) from a Special Area of Conservation and more significant construction works; transfer of raw water from Thirlmere Reservoir in the

Integrated Zone would involve construction of a very long pipeline through sensitive locations and significant pumping of the water; and desalination of seawater would cause locally significant impacts and there could be high public concern at the use of water from the Irish Sea.

12.4 The potential impacts of the feasible options

Each of the feasible options was assessed against the objectives to identify its potential impact. These were assessed based on the nature of the effect, its timing and geographic scale, the sensitivity of the people or environmental receptor that could be affected, and how long any effect might last. These were ranked based on the following scale:

Key to the symbols to be used in the relationship column:	
++	Strong positive effect of the Water Resources Management Plan option on this objective
+	Positive effect of the Water Resources Management Plan option on this objective
0	Overall neutral or insignificant effect of the Water Resources Management Plan option on this objective
-	Negative effect between the Water Resources Management Plan option on this objective
--	Strong negative effect of the Water Resources Management Plan option on this objective
?	Uncertain effect of the Water Resources Management Plan option on this objective

Table 12.2 summarises the latest assessment for options in the Integrated Water Resource Zone, and Table 12.3 for the West Cumbria Water Resource Zone. The reasons for the classifications summarised here are provided within the *Addendum to the Strategic Environment Assessment Environment Report*.

The assessment found that the options involving larger programmes of work or yielding more water tended to have the biggest impacts across the range of objectives. This reflected, for example, the greater use of resources and number of people employed during construction, and the more significant effect on security of water supply.

Many of the options have a negative effect on the objectives for resource use, with the larger supply schemes requiring considerable amounts of concrete and steel for construction. Many options were also identified as having a significant effect on energy use, identifying effects through energy embodied in the construction materials, transport during construction and operation, energy required for pumping, and energy savings where there is a reduction in domestic use of hot water. The overall assessment is based on a combination of these issues, although in general, schemes requiring more materials, those relying on pumping and those with a significant number of transport movements scored particularly poorly.

Most of the options are assumed to have negligible impacts on water bodies and wildlife. Since all abstraction from water bodies is licensed by the Environment Agency, it has been assumed that the licence would not have been granted, or would not be granted in the future, if any significant negative impacts would be expected on the local environment. However, if the sites are close to areas designated as particularly important to wildlife, or

if they involve significant construction, they are likely to be subject to further, more detailed, assessment of the potential impacts on wildlife before they could be licensed.

Table 12.2. Summary of feasible options for the Integrated Water Resource Zone

		Water supply (Ml/day)	1. Economy and employment	2. Health	3. Community wellbeing	4. Landscape and cultural heritage	5. Use of water	6. Use of other resources, including waste	7. Water	8. Energy and climate	9. Wildlife and biodiversity
INT105	Raw water transfer from Kielder Water	50	+	+	0	-	0	--	0	--	0
INT 003	Huntington WTW upgrade	30	0	+	-	0	0	-	0	--	?
INT 052	Widnes groundwater	22.7	0	+	0	0	0	-	0	--	0
INT 054	Southport groundwater	22.5	0	+	0	0	0	-	0	--	?
INT 079	Desalination from Mersey estuary	20	+	+	0	0	0	--	-	--	--
INT 006	River Ribble abstraction	17	+	+	0	0	0	--	0	--	0
INT 009b	Manchester Ship Canal abstraction (potable)	10	0	+	0	0	0	--	0	--	0
INT 1004	Leakage Detection - Stages 1	10	0	+	0	0	+	0	0	0	0
INT 1005	Leakage Detection - Stages 2	10	0	+	0	0	+	0	0	0	0
INT 1006	Leakage Detection - Stages 3	10	0	+	0	0	+	0	0	0	0
INT 1007	Leakage Detection - Stages 4	10	0	+	0	0	+	0	0	0	0
INT 1008	Leakage Detection - Stages 5	10	0	+	0	0	+	0	0	0	0
INT051	Mid-Cheshire groundwater	5	0	0	0	0	0	-	0	-	0
WE 001	Meter on change of occupancy	4.0	0	0	0	0	+	-	0	0	0
INT 073a	Warrington groundwater A	3.5	0	0	0	0	0	0	0	-	?
INT 073b	Warrington groundwater B	3.4	0	0	0	0	0	-	0	--	0
INT061	Ribble Valley groundwater	3.1	0	0	0	0	0	0	0	0	0
INT 072a	North Warrington groundwater	3	0	0	0	0	0	0	0	-	?
WE 005b	Visit and fix – meter fitting add-on	2.6	0	0	0	0	+	-	0	++	0
INT 101	Oldham groundwater	2.5	0	0	-	0	0	-	0	0	0
WE 008	Subsidised water efficient shower heads	2.0	0	0	0	0	+	0	0	++	0
WE 004a	Enhanced Water Savers Pack	1.5	0	0	0	0	0	0	0	+	0
WE 005a	Visit and fix – dedicated visit	1.4	0	0	0	0	0	0	0	+	0
WE 002	Meter high water users	1.2	0	0	0	0	+	0	0	0	0
WE 012	Free Meter Option Promotion	1	0	0	0	0	+	0	0	0	0
INT 1001	Infrastructure replacement - Phase 1	1	0	0	0	0	+	-	0	-	0
INT 1002	Infrastructure replacement - Phase 2	1	+	0	0	0	+	-	0	-	0
INT 1003	Infrastructure replacement - Phase 3	1	+	0	0	0	+	-	0	-	0
INT 1009	Pressure Reduction Stage 1	1	0	0	0	0	+	0	0	0	0
WE 003	Meter non-households	0.9	0	0	0	0	0	0	0	+	0
INT 1010	Pressure Reduction – Stages 2	0.5	0	0	0	0	0	0	0	0	0
WE 005c	Visit and fix – partner visit	0.5	0	0	0	0	0	0	0	0	0
WE 006	Community audits	0.4	0	0	0	0	0	0	0	0	0
INT 1011	Pressure Reduction – Stages 3	0.3	0	0	0	0	0	0	0	0	0
WE 007	Water butts	0.2	0	0	0	0	0	-	0	-	0
WE 011	Rainwater harvesting	0.1	0	0	0	0	0	-	0	0	0

Table 12.3. Summary of feasible options for the West Cumbria Water Resource Zone

		Water supply (Ml/day)	1. Economy and employment	2. Health	3. Community wellbeing	4. Landscape and cultural heritage	5. Use of water	6. Use of other resources, including waste	7. Water	8. Energy and climate	9. Wildlife and biodiversity
WC 013	Raw water from third party	9	0	+	-	0	0	-	0	--	?
WC 006c	South Egremont groundwater (6.4Ml/d option)	6.4	0	0	0	0	0	-	0	--	?
WC 006b	South Egremont groundwater (4.5Ml/d option)	4.5	0	0	0	0	0	-	0	-	?
WC 002	River Derwent abstraction	3	0	0	0	0	0	-	0	-	0
WC 014	Compensation flows control	1.5	0	0	0	0	0	0	0	0	?
WC 007	Roughton Gill mine adit	1.4	0	0	0	?	0	0	0	0	0
WC 008b	Thursby groundwater	1.0	0	0	-	?	0	-	0	-	?
WC 1005	Leakage Detection - Stages 1	1	0	0	0	0	+	0	0	0	0
WC 1006	Leakage Detection - Stages 2	1	0	0	0	0	+	0	0	0	0
WC 1007	Leakage Detection - Stages 3	1	0	0	0	0	+	0	0	0	0
WC 1010	Leakage Detection - Stages 4	1	0	0	0	0	+	0	0	0	0
WC 008a	Waverton groundwater	0.7	0	0	?	0	0	0	0	0	?
WC 1001	Mains replacement – Stage 1	0.11	0	0	0	0	0	-	0	-	0
WE 001	Meter on change of occupancy	0.08	0	0	0	0	0	0	0	0	0
WC 1008	Pressure Reduction Stage 1	0.05	0	0	0	0	0	0	0	0	0
WE 005b	Visit and fix – meter fitting add-on	0.05	0	0	0	0	0	0	0	0	0
WE 008	Subsidised water efficient shower heads	0.04	0	0	0	0	0	0	0	+	0
WC 1009	Pressure Reduction Stage 2	0.03	0	0	0	0	0	0	0	0	0
WE 004a	Enhanced water savers pack	0.03	0	0	0	0	0	0	0	0	0
WE 005a	Visit and fix – dedicated visit	0.03	0	0	0	0	0	0	0	0	0
WE 002	Meter high water users	0.02	0	0	0	0	0	0	0	0	0
WE 003	Meter non-households	0.02	0	0	0	0	0	0	0	0	0
WE 005c	Visit and fix – partner visit	0.01	0	0	0	0	0	0	0	0	0
WE 006	Community audits	0.01	0	0	0	0	0	0	0	0	0
WE 007	Subsidised water butts	0.004	0	0	0	0	0	0	0	0	0
WE 011	Rainwater harvesting	0.002	0	0	0	0	0	0	0	0	0

12.5 The potential impacts of the combinations of options

As described in Chapter 11, UU has chosen preferred combinations of options using a standard industry method that includes consideration of technical feasibility, financial costs and benefits, and quantified impacts on the environment and community. The preferred combinations for the Integrated and the West Cumbria zones were chosen to balance the considerations of cost and impacts, and to ensure sufficient water supplies over the next 25 years.

12.5.1 Potential impacts in the Integrated zone

In the Integrated Water Resource Zone, it is anticipated that there will be no deficit until 2022/23. It is expected that leakage reduction and water efficiency options will produce

sufficient yield to meet this deficit until 2025. From 2025, UU has identified the requirement for some enhancement to groundwater supplies through the development of certain supply enhancement options. Table 12.4 presents the potential effects against the objectives of this likely combination of options.

Table 12.4. Summary of the potential impacts of the preferred options for the Integrated zone (to be implemented by 2035)

		Water supply (Ml/day)	1. Economy and employment	2. Health	3. Community wellbeing	4. Landscape and cultural heritage	5. Use of water	6. Use of other resources, including waste	7. Water	8. Energy and climate	9. Wildlife and biodiversity
INT 052	Widnes groundwater	22.7	0	+	0	0	0	-	0	--	0
INT 054	Southport groundwater	22.5	0	+	0	0	0	-	0	--	?
INT 1004, 1005, 1006, 1009, 1010	Leakage reduction	22.8	0	+	0	0	+	0	0	0	0
WE 005b, 008, 100	Water efficiency	4.7	0	0	0	0	+	-	0	++	0
INT 0101	Oldham groundwater	2.5	0	0	-	0	0	-	0	0	0

Given the numerous policy, technological, environmental and regulatory changes that can occur over the long time period to 2025 (which will also include the production a further three WRMPs), it is considered premature to assess any potential combination of options in any further detail at this stage. However, each of these proposed schemes and their potential in-combination effects will be actively reviewed during the preparation of future WRMPs.

12.5.2 Potential impacts in the West Cumbria zone

Table 12.5 summarises the impacts from the preferred combination of options for the West Cumbria water resource zone. The cumulative effects of the preferred options indicate that there could be negative effects associated with material use and habitats but in other regards, against the objectives, the preferred combination of options are not anticipated to cause significant effects. The assessment of energy use in the operation of the South Egremont groundwater option (in Table 12.5, and later in Tables 12.6 and 12.7) does not take account of the decrease in energy use that arise from the associated reduced volumes of water supplied from Ennerdale Water – the overall increase in energy use is very small.

Table 12.5. Summary of impacts of preferred combination of options for the West Cumbria water resource zone (to be implemented by 2015)

		Water supply (Ml/day)	1. Economy and employment	2. Health	3. Community wellbeing	4. Landscape and cultural heritage	5. Use of water	6. Use of other resources, including waste	7. Water	8. Energy and climate	9. Wildlife and biodiversity
WC 006c	South Egremont groundwater (6.4 Ml/d option)	6.4	0	0	0	0	0	-	0	--	?
WC 1005, 1006, 1009	Leakage reduction	1.6	0	0	0	0	+	0	0	0	0
WE 004a, 005b, 008, 101	Water efficiency	0.3	0	0	0	0	0	0	0	+	0

Of the schemes proposed, it is the proposals for South Egremont that could have adverse effects. The option involves the development of several items of new infrastructure which would be visible to local residents; however, such effects could be mitigated by appropriate design and landscaping measures and it is anticipated that planning conditions would require permanent buildings to be designed to complement the surrounding landscape. The scheme would require materials for construction and energy for pumping during operation, and this contributes to the negative impact on resource use and energy. The scheme would lead to abstraction that could affect the river flows of the River Ehen. Recent studies show the effect of abstraction on river flows downstream of the boreholes in the lower river Ehen to be very small. Any reduction in flows would be addressed through abstraction licence changes and a new release regime at Ennerdale Water upstream of the more sensitive upper Ehen, which is in a Special Area of Conservation (SAC). It is likely that a further Appropriate Assessment (under the Habitats Regulations) or other form of environmental assessment will be required. There would need to be more detailed field investigation and risk assessment if the scheme proceeds to the abstraction licensing stage due to the presence of migratory salmonid populations and their role as hosts to part of the freshwater pearl mussel life cycle.

Tables 12.6 and 12.7 summarise the impacts from the "least-cost" and the "alternative" combinations of options for the West Cumbria Water Resource Zone (see Section 11.6). Both of these combinations of options include South Egremont groundwater development and compensation flow control at Crummock Water. In consequence, in addition to the potential effects of the South Egremont groundwater scheme, consideration is also needed of the additional potential effects of the compensation flow control on the River Derwent and Bassenthwaite Lake Special Area of Conservation (through the construction work and changes in flows released to the River Cocker) and disturbance to the Lake District National Park (as Crummock Water is an important and popular site in the National Park). The Environment Agency review of consents process will help to indicate whether the compensation flows option is likely to have an adverse effect, including "in-combination" effects with other plans/projects, on the Special Area of Conservation (which includes the remainder of the River Derwent & Bassenthwaite Lake SAC downstream of the River Cocker). It is likely that a further Habitats Regulations Assessment would be required.

Table 12.6. Summary of impacts of the "least-cost combination" of options for the West Cumbria water resource zone

		Water supply (Ml/day)	1. Economy and employment	2. Health	3. Community wellbeing	4. Landscape and cultural heritage	5. Use of water	6. Use of other resources, including waste	7. Water	8. Energy and climate	9. Wildlife and biodiversity
WC 006c	South Egremont groundwater (6.4Ml/d option)	6.4	0	0	0	0	0	-	0	--	?
WC 014	Compensation flows control	1.5	0	0	0	0	0	0	0	0	?
WC 1005, 1009	Leakage reduction	0.4	0	0	0	0	+	0	0	0	0

Table 12.7. Summary of impacts of an "alternative combination" of options for the West Cumbria water resource zone

		Water supply (Ml/day)	1. Economy and employment	2. Health	3. Community wellbeing	4. Landscape and cultural heritage	5. Use of water	6. Use of other resources, including waste	7. Water	8. Energy and climate	9. Wildlife and biodiversity
WC 006c	South Egremont groundwater (4.6Ml/d option)	4.6	0	0	0	0	0	-	0	--	?
WC 1005, 1006, 1009	Leakage reduction	1.9	0	0	0	0	+	0	0	0	0
WC 014	Compensation flows control	1.5	0	0	0	0	0	0	0	0	?
WE 004a, 005b, 008, 101	Water efficiency	0.3	0	0	0	0	0	0	0	+	0

In consequence, the preferred combination of options for the West Cumbria Water Resource Zone is considered likely to have fewer negative effects than the "least-cost combination" or "alternative combination" of options.

12.5.3 Using the findings of the assessments

The assessments helped to highlight the range of potential environmental and social impacts, including those that had been quantified and those that could only be identified qualitatively. This was used as a check alongside other qualitative and quantitative information, such as the findings of studies of customer preferences, to ensure that there were not significant issues that should affect the combination of options. The assessment outlined in this chapter did not highlight any major effects that UU had not already considered in developing the preferred combinations of options, although it helped to identify where there are more minor effects and how some of the potential negative impacts can be mitigated.

12.6 Mitigation and monitoring

As the plan is implemented, UU will include mitigation measures and monitor the effects of the plan on the environment, thereby helping to ensure that the potential impacts identified in the Strategic Environmental Assessment are considered in practice.

Mitigation measures will be identified as an integral part of developing a scheme, in particular the South Egremont groundwater option as the only new water supply scheme to be implemented in 2010-15. During the detailed planning and design, mitigation measures during and after construction would be informed by the greater detail available about construction techniques, building materials, and agreed locations and routes. As such in many cases a lot of the potential impacts (e.g. disturbance to ecology, landscape or cultural heritage, impacts of noise, visual disturbance, and disruption to footpaths and roads) would be avoided or reduced through good practice, such as avoiding sensitive locations, careful landscaping and reinstatement and use of considerate construction methods. Further environmental assessments may be required to assess the potential positive and negative effects and identify further opportunities to enhance the positive and mitigate the negative effects.

Issues highlighted through the strategic environmental assessment allow for strategic mitigation measures such as recommending schemes like the Considerate Constructors Scheme to help ensure that the patterns of working and methods used during construction minimise nuisance to local communities. With respect to material use, the use of sustainable or recycled materials should be considered, for example using recycled aggregate or plastics, as this will help to minimise the environmental and social impacts of the resource use. Approaches to mitigate the environmental impacts of energy use would be investigated, for example use of the most energy-efficient pumps. Greenhouse gas management strategies, targets and the forthcoming Carbon Reduction Commitment will facilitate this.

One of the primary mechanisms for mitigating the potential impacts of a water supply option is through the abstraction licensing process. Each abstraction from surface or ground waters would make greater use of an existing licence or would require a new licence. These licences are issued by the Environment Agency based on a review of the potential impacts on the environment and the requirement for mitigating measures to be implemented. This strategic environmental assessment has therefore assumed that where abstraction licences have been granted, appropriate mitigation of potential negative impacts on water bodies (for example through low flows or changes in the structures of rivers) and the wildlife that depends on them will have been taken.

Once the Water Resources Management Plan is implemented, its effects on the environment and people will need to be taken into account. UU expect to monitor the effects of the Water Resources Management Plan alongside the other impacts of their operations, and as such, which will include use of existing sources of information that are collected either by UU or by other relevant organisations such as the Environment Agency. In particular UU will closely monitor water abstraction volumes and undertake any necessary environmental monitoring programmes that may be identified as part of the consenting of the abstraction, in order to confirm no significant adverse effect.

United Utilities will continue to liaise with the Environment Agency, Natural England and other stakeholders. Progress on the implementation of the WRMP and identification of any issues arising will reported to the Environment Agency and Ofwat in the water resources plan review that is part of Ofwat's annual June Return process.

12.7 Consultation

The Environmental Report was issued in May 2008 as part of the consultation for the Draft WRMP. The consultation on the Environmental Report sought feedback on the way in which we have considered the potential environmental and social impacts of the options in the Draft WRMP. We asked for any comments relating to the Strategic Environmental Assessment of the Draft WRMP, but we were particularly interested in responses to the questions in the box below.

Does the assessment set out in this Strategic Environmental Assessment Environmental Report identify the most relevant potential impacts of the feasible options?

Are there are other potential impacts that should have been identified that would have affected the choice of preferred options included in the Draft WRMP?

The responses received from consultees are presented in the *Statement of Response to the Consultation on United Utilities' Draft Water Resources Management Plan* (UU, 2009), which describes how we have taken account of the comments received.

Some consultees indicated that the WRMP should include further work to complete a Habitats Regulations Assessment of the plan. We have undertaken a Habitats Regulations Assessment, as described in Section 12.3.2. The assessment is presented in the *Addendum to the Strategic Environmental Assessment Environment Report,* which was published on our website in January 2009.

These documents are available on UU's website at: www.unitedutilities.com/WaterResourcesPlan.htm

Chapter 13. Water resources and demand strategy

This chapter describes our water resources and demand strategy for 2010-15 and beyond.

13.1 Strategic principles

UU's water resources and demand strategy is to undertake the best plan that maintains the water supply reliability standards for our customers, ensures sustainable water abstraction and meets the challenge of climate change.

This strategy has been derived based on the following principles:-

- **Economic.** It is the lowest overall financial, environmental and social cost programme, and minimises impacts on customer water bills. We have considered alternative plans that comprise a greater amount of leakage reduction and water efficiency activity. However these would incur additional costs and do not provide significant environmental or social benefits over and above the most economic solutions. This is because the water source enhancement schemes that have been chosen have generally low environmental or social impacts and would be used infrequently, primarily during prolonged dry weather events.

- **Sustainable.** The need to ensure sustainable water abstraction to protect the environment by reducing water abstraction and carbon dioxide emissions has been a key feature of our plan. For example, we have included significant demand management actions because we believe them to be crucial for long-term environmental sustainability.

- **Compliant.** Our plan complies with statutory requirements and regulatory guidance. It has been prepared in full accordance with national best practice methods.

- **Consistent.** Our plan is fully consistent with UU's *Strategic Direction Statement* which sets out our core principles for our long-term planning, and identifies the need to reduce water demand and carbon consumption.

- **Flexible and robust.** The leakage reduction, water efficiency, customer metering and water source enhancement elements of the strategy can be adapted, added to or reduced in scale if changes take place. There are significant uncertainties associated with the impacts of climate change and the potential for further sustainability reductions in compliance with the European Union Water Framework Directive, that are likely to reduce the yield of some water sources.

It is important that plans are implemented to resolve the forecast supply-demand deficits in the Integrated and West Cumbria resource zones. Otherwise, if deficits remain, water restrictions such as hosepipe bans would occur more frequently than our customers require

and additional abstraction would be required from water sources during drought conditions when river flows and water levels are naturally low.

13.2 Maintaining the supply-demand balance in the Integrated Zone

Our plan to maintain an adequate supply-demand balance for the Integrated Zone, which serves over 95% of our customers, throughout the planning horizon to 2035 comprises "baseline" and "enhanced" plans.

Our baseline plans for already planned activities are:-

- Construction of a bi-directional pipeline, known as the "West-to-East Link", between Merseyside and North Manchester. It is due to be in operation by 2011. This will help us maintain adequate supplies to Greater Manchester and Merseyside if there is a need to temporarily reduce supply from a major reservoir, for example due to maintenance work or drought conditions. This will be an enhancement to our supply network to further increase the integration and flexibility of the supply within the Integrated Zone.

- Maintain current leakage levels.

- Help our customers save 9 Ml/d by 2014/15 (increasing later on to 12 Ml/d), through our base service water efficiency programme.

- Water demand reduction of 10 Ml/d by 2014/15 (increasing to 22 Ml/d by 2034/35) by the household customers that we expect to opt to be metered.

- Non-household customers are expected to reduce water demand by 90 Ml/d by 2014/15 (141 Ml/d by 2034/35) due to the effects of the economic downturn and as part of their continuing water efficiency programmes, which will be encouraged by UU's activities to promote water efficiency.

Our enhanced plans are detailed in Table 11.5 and summarised in Table 13.1. Our economic programme to maintain adequate supply-demand balances has been identified from careful consideration of a wide range of potential options, as described in Chapter 11. The enhanced plans can be summarised as:-

- Further reducing leakage by 23 Ml/d by 2034/25.

- A programme of economic water efficiency measures to save 4 Ml/d by 2034/35.

- Implementing water source enhancement of 48 Ml/d by 2034/35.

Also, we are planning leakage reduction and water efficiency research programmes during 2010-15. Although further leakage reduction and water efficiency activity are not required in 2010-15 to maintain an adequate supply-demand balance, research studies are important to help us identify more cost-effective measures for implementation in the future.

Table 13.1. Water resources and demand strategy for the Integrated Zone (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
WAFU	1931.7	1904.6	1879.8	1871.3	1868.4	1863.6
Dry year weather demand (baseline demand management included)	1873.8	1800.7 (4.0)	1770.6 (19.0)	1765.4 (25.0)	1769.5 (31.1)	1808.7 (36.0)
Target headroom	41.4	53.4	79.3	99.0	106.0	129.5
Initial Supply-Demand Balance (Ml/d)	**16.6**	**50.6**	**30.0**	**6.9**	**-7.1 (deficit)**	**-74.6 (deficit)**
Proposed plan:						
Leakage reduction	n.a.	0	0	0	7.1	22.8
Water efficiency	n.a.	0	<0.1	<0.1	<0.1	4.1
Water source enhancements	n.a.	0	0	0	0	47.7
Final Supply-demand Balance (Ml/d)	**16.6**	**50.6**	**30.0**	**6.9**	**0**	**0**

Notes:

- Values may not sum exactly due to rounding.
- The WAFU values from 2012/13 include 16.6 Ml/d benefit from implementation of the West to East Link Main (see Section 5.6).
- The dry year weather demand includes the effects of our "baseline" leakage reduction, water efficiency plan and customer metering plan (see text).
- The source enhancements included at 2034/35 are Widnes groundwater (22.7 Ml/d), Southport groundwater (22.5 Ml/d) and Oldham groundwater (2.5 Ml/d).

We will also undertake environmental investigations and option appraisals to identify the most appropriate solutions to comply with the future requirements of nature conservation legislation, including the European Union Water Framework Directive.

We expect the implementation of the Water Framework Directive to have a significant effect on our water source yields in the Integrated Zone, and we anticipate that there will be a statutory requirement to undertake widespread compulsory metering of households in the longer term. We have been asked by regulators to exclude these from our main plan. Also we hope that in the longer term leakage reduction and water efficiency will become much more cost-efficient than at present, as a result of future technological advances. We present in Section 13.9 our current view of how this alternative scenario could potentially impact on our water resources and demand strategy for the Integrated Zone.

13.3 Maintaining the supply-demand balance in North and West Cumbria

Carlisle Resource Zone serves the Carlisle local authority area which, in July 2008, was approved by the Government as a Growth Point. We have met with Carlisle City Council to understand the scale and likely locations of housing and commercial development. Although no supply deficits are currently forecast in the Carlisle Zone, the planned changes to abstraction licence conditions for the River Gelt, together with planned new development, will result in a need to invest in new infrastructure to secure adequate water supply reliability in the rural North Carlisle area.

No supply deficits are forecast in the **North Eden Resource Zone** following investment in the 2000-05 period to secure supply reliability.

Therefore, no additional measures are required in the Carlisle and North Eden zones to maintain adequate supply-demand balances. However, our base-service water efficiency programme and free meter option scheme to reduce water demand will continue to apply to these zones as well as the rest of the region.

In the **West Cumbria Resource Zone** we need to implement solutions by 2014/15 to replace water source yield that will be lost due to abstraction licence changes at Ennerdale Water and Dash Beck, as detailed in Chapter 5. The proposed plan comprises "baseline" and "enhanced" plans.

Our "baseline" plans for already planned activities are:-

- Reducing leakage by 3 Ml/d from the 2006/07 level.
- Help our customers save 0.2 Ml/d by 2014/15, through our base service water efficiency programme.
- Water demand reduction in a dry year of 0.1 Ml/d by household customers that will opt to be metered by 2014/15 (increasing to 0.4 Ml/d by 2034/35).
- Non-household customers are expected to reduce water demand by 4 Ml/d by 2034/35 due to the effects of the economic downturn and as part of their continuing water efficiency programmes, which will be encouraged by UU's activities to promote water efficiency.

Our "enhanced" plans identified as our economic programme to maintain adequate supply-demand balances (see Table 13.2) are:-

- Develop a new South Egremont groundwater scheme to enhance water source yield by 6.4 Ml/d.
- Further reducing leakage by 1.55 Ml/d by 2014/15.
- Help our customers save 0.33 Ml/d by 2014/15, through a programme of economic water efficiency measures (0.08 Ml/d) and our research programme (0.24 Ml/d).

The research project has been included, although it has a high cost per volume of water saved, because of its importance to help identify more cost-effective measures for implementation in the future.

The "enhanced" programme is the most economic and sustainable solution (including environmental and social effects as well as financial costs) to achieve a supply-demand balance. We have considered alternative combinations (see Sections 11.6 and 12.5) including one that would incur slightly lower financial costs but is identified as less environmentally sustainable than our preferred plan.

Table 13.2. Water resources and demand strategy for the West Cumbria Zone (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
WAFU	58.9	57.8	48.4	48.3	48.3	48.2
Dry weather demand (baseline demand management included)	57.9	55.0 (3.0)	54.8 (3.3)	53.8 (3.4)	53.6 (3.5)	54.6 (3.6)
Target headroom	1.4	1.9	1.8	1.6	1.4	1.5
Initial Supply-Demand Balance (Ml/d)	**-0.4 (deficit)**	**1.0**	**-8.3 (deficit)**	**-7.1 (deficit)**	**-6.7 (deficit)**	**-7.8 (deficit)**
Proposed plan:						
Leakage reduction	n.a.	0	1.6	1.6	1.6	1.6
Water efficiency	n.a.	0	0.3	0.2	0.1	0.1
Water source enhancements	n.a.	0	6.4	6.4	6.4	6.4
Final Supply-demand Balance (Ml/d)	**-0.4 (deficit)**	**1.0**	**0**	**1.1**	**1.4**	**0.3**

Note:
- Values may not sum exactly due to rounding.
- The dry year weather demand includes the effects of our customer metering plan and our "baseline" leakage reduction and water efficiency plan.

The strategy for West Cumbria has been derived from careful consideration of a wide range of potential options, as described in Chapter 11, in addition to our already planned baseline programmes for leakage reduction, water efficiency and customer metering. There is a high probability that other changes could have an additional impact on the supply-demand balance in West Cumbria. In particular, possible sustainability reduction at Overwater Reservoir and greater climate change impact in the long-term beyond 2035. This reinforces the need for a robust solution for the long-term.

13.4 Leakage reduction

Our appraisal demonstrates that reducing leakage to the levels shown in Table 13.3 is an efficient and integral part of our water resources and demand strategy. We plan to reduce total regional leakage from 468 Ml/d at 2006/07 to 440 Ml/d by 2034/35.

Table 13.3 Leakage reduction plan (Ml/d)

	Integrated Zone	Carlisle Zone	North Eden Zone	West Cumbria Zone	Region
2006/07 (actual)	442.4	4.9	2.4	18.5	468.2
2008/09 (baseline)	441.9	4.8	2.0	15.5	464.2
2014/15	441.9	4.8	2.0	14.0	462.7
2019/20	441.9	4.8	2.0	14.0	462.7
2024/25	433.9	4.8	2.0	14.0	454.7
2034/35	419.0	4.8	2.0	14.0	439.8
Reduction from 2006/07 to 2034/35	23.4	0.1	0.4	4.5	28.4

Note: Values may not sum exactly due to rounding

The reductions in the Integrated Zone totaling 23 Ml/d will be required to maintain the supply-demand balance in this zone. This will be achieved primarily through further enhanced leakage detection and repair by employing additional leak detection personnel, deploying additional leak detection equipment and ensuring that the extra leaks detected are repaired promptly.

Leakage reduction of over 4 Ml/d in West Cumbria from our 2006/07 level is planned to be achieved by 2014/15.

Planning to reduce leakage lower than these levels cannot be justified at the present time. It would require additional cost to that required to maintain our current level of service for water supply reliability (see also Chapter 11), and these costs would result in higher water bills.

We recognise that the extent of proposed leakage reduction is substantially less than the aspiration set out in the UU's *Strategic Direction Statement* (see Chapter 3) for a 20% reduction by 2035 (i.e. to attain total leakage levels of around 375 Ml/d by 2035). There are two key reasons for this. We are not allowed to take account in our WRMP of the potential effects of the European Union Water Framework Directive, by which we expect some of our abstraction licences to be changed and this may further reduce our deployable output by up to as much as 100 Ml/d. Secondly, the costs of further reducing leakage are currently very high and so we propose to carry out mains replacement studies in 2010-15 of the cost-benefit of replacing pipework for leakage reduction purposes. We hope that

this will demonstrate that in the future leakage reduction can be achieved at lower cost than we currently estimate. We anticipate that future WRMPs will project lower leakage levels than we are able to justify at present, in line with the potential position presented in Section 13.9.2.

13.5 Water efficiency

There are three key components of our water efficiency programme for 2010-15:-

- Expansion of our baseline water efficiency activities to meet new Ofwat targets.
- Economically efficient actions to help avoid supply-demand deficits in the Integrated and West Cumbria zones.
- Research programme to investigate innovative water efficiency measures.

13.5.1 Baseline programme

Our extensive baseline water efficiency programme is described in Section 6.3.2. It is being enlarged in order to comply with the new mandatory water efficiency targets set by Ofwat (*Water efficiency targets 2010-11 to 2014-15* (Ofwat, 2008)).

13.5.2 Economically efficient programme

The key elements of the economically efficient programme specifically identified as part of the proposed strategies for the Integrated and West Cumbria zones are:-

- Issue of 1,000 solicited water efficient showerheads free of charge by 2014/15 in the West Cumbria zone.
- To offer all newly metered customers in the West Cumbria zone an enhanced water savers audit (including the fitting of extra water saving devices not included in the normal pack) from 2010.
- Issue of 2,000 solicited enhanced water savers packs free of charge by 2014/15 in the West Cumbria zone.
- Issue of 50,000 solicited water efficient showerheads free of charge by 2034/35 to customers across the region.
- To have in place by 2030 the offer of an enhanced water savers audit for all newly metered customers.

This enhanced programme of work will deliver reductions in demand across the household customer base. The water savings are estimated at 0.1 Ml/d in 2014/15 and 4.2 Ml/d by 2035 as shown in Table 13.4. Our forecasts assume that once introduced these actions would be sustained throughout the planning horizon.

Table 13.4. Demand reduction benefits from the economically efficient actions (Ml/d)

Activity (over 5 years)	Estimated demand reduction at 2014/15 (Ml/d)	Estimated demand reduction at 2034/35 (Ml/d)
Issue 1,000 water efficient showerheads in West Cumbria	0.02	0.04
Offer all newly metered customers in West Cumbria an enhanced water savers audit	0.05	0.03
Issue 2,000 enhanced water savers packs in West Cumbria	0.01	0.00
Issue 50,000 water efficient showerheads to customers across the region	0	1.5
Offer of an enhanced water savers audit for all newly metered customers (from 2030)	0	2.5
Total water saving	**0.1**	**4.2**

Notes:
- Values may not sum exactly due to rounding
- The benefit of water efficiency measures is assumed to decay as customers would remove or replace the devices over time.

13.5.3 Research programme

A significant barrier to the wide use of water efficiency measures by water companies is a lack of clarity around the costs and benefits of water efficiency. Therefore we propose to build on our existing research (and by other parts of the Water Industry), by undertaking an innovative, water efficiency programme during 2010-15. The key components are:-

- **"Green Zone" West Cumbria water efficiency project** (option WE101)
  This is a major water efficiency research project to evaluate the effectiveness of alternative methods of influencing customer behaviour to save water. This is particularly important for the West Cumbria area because of the future water supply shortfall and the challenges of influencing customers in an area that is normally one of the wettest in England. The key aims are:-

  (a) To achieve a water saving in West Cumbria of over 0.2 Ml/d by 2014/15.

  (b) To determine the form of marketing/advertising customers respond to best.

  (c) To determine how people would prefer to request water efficient devices (return postcard, website, telephone), and which are the most popular water efficiency devices.

  (d) To compare the effect of continual campaigns versus seasonal campaigns.

  (e) To evaluate the costs and issues of implementing such a large scale water efficiency campaign.

(f) To communicate these findings to the wider water efficiency community.

The programme of activities could include marketing and advertising water efficiency via the following methods:-

(a) Direct mailing to every household in West Cumbria with water efficiency messages and information to request free and/or partially subsidised water efficiency devices. Water efficiency messages would be altered between unmeasured and measured houses.

(b) Speaking to customers through a variety of means, such as during meter installations or by telephone whilst customers are paying bills. Customers would be offered free and/or partially subsidised water efficiency devices (request via telephone or website).

(c) Advertising on buses, trains and at stations, or equivalent. Customers would be offered free and/or partially subsidised water efficiency devices (request via telephone or website).

(d) Advertising in the local press. Customers would be offered free and/or partially subsidised water efficiency devices (request via telephone or website).

(e) Target specific non-households with water efficiency messages, including organisations in the education, health, hotel, and restaurant sectors. In addition a number of these non-households could be offered a free/subsidised water audit.

UU would like to undertake this project in partnership with the EA, as a joined-up approach promoting the same messages can yield a number of benefits. We would also welcome collaboration with local authorities, housing associations and local interest groups. We wish to use the results to identify more cost-efficient water efficiency measures for the future.

- **Other research** (option WE100)
  We also plan to carry out other research studies as part of Ofwat's expectations for baseline water efficiency activity, including: **"Model Zero-Carbon" new development project** to consider how the implementation of water efficiency measures in new housing developments can help achieve zero-carbon status through low energy and water consumption; and **Rainwater harvesting project** to investigate the water savings and costs of rainwater harvesting at new non-household properties.

13.6 Customer metering

We will continue to meter all new properties and those households who opt to be metered under our free meter option scheme. Although, in the longer term, we anticipate the introduction of a requirement for practical universal metering by 2034/35, we have excluded this from our plan in accordance with guidance from Ofwat and the Environment Agency as there this no legal power to permit it at present.

As a result we forecast that the number of metered households will increase from 0.6 million at 2006/07 to 2.2 million at 2034/35, and that household meter penetration will increase over that period from 21% to 60% (see Table 13.5 and Section 6.4).

Table 13.6 illustrates the way that our proposed metering programme will impact on water use in the home, with average per capita consumption in normal weather reducing to below 130 litres per person-day by 2034/35.

Table 13.5. Forecast household metering

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Number of metered households ('000)	621	828	1151	1461	1706	2152
Total number of households ('000)	2936	2993	3056	3187	3318	3581
% houses metered	21	28	38	46	51	60

Table 13.6. Trends in average per capita consumption rates (litres per person-day)

	Normal year weather		Dry year weather	
	2006/07	2034/35	2006/07	2034/35
Unmetered households	144	145	154	164
New metered households	118	116	125	129
Optant metered households	128	122	139	135
Compulsory metered households	132	127	142	141
All metered households	122	119	130	132
All households	139	129	149	145

We propose that from April 2010 most newly installed and replacement customer meters will have automated meter read technology. During 2010-15 we will investigate the benefits of automated meter read and "smart meter" technology in improving the data available from water meters, and in particular the merits of different tariffs, such as rising block, that encourage greater water saving.

13.7 Water demand and carbon reductions

Our water resources and demand strategy will result in water demand reducing significantly in the future. The benefits of our strategy in reducing water abstraction and emission of greenhouse gases (due to lower energy use by UU and our customers) is summarised in Tables 13.7 and 13.8.

Table 13.7. Water demand reduction plan – water savings in normal weather year

Programme Type	Activity	Water saving by 2014/15	Water saving by 2034/35
LEAKAGE REDUCTION			
Baseline	Leakage reduction planned to be achieved by 2009/10.	4 Ml/d	4 Ml/d
Enhanced	Further leakage reduction proposed as part of our plans to maintain supply-demand balances in the Integrated and West Cumbria zones.	2 Ml/d	24 Ml/d
	Total water saving	**5 Ml/d**	**28 Ml/d**
WATER EFFICIENCY			
Baseline	Base service programme Water savings to comply with the Ofwat water efficiency targets. Our forecasts include the decay in benefits as customers remove or replace devices over time. The savings associated with publicity and many other activities cannot be reliably assessed and so are not estimated here.	9 Ml/d	12 Ml/d
Enhanced	Economic Programme Implementation of additional showerhead and water audit programmes to help maintain supply-demand balances in the West Cumbria and Integrated zones.	<1 Ml/d	4 Ml/d
	Research Programme Implementation of our 2010-15 water efficiency research programme. The benefit decays as customers remove or replace the devices over time.	<1 Ml/d	<1 Ml/d
	Total water saving (to nearest Ml/d)	**10 Ml/d**	**16 Ml/d**
HOUSEHOLD METERING			
Baseline	Free Meter Option Voluntary opting by an estimated 708,000 further houses to be metered through the free meter option by 2034/35.	10 Ml/d	23 Ml/d
Enhanced	New Tariffs Tariff studies are planned in 2010-15 which may lead to additional water savings by customers in the future, but we cannot quantify these until the studies have been completed.	-	-
	Total water saving	**10 Ml/d**	**23 Ml/d**
NON-HOUSEHOLD DEMAND REDUCTIONS			
Baseline	Industrial, commercial and institutional customers We anticipate that non-household water demand (particularly by industry) will continue to significantly decline. Our publicity and other programmes will help to influence the demand savings but the contribution by UU actions cannot be reliably estimated.	**96 Ml/d**	**157 Ml/d**
OVERALL TOTAL WATER SAVING			
	Including non-household **Excluding non-household**	**122 Ml/d** **26 Ml/d**	**224 Ml/d** **67 Ml/d**

Note: Values may not sum exactly due to rounding.

Table 13.8. Benefit of our water resources and demand strategy by 2034/35

	Reduction in water demand by 2034/35 (Ml/d)	Reduction in carbon dioxide emissions by 2034/35 (tonnes CO_2e per day)		
		By UU (on water supply)	By customers	Total
Leakage reduction	28	4	0	4
Water efficiency	16	3	66	69
Household metering	23	4	95	99
Non-household reductions	157	25	Not estimated	25
Total	224	36	161	197

Notes:

- CO_2e = carbon dioxide equivalent
- Values may not sum exactly due to rounding
- No reliable data are available to enable an estimate to be made of the energy used by non-households in heating, pumping or processing water as it varies enormously between different customers.

We are abstracting less water now than at any time since the 1960s and we expect it to reduce further in the future. Our water resources and demand strategy will reduce average water demand in each water resource zone. It therefore goes beyond the principles of "water neutrality", the concept by which "for every new development, total water use in the region after the development must be equal to or less than total water use in the region before the development".

We expect total water put into supply to reduce by 224 Ml/d between 2006/07 and 2034/35 (in a normal weather year), which is equivalent to 12% of water demand at 2006/07. Our plan will also cut carbon dioxide emissions due to UU's water supply activities by 12% from 305 tonnes carbon dioxide per day in 2006/07 to an estimated 269 tonnes per day in 2034/35. Lower energy use by household customers in heating and using less water will reduce emissions by 161 tonnes per day by 2034/35. There will also be significant savings in energy use and associated carbon impact for wastewater treatment and disposal activities by UU and by our non-household customers.

The emissions of greenhouse gases which resulted from supplying water to our customers in 2006/07 is presented in Table 13.9, whilst Figure 13.1 shows how this is expected to reduce in the future as a result of our water resources and demand strategy. The strategy will therefore make an important contribution to UU's strategic aims to ensure sustainable water abstraction and to reduce the emission of greenhouse gases.

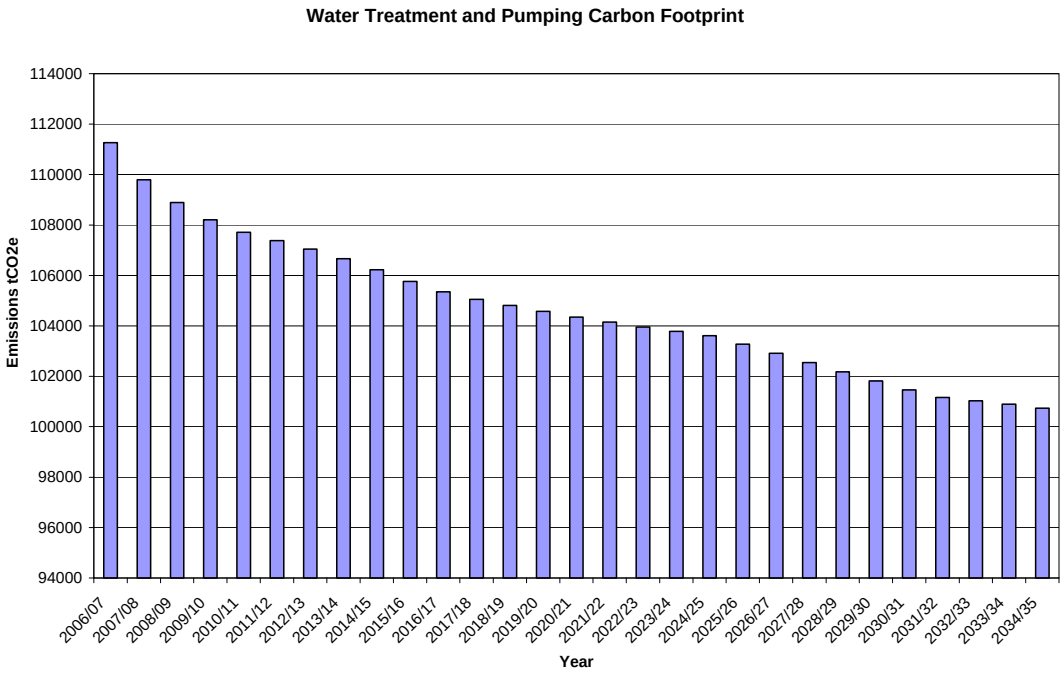
Table 13.9. Greenhouse gas emissions 2006/07

Element	United Utilities Drinking water treatment & pumping tonnes CO_2e per year
Electricity	105,456.5
Natural gas	143.8
Gas oil	1,309.9
Diesel	180.3
Kerosene	18.3
On site renewable energy use attributed to the sale of ROCs	2,813.7
On site renewable energy exported to grid	-0.4
Clean water sludges to land	1,265.1
Clean water sludges to landfill	81.4
Total	**111,268.6**

Notes:

- These figures have been calculated using the 2006/07 data in the new 2007/08 UKWIR Carbon Accounting Tool.
- The volume of clean water supplied in 2006/07 = 692,854 Ml, and so the average emission was 0.161 tonnes CO2e per Ml

Figure 13.1. Emissions of greenhouse gases (tonnes CO_2e per year)



13.8 Research and innovation

There are a variety of considerable challenges and uncertainties that impact on our future water supply and demand. It is therefore important that a range of studies are undertaken to innovate new solutions and to better understand the uncertainties. As a result we plan to carry out the following research during 2010-15 in order to develop more cost-efficient demand reduction action for implementation after 2015:-

- Major water efficiency research programme (see Section 13.5.3) with the key purpose of identifying improved methods for delivering water efficiency programmes during 2015-20.

- Investigate the benefits of mains replacement as a leakage reduction measure. This is important because we are reaching the limit of leakage reduction that can be achieved by detection and repair methods and we need improved ways of replacing mains to make further leakage reduction economic.

- Research into new leakage control technologies including new acoustic leak detection loggers, advanced network modelling techniques and working with manufacturers to develop acoustic microphones suitable for trunk mains.

- Study of supply pipe leakage volumes to update our current assessment by and to investigate the cost benefit of adopting ownership of supply pipes.

- Investigate the benefits of automated meter read and “smart meter” technology in improving the data available from water meters.

- Investigate the benefits of different tariffs that could encourage metered customers to further conserve water, and the potential for social tariffs that assist affordability for customers with low incomes.

- Further improvements to our water resource models, including development of rainfall-runoff models for improved assessment of the climate change impacts on the water source yields in our water resource zones.

- In addition we will continue to actively support national research studies by UKWIR, the Environment Agency and other organisations, in particular work to improve the understanding of climate change or development of cost-effective demand management measures.

13.9 Sensitivity analysis

Our water resources and demand strategy is based on detailed studies, calculations and judgements about future outcomes. It is therefore important to consider the sensitivity of the plan to any changes in order to demonstrate whether the plan is adequately robust and flexible. In particular we have examined:-

- Sensitivity of the supply-demand balances to changes in data (Section 13.9.1).
- Sensitivity of the strategy due to changes in supply-demand balances (Section 13.9.2).
- Sensitivity of the strategy to more detailed assessment of options (Section 13.9.3).

13.9.1 Sensitivity to changes in data

Our forecasts of water source yield, water demand and target headroom have been calculated in full accordance with national best practice. However, there are inevitably uncertainties in our forecasts as there are many things which may occur or change in the future. We have carried out detailed work to quantify possible changes and have included them in our uncertainty analysis to calculate target headroom.

Our assessments of target headroom (see Chapter 9) have quantified the potential effects of a wide range of uncertainties and enable some allowance to be made for them in the supply-demand balance calculations. Two of the key issues that are most critical are the impact of climate change on source yields (see Chapter 8) and uncertainty in future demand. Actual demand for water is likely to vary from forecast levels due to uncertainties about future conditions in North West England outside of UU's control, such as population changes, economic trends, customer expectation, and changes in domestic appliance usage.

The range of potential impacts on supply-demand balance calculations is significant as shown by Tables 13.10 and 13.11. The variation in the potential climate change effects on deployable output is particularly large: although the target headroom allowance makes some allowance for this, there is a risk that the effects will be much larger.

Table 13.10. Sensitivity of regional reduction in deployable output due to different climate change scenarios at 2034/35 (Ml/d)

	Central estimate ("Mid" climate scenario)	Upper estimate ("Dry" climate scenario)	Lower estimate ("Wet" climate scenario)
Estimated impact	-29	-505	139
Difference from Central estimate		-477	168

Note: A negative value represents a reduction increase in water available in our water sources.

Table 13.11. Sensitivity of Regional Baseline Dry Year Demand Forecast to Variations in Key Assumptions

Component	Central Estimate	Upper Demand Scenario Estimate	Effect on Dry Weather Demand at 2034/35	Lower Demand Scenario Estimate	Effect on Dry Weather Demand at 2034/35
Population growth across region from 2006/07 to 2034/35	13%	20%	+ 51 Ml/d	8%	- 38 Ml/d
Free meter option take-up (to 2034/35)	700,000	500,000	+ 5 Ml/d	1,000,000	- 7 Ml/d
Compulsory metering (from 2020/21 to 2034/35)	No compulsory metering	No compulsory metering	Nil	1.2 million	-60 Ml/d
Garden watering volume	Central estimates	25% greater	+12 Ml/d	25% lower	-12 Ml/d
Non-household water consumption	Average 1.5% pa reduction	Average 1.0% pa reduction	+ 46 Ml/d	Average 2.0% pa reduction	- 39 Ml/d
Extent of leakage reduction	Central estimates	5 Ml/d greater	+ 5 Ml/d	5 Ml/d lower	-5 Ml/d
Climate change demand scenario	Central scenario	Upper scenario	+ 3 Ml/d	Lower scenario	- 2 Ml/d
Total effects (if all events occurred)			122 Ml/d		- 163 Ml/d

13.9.2 Sensitivity of the strategy due to changes in supply-demand balances

We have carefully prepared our current best estimates of the supply-demand balances in each water resource zone (see Chapter 10 and Section 13.1). However, there are many issues outside of the control of UU that could cause the supply-demand balances to change. This includes changes in data (as discussed in Section 13.9.1) and changes in sustainability reductions.

Our current plan is based on the sustainability reductions that have been identified from the Environment Agency's review of compliance with the European Union Habitats Directive and specific national and local drivers (see Section 5.3). The Agency is continuing with its reviews of our abstraction licences, and so may later identify further proposed changes that we will need to incorporate in our 2014 WRMP.

Moreover, the implementation of the European Union Water Framework Directive over the period to 2027 will potentially result in many more of UU's abstraction licences being changed. In accordance with regulatory guidance we have not included any allowance for this uncertainty in our plan. We have identified however a potential impact of up to 100 Ml/d reduction in our water source yields by 2027.

We expect the implementation of the Water Framework Directive to have a significant effect on our water source yields in the Integrated Zone, and we anticipate that there will be a statutory requirement to undertake widespread compulsory metering of households in the longer term. We have been asked by regulators to exclude these from our main plan. Also we hope that in the longer term leakage reduction and water efficiency will become much more cost-efficient than at present, as a result of future technological advances. We present at Table 13.12 our current view of how this alternative scenario could potentially impact on our water resources and demand strategy for the Integrated Zone.

Table 13.12. Alternative water resources and demand strategy for the Integrated Zone, including: estimated impacts of the Water Framework Directive (WFD); anticipated compulsory household metering in the longer term; and lower cost leakage reduction and water efficiency in the longer term (Ml/d)

	2006/07	2009/10	2014/15	2019/20	2024/25	2034/35
Initial Supply-Demand Balance (Ml/d)	**17**	**51**	**30**	**7**	**-7 (deficit)**	**-75 (deficit)**
Estimated impact of WFD on water source yield				-30	-60	-100
Estimated demand benefit of compulsory metering					18	60
Modified Supply-Demand Balance (Ml/d)	**17**	**51**	**30**	**-23 (deficit)**	**-49 (deficit)**	**-115 (deficit)**
Proposed plan:						
Leakage reduction	n.a.	0	0	10	30	75
Water efficiency	n.a.	0	0	3	5	15
Water source enhancements	n.a.	0	0	10	14	25
Final Supply-demand Balance (Ml/d)	**17**	**51**	**30**	**0**	**0**	**0**

Note: This is an alternative strategy that has been introduced to demonstrate what might happen in the future. It does not form part of our current plan. The extent of water source enhancement is less than in the main plan (Table 13.1) based the assumption here that leakage reduction may become less expensive than currently predicted.

Competition in the water industry has the potential to impact on our WRMP. Under the water-supply licensing regime it is possible for licencees to put water into our network to supply their own customers. There are no such developments at present, and so this WRMP has not made any explicit allowance for the impacts of competition. However, our forecasts for future non-household water demand assume continuation of the past trend for non-household customers to reduce consumption of potable water supplied by UU.

These various causes of uncertainty demonstrate the potential for much larger (or smaller) supply-demand deficits than we have identified and these could clearly impact on the optimal mix of supply and demand schemes that are required.

13.9.3 Sensitivity of the strategy to more detailed assessment of options

The preparation of this WRMP has identified those supply and demand options which are most likely to form part of the overall strategy. The water savings that result from water efficiency programmes is uncertain, and so the proposed water efficiency research will be a valuable means of reducing uncertainty in the future.

We have worked closely with the Environment Agency to review the potential solutions for West Cumbria and have carried out environmental assessment desk-studies of water source options. This has helped us to identify the probable suitability of the South Egremont groundwater option, complemented by demand-side measures. There are inevitably some uncertainties in the yield of new water source options such as South Egremont groundwater. We will carry out borehole testing in the South Egremont area, based on the findings from previous tests, to determine how many boreholes are needed and where they should be located in order to achieve the required water output.

13.9.4 Response to uncertainty

Although we cannot avoid large uncertainties arising from these issues, the following activities are needed to assist efficient water resources planning:-

- There is a clear need for more research to improve the UK's understanding of how climate change will affect rainfall and water source yields.

- The Environment Agency, UU and other parties need to continue to work together to better understand the genuine needs for abstraction licence changes for the protection of the water environment.

- There is a need for UU to carry out studies, such as those listed in Section 13.8, to improve our understanding and reduce uncertainty in our supply forecasts, demand forecasts and benefits of innovative supply-demand options.

- UU's strategy must be flexible to be readily adapted in response to changing information or circumstances.

The existence of these risks reinforces the requirement for our water resources and demand strategy to be flexible and adaptable so that we can respond to issues as they arise or as clarification on them is obtained. A key element of our flexibility is the wide range

of options which could be implemented if required. We will keep our plan under review to ensure that it continues to adapt to changing circumstances.

13.10 Review of WRMP

We have carried out detailed studies to derive this WRMP. However, water resources planning is a dynamic process and UU is committed to ongoing review of the key elements of the WRMP. We have taken account of feedback from consultees and regulatory developments to revise the plan.

Our next statutory WRMP will be the 2014 WRMP, unless significant changes occur that require us to revise the plan earlier. We will review all key elements in preparing the 2014 plan, for example customer preferences for the level of service, new requirements for abstraction licence changes due to implementation of the Water Framework Directive, the impacts of climate change, customer needs for water use, opportunities for demand reduction through leakage control, water efficiency and metering, and potential needs for water supply enhancement.

As part of Ofwat's annual June Return reporting process we will provide an annual update on progress made in implementing the plan. We will also report on issues that the Environment Agency have highlighted in their August 2009 letter to UU where they wish us to progress further improvement.

Chapter 14. Conclusions

UU's water resources and demand strategy ensures that our water supply reliability standards will continue to be achieved across the region over the planning horizon (to 2034/35). It also ensures sustainable water abstraction and meets the challenge of climate change. The key elements of the strategy are described below.

- **Leakage will be reduced** as a vital part of the combination of solutions required to maintain supply-demand balances. Regional leakage will reduce from 468 Ml/d at 2006/07 to 440 Ml/d by 2034/35. This represents the most economic strategy. Alternative plans that involve more leakage reduction and less supply enhancement have been considered and discarded because of the significant additional cost, after taking account of environmental and social effects. Our research programme includes studies to find more cost-effective leakage reduction measures for inclusion in future plans.

- A large region-wide **water efficiency programme** will be carried out, including an increased programme from 2010/11 in line with the newly introduced Ofwat water efficiency targets. In addition we will carry out a large research programme (described in Section 3.5) and implement economic water efficiency schemes when required. We expect the total water saving (including our current baseline activities) to be 10 Ml/d by 2014/15 rising to 16 Ml/d by 2034/35. A larger water efficiency programme cannot be cost-justified at the present time, but our research programme is aimed at identifying more cost-efficient measures for inclusion in future plans.

- We will continue to **install water meters** at all new properties and those households who opt to be metered under our free meter option scheme. We expect that further metering will occur at a total of 822,000 new homes and 708,000 households that opt to be metered by 2034/35, who will save an estimated 23 Ml/d. In the longer term, we anticipate that universal compulsory metering of households will be required but it is not included in our plan as it is not currently permitted.

- We propose that from April 2010 most newly installed customer meters will have **automated meter read technology**. During 2010-15 we will explore the use of 'smart metering' in conjunction with automated meter read to investigate the benefits of these technologies. In particular we will evaluate the merits of better information about patterns in water use and the use of different tariffs, such as rising block tariffs which encourage greater water savings by charging higher volumetric prices for higher consumption levels. We expect to introduce new tariffs by 2015.

- UU is currently planning the construction of a bi-directional pipeline, known as the "**West-to-East link**", between Merseyside and North Manchester. It is due to be in operation by 2012. This will help us maintain adequate supplies to Greater Manchester and Merseyside in the event of needing to temporarily reduce supply from a major reservoir, for example due to maintenance work or drought conditions. This will be an enhancement to our supply network to further increase

the integration and flexibility of the supply within the Integrated Zone.

- In the **Integrated Zone** our water efficiency programme will reduce demand by 9 Ml/d by 2014/15. In addition we are constructing the West-to-East Link main and anticipate significant demand reductions by non-household customers. As a result we currently expect to maintain adequate supply-demand balances until 2021/22 without any further actions. Supply deficits are predicted from 2022/23 and so leakage levels will need to reduce by a further 23 Ml/d by 2034/35, as part of the best value plan to maintain the supply-demand balance. In addition, we will carry out the enhanced water efficiency programme to save 4 Ml/d and redevelop 48 Ml/d of water sources by 2034/35.

- Although no supply deficits are currently forecast in the **Carlisle Resource Zone**, the planned changes to abstraction licence conditions for the River Gelt, together with planned new development in the next few years, result in a need to invest in new infrastructure to secure adequate water supply reliability in the rural north Carlisle area.

- No supply deficits are forecast in the **North Eden Resource Zone** following investment in the 2000-05 period to secure supply reliability.

- In the **West Cumbria Resource Zone** we need to implement solutions by 2014/15 to replace yield that will be lost due to abstraction licence changes at Ennerdale Water and Dash Beck. We already plan to reduce leakage in West Cumbria by 3 Ml/d as part of our current "baseline" leakage plan and to help customers save 0.2 Ml/d through our base-service water efficiency programme. We expect household customers who opt to be metered and non-household customers to reduce their water consumption. In addition a new groundwater scheme of 6.4 Ml/d deployable output together with a further 1.9 Ml/d of water savings through enhanced leakage reduction and water efficiency programmes is required by 2014/15.

- Undertake environmental investigations and option appraisals to identify the most appropriate solutions to comply with the future requirements of nature conservation legislation, including the European Union Water Framework Directive.

Our water resources and demand strategy will significantly reduce water demand. We expect total water put into supply to reduce by 12% between 2006/07 and 2034/35 (in a normal weather year). The strategy will therefore make an important contribution to UU's strategic aims to ensure sustainable water abstraction and to reduce the emission of greenhouse gases.

Our forecast average per capita consumption rate in a normal year at 2030 is 129 litres per person per day, which is consistent with the Government's *Future Water* (Defra, 2008) aspirational ambition of achieving 130 litres per person per day by 2030. However, we anticipate that widespread compulsory metering will become a statutory requirement in the longer term and this will result in even lower levels.

We consider that this plan strikes the appropriate balance between the expectations of our customers for a high standard of water supply security at affordable prices and the need to

protect the environment. There are significant uncertainties about the level of impact of sustainability reductions and climate change on supply-demand balances in the longer term. These issues could result in larger deficits than we are currently forecasting, and so we have ensured our strategy is adaptable to respond to such risks as they arise. In addition we are constructing a new West to East Link main to improve the flexibility and resilience of the water supply in our largest water resource zone. We will be able to review all elements of our supply-demand assessments when we prepare our 2014 WRMP, and will modify our plans as necessary. A key element of our flexibility is the wide range of options that could be implemented if needed, and so our plan can be easily modified or added to if circumstances change or more information becomes available.

We are grateful to consultees for the comments they have made on our Draft Water Resource Management Plan so that we can ensure that our plan takes account of stakeholder views. On 3rd August 2009, the Secretary of State for Environment, Food and Rural Affairs confirmed that UU has adequately taken account of the views of stakeholders, and approved the publication of the Final WRMP.

Part 3.

Appendices

Appendix 1. Glossary

Agency	Environment Agency (EA)
AMP	Asset Management Plan: AMP3 covers the period April 2000 to March 2005, AMP4 covers the period April 2005 to March 2010, etc.
Aquator™	The name of a water resources computer modelling system used by UU.
Average Incremental Social Cost (AISC)	The ratio of present Social Costs over Present Net Value of additional water delivered or reduced demand.
BAP	Biodiversity Action Plan
Baseline Demand Forecast	A demand forecast which reflects a company's current demand management policy but which assumes the achievement of the current agreed target for leakage during the forecast duration, as well as the implementation of the current company Water Efficiency Plan, irrespective of any surplus.
CC Water	Consumer Council for Water
CC Wales	Countryside Commission for Wales
Critical Period	The length of time between a reservoir being full and the reservoir reaching minimum storage during the worst drought on record.
DCLG	Department for Communities and Local Government
Defra	Department for the Environment, Food and Rural Affairs.
Demand Management	The implementation of policies or measures which serve to control or influence the consumption or waste of water. (This definition can be applied at any point along the chain of supply).
Deployable Output	The output of a commissioned source or group of sources or of a bulk supply as constrained by: the environment; abstraction licences; water quality; existing water treatment and supply system capacities.
DETR	Department of the Environment, Transport and the Regions (which no longer exists and many of its functions are now undertaken by the new department Defra).
Distribution Input	The amount of water entering the distribution system at the point of treated water production.

Distribution Losses	Comprises water lost from trunk mains, service reservoirs, distribution mains and communication pipes. Distribution losses = distribution input less water taken.
DMA	District Meter Area – an area (of up to 3000 properties) where the supply to it is continuously monitored.
Dry Year Annual Daily Demand	The level of demand, which is just equal to the maximum annual average, which can be met without the introduction of demand restrictions at any time during the year. This should be based on a continuation of current policies regarding demand management. The dry year demand should be expressed as the total demand in the year divided by the number of days in the year.
EA	The Environment Agency (or the Agency)
EBSD	*Economics of Balancing Supply and Demand* – a key methodology document published by UKWIR in 2002.
ELL	Economic level of leakage, which is being superseded by the concept of "sustainable economic level of leakage" (SELL).
Final Planning Demand Forecast	A demand forecast that reflects a company's preferred policy for managing demand and resources through the planning period, after taking account of all options through economic analysis.
Habitats Directive	The European Union Habitats Directive (92/43/EC) is the instrument through which Member States must identify and protect as "Special Areas of Conservation" (SAC) certain sites that are representative of specified habitats for specific species which are of European importance. It also covers "Special Protection Areas" (SPA) but none are identified as being affected by UU abstractions.
Headroom	Available headroom is the difference (in Ml/d or %) between WAFU (including imported water) and demand at any given point in time. See below for Target Headroom.
Household	A property used as a single domestic dwelling as defined by Ofwat.
Initial Supply-Demand Balance	The difference between WAFU and baseline demand forecast (including target headroom) before any additional demand management measures or source enhancements.
LeakLine	A free telephone number for the public to report leaks to UU.
Level of Service	Reliability of water supply to our customers expressed as the frequency of the imposition of water use restrictions.

Ml/d	Megalitres per day (million litres per day).
Micro-component analysis	The process of deriving estimates of future consumption based on expected changes in the individual components of customer use.
MOSPA™	The name of a water resource simulation and optimisation model used by UU.
NERA	National Economic Research Associates.
Non-household	Properties receiving potable supplies but which are not occupied as domestic premises, i.e. factories, offices, commercial properties, and cattle troughs. They also include properties containing multiple households, which receive a single bill (e.g. block of flats).
Normal Year Annual Daily Demand	The total demand in a year with normal or average weather patterns, divided by the number of days in the year.
Net Present Value (NPV)	Net Present Value of a schedule of costs for a programme. NPV is a very widely used method to combine various costs occurring over a period of time into a single value for comparison with the NPV of an alternative programme.
NRA	National Rivers Authority, which was replaced by the Environment Agency (EA) in 1996.
ODPM	Office of the Deputy Prime Minister
Ofwat	The public name of the Water Services Regulatory Authority, previously called Office of Water Services (the economic regulator of the water industry in England and Wales).
ONS	Office for National Statistics.
Outage	A temporary loss of deployable output due to planned or unplanned events. An outage is temporary in the sense that it is retrievable, and therefore deployable output can be recovered.
PCC	Per capita consumption (in litres per person per day)
Price Review or Periodic Review	A review (normally every 5 years) conducted by Ofwat of water tariffs, price limits, water company investment plans and service levels to customers.
PR09	Price review at 2009 to determine water prices, water company investment plans and service levels for the period 2010-15.

Point of Production	The point where treated water enters the distribution system. Defined as raw water into treatment less treatment works operational use and treatment works losses.
Resource Zone	The largest possible zone in which all resources, including external transfers, can be shared and hence the zone in which all customers experience the same risk of supply failure from a resource shortfall.
SAC	Special Area of Conservation designated under the EU Habitats Directive
SEA	Strategic environmental assessment – see Chapter 12.
SELL	Sustainable economic level of leakage, a concept recently introduced by Ofwat in 2007.
SSSI	Site of Special Scientific Interest
Supply Pipe Losses	Losses that occur from pipes which are the responsibility of the customer.
Sustainability Reduction	Reduction in deployable output of a water source, or group of water sources, due to change in abstraction licence conditions imposed by the Environment Agency to ensure more environmentally sustainable water abstraction.
Target Headroom	Target headroom is the threshold of minimum acceptable headroom, which would trigger the need for total water management options to increase WAFU or decrease demand.
Total Leakage	The sum of distribution losses and customer supply pipe losses.
Total Water Management	All water management activities from source to end use (i.e. resource management, production management, distribution management and customer-side management)
Tripartite Report	The short name often given to the Ofwat, EA and Defra (2002) report: *Future Approaches to Leakage Target Setting for Water Companies in England and Wales*
UKCIP	United Kingdom Climate Impacts Programme.
UKWIR	United Kingdom Water Industry Research Limited .
UU	United Utilities Water PLC, the water company for North West England.
Water Available For Use (WAFU)	The value of Ml/d calculated by the deduction from deployable output of allowable outages and planning allowances in a resource zone.

Water Framework Directive	The European Union Water Framework Directive (2000/60/EC) establishes a strategic "river basin planning" approach to managing the water environment, including achievement of good ecological status in water bodies by 2015. It provides a consistent approach for ensuring compliance with standards and objectives set for protected areas, and implementation of programmes of measures to meet those objectives.
Water Taken Unbilled	Water supplied to customers for legitimate purposes which is unbilled and water taken illegally.
WRc	Water Research Centre
Yield	A general term for the reliable supply of water from a source. More specific, defined terms are used in this document – see Water Available For Use and Deployable Output.

Appendix 2. Bibliography

Consumer Council for Water (2006), *Public perceptions on water use*

Consumer Council for Water (2006), *Using water wisely consumer research*

Department for Communities and Local Government (2006), *Code for Sustainable Homes*

Department for Communities and Local Government (2007), *Water Efficiency in New Buildings*

Department for Communities and Local Government (2007), *Homes for the Future: more affordable, more sustainable*

Department for Communities and Local Government (2007), *New Projections of Households for England and the Regions to 2029*

Department for Communities and Local Government (2008), *Second Round Growth Points: Partnerships for Growth*

Defra (2003), *CCDeW: Climate Change and the Demand for Water* (Report by T E Downing, *et al* for Defra)

Defra (2004), *Principal guidance from the Secretary of State to the Director General of Water Services: 2004 periodic review of water price limits*

Defra (2007), *Water Resources Management Regulations*

Defra (2007), *Consultation on Water Metering in Areas of Serious Water Stress*

Defra (2007), *South West Pilot Scheme on Water Affordability* (Report by WRc for Defra)

Defra (2007), *The Water Resources Management Plan Direction 2007*

Defra (2007), *The Water Resources Management Plan (No. 2) Direction 2007*

Defra (2007), *Statement of Obligations: Information for water and sewerage undertakers and regulators on statutory environmental and drinking water provisions applicable to the water sector in England*

Defra (2008), *Future Water: The Government's Water Strategy for England*

Department of the Environment (1996), *Water Resources and Supply: Agenda for Action*.

Department of the Environment, Transport and the Regions (1999), *Maintaining Public Water Supplies: Ministerial Guidance to the Director-General of Water Services on Issues Arising in the Preparation of Water Resources Plans by the Water Companies of England and Wales*

Entec UK Limited (2008), *Strategic Environmental Assessment of United Utilities' Draft Water Resources Management Plan* (Report for UU)

Entec UK Limited (2009), *Addendum to Strategic Environmental Assessment Environment Report* (Report for UU)

Environment Agency (1997), *Reassessment of Water Company Yields*

Environment Agency (1999), *Planning Public Water Supplies* (Report to the Secretaries of State for DETR and Wales, June 1999)

Environment Agency (2001), *First National Review of Water Company Water Resource Plans* (March 2001)

Environment Agency (2001), *Water Resources for the Future: A Strategy for England and Wales* (March 2001)

Environment Agency (2001), *Water Resources for the Future: A Strategy for North West England* (March 2001)

Environment Agency (2001), *A Scenario Approach to Water Demand Forecasting* (August 2001)

Environment Agency (2003), *Benefits Assessment Guidance and Valuation for Water Resources and Water Quality Schemes* (Report by Risk & Policy Analysts for EA)

Environment Agency (2004), *Maintaining Water Supply*

Environment Agency (2007), Identifying *Areas of Water Stress (Consultation document)*

Environment Agency (2007), *Methods of Estimating Populations and Household Projections*

Environment Agency (2007), *Water for People and the Environment (Consultation on EA's national water resources strategy)*

Environment Agency (2008), *Water Resources Planning Guideline*

Environment Agency (2009), *Water for people and the environment – Water Resources Strategy for England and Wales*

Government Office for the North West (2008), *North West of England Plan: Regional Spatial Strategy to 2021*

House of Commons Environment Committee (1996), *Water Conservation and Supply*

House of Lords Select Committee on Science and Technology (2006), *Inquiry into Water Management*

Institute of Hydrology (October, 1996), *Hydrological Summary of Great Britain*

Mott McDonald (2008), *Headroom Uncertainty Assessment* (Report prepared for UU)

National Rivers Authority (1995), *Surface Water Yield Assessment*

National Economic Research Associates (2003), *The Impact of Household Metering on Consumption: Empirical Analysis* (Report prepared for UU)

North West Regional Assembly (2005), *Draft Submitted Regional Spatial Strategy for North West England*

Office for National Statistics (2008), *2006-based subnational population projections*

Ofwat, EA and Defra (2002), *Future Approaches to Leakage Target Setting for Water Companies in England and Wales* (Known as the "Tripartite Report", prepared by Water Research Centre for Ofwat, EA and Defra)

Ofwat (2007), *Business Plan Guidelines*

Ofwat (2007), *June Return Reporting Requirements*

Ofwat (2007), *Security of supply, leakage and the efficient use of water: 2006-07 report*

Ofwat (2007), *Water efficiency initiatives – Good practice register* (Part of *Security of supply, leakage and the efficient use of water: 2006-07 report*)

Ofwat (2007), *Providing best practice guidance on the inclusion of externalities in the ELL calculation* (Report by RPS Consultants for Ofwat)

Ofwat (2007), *Alternative approaches to leakage target setting* (Report by WRc for Ofwat)

Ofwat (2007), *Leakage methodology review: Variation in per capita consumption estimates* (Report by Tynemarch Systems Engineering for Ofwat)

Ofwat (2007), *Draft guidance on Ofwat expectations on the use of cost-benefit analysis by companies to justify business plans*

Ofwat (2007), *Setting price limits for 2010-15: Framework and approach – a consultation paper*

Ofwat (2008), *Ofwat's future strategy for customer charges for water and sewerage services: a consultation*

Ofwat (2008), *Water supply and demand policy*

Ofwat (2008), *Water efficiency targets 2010/11 to 2014/15*

UK Climate Impacts Programme (2002), *Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report*.

UK Climate Impacts Programme (2009), *Adapting to Climate Change – UK Climate Projections* (sponsored by Defra).

UKWIR/Water Research Centre (1994), *Managing Leakage*

UKWIR/Water Research Centre (1994), *National Metering Trials: Final Report*

UKWIR (1995), *A Methodology for the Determination of Outputs of Groundwater Sources*

UKWIR/National Rivers Authority (NRA) (1995), *Demand Forecasting Methodology*

UKWIR (1995), *Outage Allowance for Water Resource Planning*

UKWIR/Environment Agency (1997), *Forecasting Water Demand Components*

UKWIR (1999), *Best Practice for Unmeasured Per Capita Consumption Monitors*

UKWIR/Environment Agency (2000), *A Unified Methodology for the Determination of Output from Water Resources*

UKWIR/Environment Agency (2001), *Critical Period Groundwater Yield*

UKWIR/Environment Agency (2002), *Economics of Balancing Supply and Demand (EBSD)* (Report by National Economic Research Associates for UKWIR/EA)

UKWIR (2002), *An Improved Method for Assessing Headroom* (Report by Mott McDonald for UKWIR)

UKWIR (2003) *Effect of Climate Change on River Flows and Groundwater Recharge: UKCIP02 Scenarios* (Report by N.W. Arnell for UKWIR)

UKWIR (2003), *A Framework Methodology for Estimating The Impact of Household Metering on Consumption* (Report by National Economic Research Associates for UKWIR)

UKWIR (2003), *Quantification of the Savings, Costs and Benefits of Water Efficiency*

UKWIR (2005), *Towards Best Practice for the Assessment of Supply Pipe Leakage* (Report by Tynemarch Systems Engineering Limited for UKWIR)

UKWIR (2005), *Critical Review of relevant research concerning the effects of charging and collection methods of water demand, different customer groups and debt* (Report by Professor Herrington for UKWIR)

UKWIR (2006), *Peak Water Demand Forecasting Methodology* (Report by Atkins Limited for UKWIR)

UKWIR (2006), *Sustainability of Water Efficiency Measures*

UKWIR (2006), *Effect of Climate Change on River Flows and Groundwater Recharge: A Practical Methodology*

UKWIR (2006), *Strategic Environmental Assessment – Guidance for water resources management plans and drought plans* (Report by Cascade Consulting for UKWIR)

UKWIR (2007), *Effect of Climate Change on River Flows and Groundwater Recharge: Guidelines for resource assessment and UKWIR06 scenarios*

UKWIR (2007), *Effect of Climate Change on River Flows and Groundwater Recharge: A practical methodology for draft recharge and groundwater level impact assessment*

UKWIR, Defra, EA and Ofwat (2007), *A Framework for Valuing the Options for Managing Water Demand*

United Utilities (1999), *Water Resources Plan* (Report to the Environment Agency)

United Utilities (1999), *Report on Solway Water Conservation Programme*

United Utilities (2004), *Water Resources Plan* (April 2004) (Report to the Environment Agency)

United Utilities (2004), *Business Plan* (Report to Ofwat)

United Utilities (2006), *United Utilities' Sustainable Development Policy*

United Utilities (2007), *June Return 2007* (Report to Ofwat)

United Utilities and Liverpool John Moores University (2007), *Water and Energy Efficient Showers*

United Utilities (2007), *Economic Level of Leakage Appraisal* (Report to Ofwat as part of the 2007 June Return)

United Utilities (2007*), Report to the Environment Agency on the Review of Groundwater Source Yields*

United Utilities (2007), *United Utilities Strategic Direction Statement 2010-2035: where we are heading*

United Utilities (2008), *Final Statutory Drought Plan*

United Utilities (2008), *Draft Water Resources Management Plan* (published on 2nd May 2008)

United Utilities (2008), *Efficient Showerhead Offer: Project Report*

United Utilities (2009), *Statement of Response to the Consultation on United Utilities' Draft Water Resources Management Plan*

United Utilities (2009), *Revised Draft Water Resources Management Plan* (published on 31st January 2009)

University of Bath (2006), *Inventory of Carbon and Energy* (Report by G.Hammond and C.Jones)

Water Research Centre (2000), *Towards a National Micro-Component Monitor*

Water Research Centre (2005), *Increasing the Value of Domestic Water Use Data for Demand Management*

Water Research Centre (2007), *Cost-Benefit Analysis of Metering Policies*

Water Services Association, Water Companies Association, Ofwat, Water Research Centre and Department of the Environment (1993), *Final Report of the National Metering Trials Working Group*

Waterwise (2008), *Evidence base for large-scale water efficiency*

Appendix 3. Useful websites

Organisation	Website
Chartered Institute of Water and Environmental Management (CIWEM)	ciwem.org
Consumer Council for Water	ccwater.org.uk
Department for Communities and Local Government (DCLG)	communities.gov.uk
Department for the Environment, Food and Rural Affairs (Defra)	defra.gov.uk
Environment Agency (EA)	environment-agency.gov.uk
North West Regional Assembly (NWRA)	nwra.gov.uk
Ofwat	ofwat.gov.uk
Office for National Statistics (ONS)	statistics.gov.uk
UK Climate Impacts Programme (UKCIP)	ukcip.org.uk
UK Water Industry Research Limited (UKWIR)	ukwir.org
United Utilities (UU)	uuplc.co.uk or unitedutilities.com
Water Research Centre (WRc)	wrcplc.co.uk
Water UK	water.org.uk
Waterwise	waterwise.org.uk

Appendix 4. List of consultees

The following table lists the organisations we were required to consult on the Draft WRMP, in accordance with the *Water Resources Management Plan Regulations* (Defra, 2007). On 2nd May 2008 we sent an electronic copy of the Summary Report to each organisation and inform them of the availability of the full report via UU's website.

On 2nd May 2008 we also sent an electronic copy of the Summary Report to a large number of individuals and other organisations with whom we have had contact on water resources issues and thought they may be interested in the plan.

Full details of the consultation are presented in our Statement of Response, which is available on our website at: www.unitedutilities.com/WaterResourcesPlan.htm

Environment Agency	South Lakeland District Council
Water Services Regulation Authority (Ofwat)	South Ribble Borough Council
Secretary of State for Environment, Food & Rural Affairs	St Helens Metropolitan Borough Council
National Assembly for Wales	Stockport Metropolitan Borough Council
Northwest Regional Development Agency	Tameside Metropolitan Borough Council
Allerdale Borough Council	Trafford Metropolitan Borough
Barrow in Furness Borough Council	Vale Royal Borough Council
Blackburn with Darwen Borough Council	Warrington Borough Council
Blackpool Borough Council	West Lancashire District Council
Bolton Metropolitan Borough Council	Wigan Metropolitan Borough Council
Burnley Borough Council	Wirral Metropolitan Borough Council
Bury Borough Council	Wyre Borough Council
Carlisle City Council	Merseyside Information Service
Cheshire County Council	Association of Greater Manchester Authorities
Chester City Council	Go-Regions
Chorley Borough Council	Lake District National Park Authority
Congleton Borough Council	Peak District National Park Authority
Copeland Borough Council	Snowdonia National Park Authority
Crewe and Nantwich Borough Council	Countryside Commission
Cumbria County Council	Natural England
Eden District Council	Historic Buildings and Monuments Commission for England (English Heritage)
Ellesmere Port and Neston Borough Council	Countryside Council for Wales
Fylde Borough Council	Cadw
Halton Borough Council	British Waterways Board
High Peak Borough Council	Mersey Docks and Harbour Company
Hyndburn Borough Council	Manchester Ship Canal Company
Knowsley Metropolitan Borough Council	Associated British Ports
Lancashire County Council	Heysham Port Ltd
Lancaster City Council	Lancaster Port Commissioners
Liverpool City Council	Cumbria County Council (Workington Harbour)
Macclesfield Borough Council	Whitehaven Harbour Commissioners
Manchester City Council	Consumer Council for Water
Oldham Metropolitan Borough Council	Dee Valley Water Group
Pendle Borough Council	Dwr Cymru
Preston City Council	Northumbrian Water
Ribble Valley Borough Council	Severn Trent Water
Rochdale Borough Council	Yorkshire Water
Rossendale Borough Council	
Salford City Council	
Sefton Council	

Appendix 5. WRMP directions

This Appendix describes how UU has complied with the Government's requirements for the information that should be included in a water resources management plan (WRMP).

The Water Industry Act 1991 as amended by the Water Act 2003

The Water Act 2003 introduced the requirement for statutory water undertakers to prepare WRMPs, which are to include the information as shown in the following text box.

Section 37A(3) of The Water Act 2003:
A water resources management plan shall address in particular─

(a) the water undertaker's estimate of the quantities of water required to meet those obligations;

(b) the measures which the water undertaker intends to take or continue for the purpose set out in subsection (2) above (also taking into account for that purpose the introduction of water into the undertaker's supply system by or on behalf of licensed water suppliers);

(c) the likely sequence and timing for implementing those measures; and

(d) such other matters as the Secretary of State may specify in directions.

We have complied with these requirements as described below.

(a) Quantities of water required

The current and future volumes of water required to meet our obligations to maintain water supplies to our customers are described in Chapter 7 of this WRMP.

(b) Measures required and (c) Timing of measures in a potential drought

The activities undertaken by UU to supply water for use by customers and the timing of actions required in the event of a potential drought are described in Section 4.1 of this WRMP.

(d) Matters specified in directions

The additional requirements in the WRMP directions are discussed below.

Water Resources Management Plan Direction 2007

The Water Resources Management Plan Direction 2007 came into force on 1st May 2007. It sets out the steps a statutory water undertaker must follow with respect to publication and consultation of a draft WRMP, and the publication of its final plan.

The Direction also specifies details that must be included in the WRMP, as shown in the following text box.

Additional matters to be addressed in water resources management plans:

In accordance with section 37A(3)(d), a water resources management plan must include a description of the following matters—

(a) how frequently the water undertaker expects it may need to impose prohibitions or restrictions on its customers in relation to the use of water under each of the following—
(i) section 76;
(ii) section 74(2)(b) of the Water Resources Act 1991(**c**); and
(iii) section 75 of the Water Resources Act 1991;

(b) the appraisal methodologies which the water undertaker has used in choosing the measures it intends to take or continue for the purpose set out in section 37A(2), and its reasons for choosing those measures;

(c) the emissions of greenhouse gases which are likely to arise as a result of each measure which the water undertaker has identified in accordance with section 37A(3)(b);

(d) how the supply and demand forecasts contained in the water resources management plan have taken into account the implications of climate change; and

(e) except where the water undertaker does not supply, and will continue to not supply, water to premises in which, or in any part of which, a person has his home, how the water undertaker has estimated future household demand in its area over the planning period, including the assumptions it has made in relation to population and housing numbers.

We have complied with these requirements as described below.

(a) Frequency of imposing prohibitions or restrictions on customers

The minimum level of service for water supply reliability that UU plans to provide is set out in Section 2.5 of this WRMP. In Section 5.7 we have provided details of how the views of customers and the needs of the environment have been used to determine the preferred level of service, and how we have made improvements in recent years to achieve it. The table below compares the frequency of customer water restrictions that UU plans to achieve with the frequency of such events that have occurred since formation of regional water authorities in 1974 – United Utilities was formed from the regional water authority for North West England (North West Water Authority).

Type of water use restriction	Historic events since 1974	Current level of service frequency
Hosepipe ban (Section 76 of WRA 1991)	1976, 1984 and 1995/96	No more than 1 in 20 years
Prescribed Uses Order (Section 74(2)(b) of RWA 1991)	1976, 1984 and 1995/96	No more than 1 in 35 years
Standpipe or rota cuts Emergency Drought Order (Section 75 of RWA 1991)	None	Never

Note: Prescribed Uses Order (often referred to as a "non-essential use ban") prohibits the water use for specific types of non-essential use. It is a type of "Ordinary Drought Order".

(b) Appraisal methodologies

The appraisal methodologies used in this WRMP to derive the solutions (measures) to maintain adequate water supplies are set out in Chapters 11 and 12, with additional information in Appendix 6.

(c) Emission of greenhouse gases

The substantial reduction in emission of greenhouse gases that are likely to arise from the implementation of our plan are described in Section 13.7. The emissions that could arise from the individual schemes we propose to implement before 2019/20 are summarised as follows:-

Table A. Greenhouse gas emissions

Scheme	Construction including embedded carbon (tonnes CO2e)	Operation (tonnes CO2e per day)
West-to-East Link main	38,000	0.18
South Egremont groundwater	165	0.12
Leakage reduction	22	-0.10
Water efficiency programmes	68	-2.06

Notes:

- The West-to-East Link main is an approved scheme that is being implemented for a variety of purposes, not just to help maintain the supply-demand balance.
- The greenhouse gas emissions for the South Egremont groundwater option does not take account of the decrease in energy use arising from the associated reduced volumes of water supplied from Ennerdale Water – the overall increase in greenhouse gas emission is negligible.

(d) Taking account of the implications of climate change

The implications of climate change on water source yields and water demand are detailed in Chapter 8 of this WRMP, with further information presented in Chapters 5, 7 and 9.

(e) Estimation of future household demand

Our forecasts of population, housing numbers and household demand are presented in Chapter 7 of this WRMP, together with details of the methodologies and the assumptions that have been used.

Water Resources Management Plan (No. 2) Direction 2007

The Water Resources Management Plan (No. 2) Direction 2007 was subsequently amended by the Water Resources Management Plan (No.2) (Amendment) Direction 2007, and came into force on 29th November 2007. It specifies further information that must be included in a WRMP concerning household metering, as shown in the following text box.

Additional matters to be addressed in water resources management plans in relation to charging by reference to volume of water supplied:

In accordance with section 37A(3)(d), a water undertaker shall include in its water resources management plan a description of the following matters—

(a) its estimate of the increase in the number of domestic premises in its area, over the planning period, in respect of which it will be required to fix charges by reference to volume of water supplied to those premises under section 144A;

(b) "where the whole or part of its area has been determined by the Secretary of State to be an area of serious water stress under regulation 4(1) of the Regulations, its estimate of the number of domestic premises which are in that area and in respect of which it will fix charges by reference to volume of water supplied to those premises over the planning period;".

(c) its estimate of the increase in the number of domestic premises in its area (excluding any domestic premises which are included in the estimate referred to in sub-paragraph (b)), over the planning period, in respect of which section 144B(2) will not apply because the conditions referred to in section 144B(1)(c) are not satisfied and in respect of which it will fix charges by reference to volume of water supplied to those premises;

(d) full details of the likely effect of what is forecasted pursuant to sub-paragraphs (a) to (c) on demand for water in its area;

(e) the estimated cost to the water undertaker in relation to the installation and operation of water meters to meet what is forecasted pursuant to sub-paragraphs (a) to (c) and a comparison of that cost with the other measures which it might take to manage demand for water, or increase supplies of water, in its area to meet its obligations under Part III of the Water Industry Act 1991; and

(f) a programme for the implementation of what is forecasted pursuant to sub-paragraphs (b) and (c).

We have complied with these requirements as described below.

(a) Forecast household meter numbers

Our customer metering plan, together with details of the estimated numbers of households that will be metered in the future, is described in Section 6.4.

(b) Compulsory metering in areas of serious water stress

There are no areas of serious water stress in the UU region and so this does not apply to this WRMP.

(c) Forecast household meter numbers not in an area of water stress

Our customer metering plan is set out in Section 6.4 including forecast numbers. They exclude areas of serious water stress as there are no such areas in the UU region

(d) Effect of customer metering

The water savings that are expected from our metering programme are set out in Section 13.7 and Table C (below).

(e) Costs of metering

The costs of metering programmes that are permissible for UU to adopt are described in Chapter 11. Further details of the economics of the statutorily required Free Meter Option (FMO) are considered below, together with a possible enhanced FMO approach. The average incremental social costs (AISCs) can be directly compared with the values for other metering policies that are permitted in the UU region and other water supply-demand options presented in Chapter 11.

UU offers a free water meter to any domestic customer that requests it since the introduction of a FMO scheme for households in April 2000, in accordance with the *Water Industry Act 1999* (whereas a charge had been made previously). The number of customers opting to be metered each year has increased significantly since 2000 due in part to increased awareness of the benefits of the FMO scheme. The main promotional activities by UU have been:-

- Advertisement of the scheme in the leaflet accompanying all 2.3 million unmeasured household customers' bills.
- Advertisement on the UU website.
- Promotion of the scheme in the *Refresh* customer magazine (sent to 300,000 customers) and our *Extracare* customers through our *inTouch* magazine.

The installation of a meter generally results in a reduction in domestic consumption. By further promoting the benefits of metering to some customer groups the uptake of FMO can be significantly increased, and as a result customer demand can be further reduced.

Two options for FMO promotion were reviewed. The first, FMO (natural opting rate) considers the costs and benefits of continuing the baseline FMO programme. The second option, Promotion of FMO, considers more extensive marketing of the FMO scheme to boost interest in the scheme, and as a result installing an extra 10,000 meters per year for five years. The AISC values are summarised in the table below, and are broadly in line with a cross industry comparison of FMO costs and benefits "*Cost-Benefit Analysis of Metering Policies*" (WRc, 2007).

Table B. Options for FMO delivery during 2010-15

Option title and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m^3)
FMO (natural opting rate) (WE 000) Natural domestic FMO requests without extra promotion.	4.64	278.58	-10.42	268.16
Promotion of FMO (WE 012) Additional meters through extra promotion of domestic FMO scheme	1	299.12	-10.42	288.70

It is evident that the extra promotion of the FMO scheme are not economically viable. As a result UU will instead continue with the existing, statutorily required, baseline FMO programme (see Section 6.4). If it becomes necessary we will consider carrying out targeted publicity programmes, but do not plan general further promotion of the scheme as it is not currently an economic approach to maintaining the supply-demand balance.

(f) Meter installation programme

Our region-wide meter installation programme is summarised in Section 6.4. Our methodology and approach for forecasting the numbers of new homes and households opting to be metered is described in Section 7.3. The annual programme to 2019/20 is presented below.

Table C. Annual metering programme

Year	Estimated number of new homes metered	Estimated number of meter optants	Total number of households to be metered	Estimated average water saving (Ml/d)
2007/08 (actual)	25,646	37,734	63,380	0.77
2008/09	18,412	58,850	77,262	1.68
2009/10	9,206	53,544	62,750	2.77
2010/11	12,225	53,544	65,769	3.82
2011/12	15,243	50,170	65,413	4.85
2012/13	18,262	47,298	65,560	5.85
2013/14	21,281	43,008	64,289	6.80
2014/15	24,299	38,103	62,402	7.68
2015/16	33,760	33,480	67,240	8.46
2016/17	33,760	29,223	62,983	9.19
2017/18	33,760	25,846	59,606	9.85
2018/19	33,760	22,878	56,638	10.46
2019/20	33,760	20,333	54,093	11.02

Note: The estimated average water saving presented here refers just to meter optants since 2006/07 and is for normal weather year.

Appendix 6. Option appraisal methodology

Overview

This Appendix describes the approach adopted for each of the 14 stages in the national best practice method for option appraisal. Some of the stages involve key decisions and so these are presented in detail. The information presented here was submitted to the Environment Agency (EA) alongside our Draft WRMP but we have decided to include it as part of the WRMP document in this Final WRMP.

The "Total Water Management" approach has been carried out in accordance with national best practice as detailed in the UKWIR/EA (2002) report *Economics of Balancing Supply and Demand* (EBSD) to assess and compare the alternative options to balance supply and demand during the period 2010/11 to 2034/35. The EBSD report sets out a structured approach for carrying out each stage of the option appraisal, which is consistent with the staged approach, set out in the Environment Agency's *Water Resources Planning Guidelines* (2008).

The EBSD approach to the development of a supply-demand strategy has been applied to each of the four water resource zones (WRZs).

Stage 1: Assemble Supply and Demand Forecasts

Detailed water supply, demand and target headroom forecasts have been produced for each of the four WRZs – see Chapters 5, 7 and 9.

Stage 2: The Planning Problem

Deficits in the supply-demand balance are forecast for the Integrated and West Cumbria WRZs. There is no deficit forecast for Carlisle and North Eden WRZs. Further details can be found in Chapter 10.

Stage 3: Unconstrained Options Set

Unconstrained options sets have been developed for the Integrated and West Cumbria WRZs. The EA has been consulted on the scope of these unconstrained lists. All of the generic option types listed in the EBSD report have been considered. For each WRZ the options have been screened (in order to remove options that clearly cannot form part of the problem solution) according to the following criteria:

Screen 1 - Does the option address the problem?
Screen 2 - Does the option avoid breaching any unalterable constraints?
Screen 3 - Is the option promotable (that is, does it meet customer and regulatory expectations)?
Screen 4 - Is the risk of the option failing acceptable?

The results of this screening are shown for each WRZ in Table D. Those option types that are identified as feasible are "Ticked" (✓) and have been included for economic (including environmental) appraisal. "Crossed" (✗) options are unfeasible. "N/A" options are already implemented as fully as possible.

Table D. Water Resource Zones Unconstrained Options Set

		Screening process				Feasible option	Comments
EBSD option type	**WRZ**	**1**	**2**	**3**	**4**		
Direct River Abstraction	Integrated					✓	Increased abstraction from the River Dee within existing abstraction licence conditions, abstraction from the River Ribble and abstraction from Manchester Ship Canal are potential options and have been considered in the supply-demand economic appraisal.
	West Cumbria					✓	Abstraction from the lower River Derwent is a potential option and has been included in the supply-demand economic appraisal, although there are environmental concerns.
New Reservoir Storage	Integrated			✗			Construction of a new reservoir at Borrow Beck has been considered. However, it has been discarded as there would be overwhelming opposition from environmental groups and the scheme would be unpromotable unless there were no practical alternatives.
	West Cumbria		✗	✗			Construction of a new reservoir would meet overwhelming public resistance and a planning application is unlikely to be accepted unless there were no other practical alternatives. However, we have considered options to bring Cogra or Meadley reservoirs back into use, but they are discarded because of the small quantities of water availability, relative to the high cost of reinstating or refurbishing the infrastructure.
Reservoir Raising	Integrated			✗			Raising Stocks Reservoir and Haweswater Reservoir are potential options. However, they have been discarded as there would be overwhelming opposition from environmental groups and the scheme would be unpromotable unless there were no practical alternatives.
	West Cumbria		✗	✗			Raising of the levels of the following lakes or existing UU impounding reservoirs was considered: Ennerdale Water or Crummock Water, Chapel House or Overwater reservoirs. However such schemes have been discarded as very likely to meet with overwhelming public and environmental opposition.

EBSD option type	WRZ	Screening process 1	2	3	4	Feasible option	Comments
Ground-water Wells (Boreholes)	Integrated					✓	The development of a number of existing groundwater treatment sites and new groundwater sources are potential options and these have been included in the supply-demand economic appraisal.
	West Cumbria					✓	Development of new groundwater wells at South Egremont, Waverton and Thursby are potential options. These options have been included in the supply-demand economic appraisal.
Infiltration Galleries	Integrated	✗					This option offers no significant advantages over direct river abstraction in North West England.
	West Cumbria						
Artificial Storage and Recovery Wells	Integrated	✗					These options offer no advantages over development of groundwater boreholes. There is generally adequate water availability within the existing aquifers and so the need for any recharge in the North West is extremely limited.
	West Cumbria						
Aquifer Recharge	Integrated	✗					
	West Cumbria						
Desalination	Integrated					✓	There are a number of possible locations. A desalination plant, located adjacent to the Mersey Estuary has been included for economic appraisal.
	West Cumbria			✗			Desalination, utilising seawater abstracted from the Irish Sea has been considered but has been discarded because it would not be acceptable to customers due to perceived risks from radioactive contamination.
Reclaimed Water	Integrated			✗			Direct reclamation of wastewater has been discarded because of the potential for strong public opposition on perceived health grounds. A scheme to use water from the Manchester Ship Canal downstream of Davyhulme wastewater treatment works has been considered under "direct river abstraction".
	West Cumbria						
Bulk and Raw Water Transfers	Integrated					✓	Transfer of raw water from Kielder Reservoir to an existing WTW in South Cumbria is a potential option and has been included in the supply-demand economic appraisal. Raw water transfer from Thirlmere Reservoir was also considered.

EBSD option type	WRZ	Screening process 1	2	3	4	Feasible option	Comments
	West Cumbria					✓	Transfer of raw water from a third party to West Cumbria via a new treatment works is a potential feasible option. Transfer of water from Thirlmere Reservoir to Workington has been discarded as excessively expensive. An option to use water from Lake Bassenthwaite was considered discarded as being very costly and unlikely to win support from environmental regulators and stakeholders.
Tankering of Water	Integrated West Cumbria	✗	✗	✗	✗		Due to the size of the area involved, tankering of water would not satisfy operational needs and would involve significant environmental impact from traffic movements.
Sophisticated Conjunctive Management	Integrated	✗					Conjunctive management of water resources within the Integrated WRZ is already highly optimised.
	West Cumbria	✗					Improvement schemes during 2000-05 in West Cumbria have strengthened the integration of the supplies within the WRZ. The need for any further improvements will depend on the scale and location of sustainability reductions and the supply options that are preferred – any needs will be considered as part of individual supply options.
Compulsory metering	Integrated West Cumbria					✓	Installation of meters at industrial, commercial and institutional premises has been extensively implemented. All new household and non-household properties are metered. Universal compulsory metering of households is not permitted as the UU region has been identified by the Environment Agency as "low water stress". Options included in the economic option appraisal are:- • Compulsory metering of households on change of occupancy • Compulsory metering of high water users (e.g. owners of swimming pools or garden sprinklers) • Additional compulsory metering of non-households
Meter installation policy	Integrated West Cumbria	✗					UU are proposing to install smart meters from 2010 and to investigate alternative tariffs (such as rising block or seasonal tariffs) during 2010-15. It is intended that new tariffs which encourage customers to conserve more water will be applied from 2015. As such improvements are already planned; there are no feasible further supply-demand options at present.
Metering of sewerage flow	Integrated	✗					Meters have been installed on sewerage flows for all the larger traders in the UU region. For

EBSD option type	WRZ	Screening process 1	2	3	4	Feasible option	Comments
	West Cumbria						smaller sized traders, the water meter readings are taken and used to compare with water volume usage that forms part of the production process. This option is already implemented as fully as practical. There would be a high cost in metering the remaining un-metered customers.
Introduction of special fees	Integrated	✖					UU does not charge special (additional) fees on households who use garden sprinklers, hosepipes, outside taps or swimming pools. If such fees were implemented, it would be difficult to implement and would be seen as a tax on honesty. Customers who did pay would feel they were entitled to "unlimited" supplies.
	West Cumbria						
Changes to existing measured tariffs	Integrated						Changes to existing measured tariff have been considered and are either not justified or are already implemented as fully as practicable at the present time. In the longer term there is potential for "rising block volumetric" or "seasonal" tariffs to discourage unnecessary use of water, but these require the widespread installation of "smart meters" that can record greater detail of information than current meters. UU is proposing to install such meters from 2010 and so in several years time it will be appropriate to reconsider more sophisticated tariffs. In preparation for the option of variable tariffs a number of tariff trials will take place between 2010 and 2015.
	West Cumbria			✖			
Introduction of special tariffs for specific users	Integrated	✖					The options considered include: introducing "interruptible" industrial supplies, introducing lower charges for major users with significant storage, introducing higher cost "ban free" sprinkler or hosepipe licences, or introducing spot pricing for selected customers. None are considered justifiable as they do not address the supply-demand balance issues in the UU region.
	West Cumbria						
Targeted water conservation information	Integrated					✓	UU will continue to implement extensive water conservation and education programmes, as described in the main report. Further programmes in accordance with the Ofwat good practice register will also be adopted (as described in the main report) and so there is no additional benefit of also including them in the economic appraisal.
	West Cumbria						
Advice and information on direct	Integrated					✓	There is negligible use of drinking water for irrigation in the UU region. The use of raw water does not fall within the remit of UU. A

EBSD option type	WRZ	Screening process 1	2	3	4	Feasible option	Comments
abstraction and irrigation techniques	West Cumbria						targeted campaign for water efficiency in farming and agriculture was undertaken in 2007 and UU continues to promote water conservation. This is therefore already taking place and so there is no need to include them in the economic appraisal.
Advice and information on leakage detection and fixing techniques	Integrated West Cumbria					✓	UU already provide such advice and information. For example in the free Water Savers Pack, A Simple Guide to Your Water Meter Pack and the free water audit packs for households and non-households. UU will continue to provide such information and so there is no need to also include them in the economic appraisal.
Water saving devices	Integrated West Cumbria					✓	Options considered in the economic option appraisal include: • Retro-fitting of dual-flush devices to household toilets • Retro-fitting of low-volume showerheads in homes • Provision of subsidised water butts In addition UU will continue to promote and provide cistern devices, hose-gun triggers and water storing crystals free of charge, as part of our wide-ranging water efficiency programme.
Recycling and re-use	Integrated West Cumbria					✓	Retro-fitting of rainwater harvesting systems in homes has been included in the economic option appraisal as stakeholders would expect to see it included although it is very expensive. In addition UU will continue to offer water butts at discounted prices or given away at special events, as part of UU's baseline water efficiency programme The retro-fitting of grey-water recycling systems in homes has been discarded because of the high cost, high energy requirements and health risks.
Other Water Efficiency Measures	Integrated					✓	Options included in the economic option appraisal are: • "Visit-and-fix" household audits to retro-fit a range of water saving devices (e.g. low volume showerhead, cistern devices), detect leaks and repair on the property, and provide water saving advice. • Household self-audits to provide

EBSD option type	WRZ	Screening process 1	2	3	4	Feasible option	Comments
	West Cumbria						households with pack of water saving devices to retro-fit in their home (e.g. cistern device, shower-timer, hose gun trigger, water storing crystals), and provide water saving advice. • Community audits for schools, care homes and other community buildings to retro-fit a range of water saving devices (e.g. low volume showerhead, cistern devices), detect leaks and repair on the property, and provide water saving advice
Leakage Reduction	Integrated West Cumbria					✓	UU has significantly reduced leakage over the past 15 years and remains committed to meeting its leakage targets in the future. The reductions have been achieved by a combination of measures including active leakage detection, enhanced leakage monitoring, pressure reduction and replacement of mains in poor condition. Options included in the economic option appraisal are:- • Further active leakage detection and repair (by water resource zone) • Further pressure reduction (by water resource zone) • Further mains replacement (by water resource zone)
Leak detection	Integrated West Cumbria					✓	
Pressure reduction programmes	Integrated West Cumbria					✓	
Advance replacement of mains for leakage	Integrated West Cumbria					✓	
Customer supply pipe leakage reduction	Integrated West Cumbria					✓	UU continues to provide a free service for the repair of leaking external household supply pipes. Since this service was introduced in 1996 over 100,000 customer supply pipes have been repaired or replaced free of charge. As this strategy is currently taking place there is no need to include it in the economic appraisal. We have not considered taking over ownership of supply pipes from customers as this would require new legislation.
Distribution capacity expansion	Integrated West Cumbria	✗					The expansion of distribution capacity does not directly provide additional deployable output in our WRZs and so has not been directly considered in the economic analysis. Some supply options include an element of capacity expansion.
Diagnostic studies	Integrated West Cumbria					✓	UU continues to invest in research into the development of various techniques to detect leakage from large mains. This is therefore already taking place and so there is no additional benefit from including it in the economic appraisal

EBSD option type	WRZ	Screening process 1	2	3	4	Feasible option	Comments
Improved leakage detection and reduction on raw water mains	Integrated West Cumbria	✖					Leakage from raw water mains is thought to be small and mainly diffuse (weeping joints etc), and it is not practicable or economic to detect such leakage. UU already regularly inspects and surveys its raw water mains and repairs any identified leaks.

Stage 4: Feasible Options Set

Feasible options sets have been derived for each of the WRZs, based on the results of the screening criteria applied in Table D. The options that did not pass one or more of the screening tests were considered infeasible options.

The feasible options sets are described in Appendix 7.

Stage 5: Impacts, Costs and Benefits of Options

Environmental and Social Impacts

The environmental and social impacts have been assessed for each option by specialist consultants Entec on behalf of UU. These have informed the strategic environmental assessment (SEA) methodology for the appraisal of the options, details of which can be found in *Strategic Environmental Assessment* (Entec on behalf of UU, 2008) and the *Addendum to Strategic Environmental Assessment* (Entec on behalf of UU, 2009).

Financial Costs

UU has identified the capital and operating costs associated with each option, using current best available information on the likely scope of each scheme. The cost data is consistent with that used for the preparation of UU's 2009 business plan submission to Ofwat.

Environmental and Social Costs

The environmental and social costs have been assessed from a detailed study by specialist environmental consultants (Entec) on behalf of UU, and have been incorporated in the calculation of AISC values reported in Chapter 11.

The environmental and social impact issues associated with construction activity that were assessed include:-

- Construction Period (yrs)
- Built Environmental Impact
- HGV Movements (No)

- Energy (Kwh/Ml)
- Noise Impact
- Odour Problems
- Embodied Energy values (kg)

Stage 6: The Modelling Framework

The EBSD report identifies that there are three possible modelling frameworks that can be utilised:

- "Current Framework"
- "Intermediate Framework"
- "Advanced Framework"

The feasibility of collecting the necessary data and applying each of the frameworks has been assessed in accordance with the EBSD guidance and is summarised in Table E below. The Intermediate Framework has been selected as the most appropriate modelling framework. The Environment Agency has been consulted on the framework selection and is supportive of UU's preference to use the Intermediate Framework.

Table E. Modelling Framework Assessment

Availability of Data	Comment
The Current Framework	Data are available in order to apply the Current Framework.
The Intermediate Framework	Data are available in order to apply the Intermediate Framework.
The Advanced Framework	The very detailed "Willingness to Pay" data that would be required are not available in order to be able to apply the Advanced Framework.
Expertise Available to Collect Data	**Comment**
The Current Framework	Expertise is available in order to collect data and apply the Current Framework.
The Intermediate Framework	Expertise is available in order to collect data and apply the Intermediate Framework.
The Advanced Framework	United Utilities has no prior experience of collecting data for the Advanced Framework.
Time and Resources Available to Collect Data	**Comment**
The Current Framework	Time and resources are available in order to collect data and apply the Current Framework.
The Intermediate Framework	Time and resources are available in order to collect data and apply the Intermediate Framework.
The Advanced Framework	Time and resources could be made available if the above two conditions had been met, and UU was seeking to improve its supply reliability standards.

Stage 7: The Selection Routine

The selection routine is central to the planning process. The candidate selection routines available are as follows:-

- The AIC/AISC Approach
- Linear / Integer programming-based model formulations
- Stochastic-programming model formulation

Note:
AIC = Average Incremental Cost (pence/m^3), which is calculated based on the NPV capital and operational costs seen by UU and the WAFU value of the option.
AISC = Average Incremental Social Cost (pence/m^3), which is calculated similarly to AIC but includes environmental and social costs.

UU have used both the AISC approach and the Mathematical (Linear/Integer) Programming approach. The AISC approach provides a simple means of comparing the unit cost of alternative options and is additionally required to be reported to the Environment Agency as part of the WRMP. AISCs are very helpful in giving an initial indication of those options that are more economic, However, a mathematical programming model is a much more robust approach to derive the optimal programme of options within the planning horizon that best meets any supply-demand deficit at least cost, and so UU has used a mathematical optimisation model to derive the preferred solutions. Table F summarises the assessment of the candidate selection routines in accordance with the EBSD guidance.

Stage 8: Average Incremental and Social Costs (AISC)

AISC and AIC values have been calculated for each feasible option identified at Stage 4. The following key assumptions have been used for all calculations:

- A calculation horizon of 100 years has been used to calculate the AIC / AISCs.
- A discount rate of 4.5% has been used for Net Present Value calculations of capital (CAPEX) and operational (OPEX) costs.
- A discount rate of 4.5% has been used Net Present Value calculations of environmental and social costs.

These discount rates are consistent with current Treasury and regulatory guidance. Alternative values for the discount rate have been considered as part of the sensitivity analysis of the water resources and demand strategy, and we found that varying the discount rate had no significant impact on the optimal combination of solutions.

Summary values of the AIC/AISCs calculated for each feasible option in the Integrated and West Cumbria WRZs are presented in Chapter 11.

Table F. Selection Routine Assessment

Accuracy of Approach	Comment
AISC Approach	The AISC approach is likely to be too simplistic considering the planning horizon and number of potential options available.
Linear/Integer Programming	This approach is likely to deliver an optimal programme of options for each WRZ.
Stochastic Programming	This approach takes into account uncertainties in forecasts but model formulation is less likely to be tractable.
Likely Success of Approach	**Comment**
AISC Approach	This approach does not scale well – the larger and more complex the problem, the greater the likelihood of a sub-optimal set of options being selected.
Linear/Integer Programming	With this approach, a global optimum is likely and commercial software is available for this approach. Indivisibilities in scale can be fully taken into account.
Stochastic Programming	This approach has the potential to find a more robust, lower cost solution. However no commercially available software is currently available and has higher data requirements. Likely to be complex and time-consuming to deliver.
Costs of Proposed Approach	**Comment**
AISC Approach	This is the cheapest of the candidate selection routines, requiring least data input and fewest skilled resources.
Linear/Integer Programming	This approach can be run on commonly available commercial software (e.g. Microsoft Excel), it is relatively straightforward to implement and requires less skilled resources than the stochastic approach.
Stochastic Programming	This approach has higher data requirements (i.e.: more costly) and due to the lack of commercial software is likely to have significantly higher skilled resource requirements.

Stage 9: Target Level of Service

The target levels of service for the current and intermediate frameworks are as follows:

- The frequency of hosepipe bans and Drought Permits to augment supplies is 1 in 20 years.
- The frequency of Drought Orders to restrict non-essential water use and further augment supplies is 1 in 35 years.
- No standpipes or rota cuts during worst drought on record (1927-2008)

The justification for this level of service has been based on consultation with customers and regulatory considerations, as described in Chapter 2.

The Advanced Framework is not being used in this planning process and so customer willingness to pay data is not therefore required. However, UU has undertaken willingness to pay surveys to inform the choice of level of service as discussed in Section 5.7.

Stage 10: Apply the Modelling Framework and Selection Routine

The Intermediate Modelling approach using stochastic (i.e. probabilistic) Monte Carlo modelling has been applied to the uncertainties in the supply and demand forecasts. The results have been incorporated into our assessments of target headroom

The economic and environmental appraisal to derive the water resources and demand strategy to maintain the supply-demand balance in the Integrated and West Cumbria WRZs is described in Chapters 11, 12 and 13. For each WRZ, the most economic combination of solutions was identified by mathematical programming optimisation. No supply-demand deficits are anticipated in the Carlisle and North Eden WRZs. Use of a modelling framework is therefore not required for these WRZs.

Stage 11: Indivisibilities (for the AISC Approach)

We have used the AISC values to identify initial ranking of options according to their overall unit cost. However, in accordance with the EBSD methodology, a mathematical programming approach has been adopted to derive optimal programmes of options to meet any supply deficits. This avoids "indivisibilities" (i.e. inability to account for part-schemes) in the final solutions that can occur if the AISC approach is used to determine the optimal solutions.

Stage 12: Tariff and Demand Feedbacks

UU has identified that the feedback effects are likely to be small. This has been confirmed by our econometric modelling of non-household water demand, which demonstrates that the effect of a "real price of water" on non-household demand is very small. We have identified a price elasticity of -0.1, i.e. a 10% increase in the real price of water would lead to a 1% fall in non-household demand. This is consistent with Herrington (UKWIR, 2005) who suggests an elasticity of -0.1 to -0.2 for households. The impact of the proposed supply-demand programme on water prices for UU is small compared with the expenditure requirements of the quality enhancement and maintenance programmes. For these reasons any feedback effects of any tariff impacts on supply-demand deficits and solutions will be negligible and so have not been specifically investigated.

Stage 13: Further allowance for Risk, Environment and Equity

Chapter 13 includes a descriptive appraisal of risks, and environmental and other uncertainties. It concludes that we have a flexible plan and so there is no need for modification.

Stage 14: EBSD Checklist

The information in this Appendix provides a detailed check that all stages of the EBSD have been completed for each WRZ.

Appendix 7. Option descriptions

Overview

This Appendix provides a summary description of each of the feasible options that were identified from the option screening in Stage 3 and 4 described in Appendix 6. They have been included in the economic appraisal (see Chapter 11). The sections comprising this Appendix are:-

- Water efficiency and metering options (all water resource zones)
- Leakage control options for the Integrated Water Resource Zone
- Leakage control options for the West Cumbria Water Resource Zone
- Supply-side options for the Integrated Water Resource Zone
- Supply-side options for the West Cumbria Water Resource Zone
- Supply-side options for the Carlisle Water Resource Zone
- Utilisation-based AISCs of supply-side schemes.

A list of the relevant feasible options is presented at the start of each section.

Water efficiency and metering options (all water resource zones)

The feasible options that we have assessed in the economic (including environmental) appraisals for the Integrated and West Cumbria zones are listed in Table G. The options are described below – the details relate to the region as a whole and, for the purpose of consistency of presentation in this Appendix only, assume implementation begins from 2010/11. In each case the scope, cost and benefit associated with any West Cumbria options is very much smaller, about 2% of the regional values, with the Integrated Zone accounting for about 96% of the regional amounts.

Table G. Feasible options appraised for metering and water efficiency

Option Reference	Option Name / Description
WE 001	Meter on Change of Ownership
WE 002	Meter High Water Users
WE 003	Meter Non-households
WE 004a	Enhanced Water Savers Pack
WE 005a	Domestic ‘visit and fix’ - dedicated visit
WE 005b	Domestic ‘visit and fix’ - meter fitting add on
WE 005c	Domestic ‘visit and fix’ - partner visit

Option Reference	Option Name / Description
WE 006	Community Audits
WE 007	Water butts
WE 008	Water efficient showerheads
WE 011	Rainwater
WE 012	Promotion of FMO

WE 001 - Meter on change of occupancy

Under the Water Industry Act 1999 it is permissible for water companies to compulsorily meter properties on change of occupancy. United Utilities do not currently exercise this option; however if this metering option was exercised the number of properties being metered could increase significantly and UU would expect the water consumption at newly metered properties to reduce.

Metering, on average reduces the demand from a domestic property. The introduction of compulsory metering on change of occupancy could reduce demand from a property by around 9% (based on UU assessment of unmetered household customers' micro-component usage and metering affects on micro-components).

In the event that such an approach to metering was to be adopted it would be necessary to address a number of practical and customer related issues. In particular the overall costs and benefits realised from compulsory metering are uncertain. These issues could best be addressed through a limited roll out of compulsory metering in 2010-15. This would allow a more clear understanding of the benefits and costs of this option to be developed.

The estimated savings per property is 33 litres per day (in a dry year). This is ≈ 9% of an average unmetered property's consumption. Potential savings include reduced consumption for bathing, cleaning, garden/ outdoor use, and other miscellaneous use. As the meter would generally be internally fitted (in line with UU smart meters policies) there would be little supply pipe leak reduction benefits. After five years the estimated water savings would total 4.1 Ml/d spread over 125,000 properties.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.81	1.63	2.44	3.26	4.07	4.07	4.07

This option assumes the compulsory metering of 25,000 homes a year for 5 years. A total of 125,000 meters would be installed inside domestic properties with AMR capabilities built in.

Scope includes; property identification, meter purchase, meter installation, meter survey, direct customer communication, extra billing costs, and meter replacement. Also included within the option is the cost of conducting a customer information campaign on the change of metering policy, and the cost of handling increased customer queries and complaints.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- Logistical practicalities of meter installation between household occupancy, including identification of suitable properties, contacting customers that are between addresses, and gaining access to properties.
- Potentially negative media and customer reaction to compulsory metering
- Uncertainty around actual water savings associated with compulsorily metered customers
- Potential for increased debt in some vulnerable customer groups

WE 002 - Meter high water users

Under the Water Industry Act 1999 it is permissible for water companies to compulsorily meter properties that use certain high water using appliances such as garden sprinklers and/or outdoor swimming pools. United Utilities do not currently exercise this option; however if this metering option was exercised the number of properties being metered could increase and UU would expect the water consumption at newly metered properties to reduce.

Metering, on average reduces the demand from a domestic property. The introduction of compulsory metering of high water users could reduce demand from a property by around 12% (based on UU assessment of unmetered household customers' micro-component usage and metering affects on micro-components).

In the event that such an approach to metering was to be adopted it would be necessary to address a number of practical and customer related issues. In particular the overall costs and benefits realised from compulsory metering are uncertain. These issues could best be addressed through a limited roll out of compulsory metering in 2010-15. This would allow a more clear understanding of the benefits and costs of this option to be developed.

The estimated savings per property is 50 litres per day (in a dry year). This is ≈ 12% of an average high water consumer's daily demand. Potential savings include reduced consumption through bathing, cleaning, garden/ outdoor use, and other miscellaneous use. As the meter would generally be internally fitted (in line with UU smart meters policies) there would be little supply pipe leak reduction benefits. After five years the estimated water savings would total 1.3 Ml/d spread over 25,000 properties.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.25	0.50	0.75	1.00	1.27	1.27	1.27

This option assumes the compulsory metering of 5,000 homes a year for 5 years. A total of 25,000 meters would be installed inside domestic properties with AMR capabilities built in.

Scope includes; property identification, meter purchase, meter installation, meter survey, direct customer communication, extra billing costs, and meter replacement.

Also included within the option is the cost of conducting a customer information campaign on the change of metering policy, and the cost of handling increased customer queries and complaints.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- The logistical practicality of high water user identification, in particular ensuring any approach is seen to be fair and equitable.
- Logistical practicalities of meter installation, including compelling unwilling customers and gaining access to their property.
- Potentially negative media and customer reaction to compulsory metering.
- Uncertainty around actual water savings associated with compulsorily metered customers.
- Potential for increased debt in some vulnerable customer groups.

WE 003 - Meter non-households

Under the Water Industry Act 1999 it is permissible for water companies to compulsorily meter non-household properties.

United Utilities has already implemented large programmes to compulsorily meter non-household properties. There remain only a small number of non-households that have not had meters installed. The remaining ≈ 15,000 un-metered non household properties have generally appreciable barriers to successful meter installation, such as shared supply pipes, or inappropriate plumbing. In addition they tend to be relatively small non-household water users.

Metering, on average reduces the demand from a property. UU could introduce compulsory metering for the remaining unmetered non-household properties in AMP5. This could reduce demand by around 9% for each property (based on UU assessment of unmetered non-household customers' usage and metering effects).

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The estimated savings per property is 59 litres per day (in a dry year). This is ≈ 9% of the average unmetered non-household consumer's daily demand. Potential points of saving include reduced consumption through cleaning, garden/ outdoor use, and other miscellaneous use. As the meter would generally be internally fitted (in line with UU smart meters policies) there would be little supply pipe leak reduction benefits. After five years the estimated water savings would total 0.9 Ml/d spread over 15,000 properties.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.18	0.35	0.53	0.71	0.88	0.88	0.88

This option assumes the compulsory metering of 3,000 properties a year for 5 years. A total of 15,000 meters would be installed inside properties with AMR capabilities built in.

Scope includes; property identification, meter purchase, meter installation, meter survey, direct customer communication, extra billing costs, and meter replacement.

Also included within the option is the cost of conducting a customer information campaign on the change of metering policy, and the cost of handling increased customer queries and complaints.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- Logistical practicalities of meter installation, including compelling unwilling customers and gaining access to their property.
- Potentially negative media and customer reaction to compulsory metering.
- Uncertainty around actual water savings associated with compulsorily metered customers.
- Potential for increased debt in some customer groups.

WE 004a – Enhanced Water Savers Pack

Providing customers with detailed information on how to assess and reduce their water usage would help to reduce average consumption. Promoting voluntary self audits is one mechanism to achieve this. United Utilities currently provide a water savers pack, including a cistern device and leaflet with water saving tips free of charge for any customer that requests it.

This option allows for 20,000 customers a year volunteering to undertake a self audit through an enhanced Water Savers Pack. Each audit will consist of a Save-a-Flush device, hose trigger gun, water crystals, shower bag, shower timer, and further advice on how to save water around the home and in the garden (this option goes beyond proposed baseline water efficiency activity, under which UU offers free water savers pack that consist of a save-a-flush and water saving advice.)

The estimated additional savings per property is 10.18 litres per day. After five years this would result in a total of 0.79 Ml/d savings, after fifteen years 1.38 Ml/d would be saved. This takes into account a decay in water saving benefits each year.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.21	0.38	0.53	0.67	0.79	1.18	1.38

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- High uncertainty around realised water savings.
- High uncertainty around public willingness to undertake audits.

WE 005a - Domestic 'visit and fix' – dedicated visit

Providing customers with detailed information on how to assess and reduce their water usage would help to reduce average consumption. Promoting 'visit and fix' home audits is one mechanism to achieve this. Savings can be further improved by providing customers with water saving devices whilst visiting the property.

United Utilities currently provides a water savers pack, including a cistern device and leaflet with water saving tips free of charge for any customer that requests it.

This option consists of 5,000 customers a year volunteering to undertake an audit and acting towards water conservation as a result. This scheme involves retrofitting a basket of water efficiency measures within a target Demand Management Zone (DMZ). Each 'visit and fix' would consist of a qualified surveyor visiting a customer's property, providing and installing water saving devices, and providing tailored water saving advice. This would be a large scale scheme that would include a widespread media and communications campaign and mail shot to all households within the defined area.

The estimated savings per property is 37.57 litres per day. After five years this would result in a total of 0.73 Ml/d savings, after fifteen years 1.24Ml/d could be saved. This takes into account a decay of water saving benefits each year.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.19	0.35	0.49	0.62	0.73	1.08	1.24

The implementation of the scheme will be planned on a street by street basis if possible, which would maximise the efficiency of installing the devices and reduce costs. The basket of measures would include offers of a water butt, tap aerator, shower timer, aerator showerhead, cistern displacement device, and/or dual flush conversion. (NOTE: This option is a direct translation of Scenario 2 as detailed in the Waterwise Evidence Base for Large-scale Water Efficiency in Homes)

This option assumes 5,000 customers a year will volunteer to undertake an audit and act towards water conservation as a result. It is anticipated that these audits will not be spread out evenly over the full five year period.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- High uncertainty around realised water savings.
- High uncertainty around public willingness to undertake audits.

WE 005b - Domestic 'visit and fix' – meter fitting add on

Providing customers with detailed information on how to assess and reduce their water usage would help to reduce average consumption. Promoting 'visit and fix' home audits is

one mechanism to achieve this. Savings can be further improved by providing customers with water saving devices whilst visiting the property.

United Utilities currently plan to provide a water savers pack, including a cistern device and leaflet with water saving tips free of charge for any customer that requests it.

This option consists of all new meter optant customers each year (about 46,000 per annum in 2010-15) being offered an extended water savers audit as part of the free meter option (FMO) offer. This offering would go beyond the current plan of offering a water savers pack and cistern displacement device by offering a rnage of other water saving devices.

This scheme involves retrofitting extra water efficiency measures at the time of metering a FMO property. This would be a large scale scheme that would include a media and communications campaign. The implementation of the scheme will be planned to use the existing visits to survey homes for meter fitting as an opportunity to also fit water saving devices.

The estimated additional savings per property is 14.81 litres per day. After five years this would result in a total of 2.59 Ml/d savings, after fifteen years savings would decay to 0.65Ml/d. This takes into account a decay of water saving benefits each year.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.79	1.43	1.95	2.33	2.59	1.30	0.65

The extra basket of measures would include offers of a water butt voucher, shower timer, and aerator showerhead (other water saving devices would required skilled fitters and so have not been considered). This option will run for five years only as the decay in FMO after that date limits its water-available-for-use benefit significantly. (NOTE: This option is a modified translation of Scenario 5 as detailed in the Waterwise Evidence Base for Large-scale Water Efficiency in Homes)

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- High uncertainty around realised water savings.
- High uncertainty around public willingness to undertake audits.

WE 005c - Domestic 'visit and fix' – partner visit

Providing customers with detailed information on how to assess and reduce their water usage would help to reduce average consumption. Promoting 'visit and fix' home audits is one mechanism to achieve this. Savings can be further improved by providing customers with water saving devices whilst visiting the property.

United Utilities currently provides a water savers pack, including a cistern device and leaflet with water saving tips free of charge for any customer that requests it.

This option consists of 10,000 customers a year receiving a water audit and acting towards water conservation as a result. UU would partner with housing associations to convert eligible toilets into dual flush using retrofit devices. The fitting would take place when a plumber visits a home to undertake an annual gas survey, which is required for all homes managed by a housing association.

The partnership reduces the costs of installation since the surveyor is already entering the home, and also reduces costs associated with recruitment. High uptake rates are expected since the housing association can encourage retrofit into their properties.

NOTE: This option is a direct translation of Scenario 1 as detailed in the Waterwise Evidence Base for Large-scale Water Efficiency in Homes (Waterwise, 2008). However the Waterwise evidence base does not account for significant costs incurred by partnering organisations in its analysis. We have included those costs in our assessment of the scheme AIC. This leads to our AIC and AISC valuations being significantly higher than the Waterwise reported values.

The estimated savings per property is 6.39 litres per day. After five years this would result in a total of 0.25 Ml/d savings, after fifteen years 0.42 Ml/d could be saved. This takes into account a decay of water saving benefits each year.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.06	0.12	0.19	0.21	0.25	0.37	0.42

This option assumes 10,000 customers a year will volunteer to undertake an audit and act towards water conservation as a result. It is anticipated that these audits will not be spread out evenly over the full five year period.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- High uncertainty around realised water savings.
- High uncertainty around public willingness to undertake audits.

WE 006 - Community audits

Providing schools, hospitals, prisons, and other large community water users with detailed information on how to assess and reduce their water usage would help to reduce overall consumption. Promoting community audits is one mechanism to achieve this. Savings can be further improved by providing customers with water saving devices and repairing leaks whilst visiting the property.

A United Utilities led programme, targeting 1,000 community audits over 5 years is a logistically viable approach. This five year programme would be repeated every five years, reaching over 5,000 properties after 25 years. This would need to be supported by a concerted communication campaign, including direct mailing and local advertising.

There is insufficient evidence available to robustly assess likely water savings from a Community Audits scheme. An expert best estimate of likely savings is that around 282 litres per property per day would be saved (based on 15 dual flush retrofits); however this is only an estimate. This would give a saving of 0.22 Ml/d after five years, and 0.38 Ml/d after fifteen years. This takes into account decay of water saving benefits each year.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.06	0.11	0.15	0.19	0.22	0.33	0.38

A community audit is likely to consist of a visit to a property by a qualified surveyor. They would produce an action list of water saving options, and provide low cost water saving devices e.g. dual flush conversion kits.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- High uncertainty around realised water savings.
- High uncertainty around public willingness to undertake audits.

WE 007 - Subsidised water butts

Water butts are a practical way of saving water for many domestic properties. They are well understood by the public, and are readily available from most garden centres and DIY retailers. In the past United Utilities has promoted customer uptake of water butts, and subsidised the purchase of water butts by domestic customers.

United Utilities could further promote the uptake of water butts through an annual large scale voucher programme, offering 10,000 United Utilities customers £20 vouchers towards the purchase of a water butt. These vouchers could be redeemed at a range of DIY retailers and garden centres.

Over 25 years 250,000 water butts could be distributed.

The estimated savings per property is 2.7 litres per day (The effect of installing water butts on garden watering, Essex & Suffolk Water, 2002) in a dry year. After five years this would result in a total of 0.1 Ml/d savings, and after fifteen years this would increase to 0.18 Ml/d. There is no assumed decay rate for the benefits of water butts.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.03	0.05	0.07	0.09	0.10	0.15	0.18

Whilst the option plans 10,000 vouchers being distributed each year over a five year AMP it is likely that the programme will be front end loaded, with most vouchers being redeemed in the first couple of years.

This option also includes an ongoing customer awareness campaign.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- Uncertainty around realised water savings.
- Public take up of water butts is likely to be influenced by weather, urbanisation levels, and metering levels.

WE 008 - Free water efficient showerheads

Mixer showers use a large volume of water during a typical shower, especially if the water pressure is artificially increased through the use of a pump.

A major study undertaken by United Utilities and Liverpool John Moores University (2007) showed that fitting water efficient aerated showerheads reduces the volume of water used by the shower without significantly reducing the shower experience for users. Importantly it also significantly reduces the energy used in the home on heating water, providing important reductions in carbon emissions.

United Utilities could promote the use of water efficient showerheads through a targeted programme of free water efficient showerhead distribution. It is practical to consider a programme issuing 50,000 free showerheads to domestic volunteers over a five year period. This would result in 250,000 showerheads being issued over 25 years.

The estimated savings per property is 38 litres per day (Water Efficient Showers, UU & LJMU, 2007).

Similar water saving devices have an anticipated installation rate of 73% (UU June Return 2007). After five years this would result in 1.07 Ml/d savings, increasing to 1.87 Ml/d after fifteen years. This takes into account a decay of water saving benefits each year.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.28	0.52	0.73	0.91	1.07	1.60	1.87

Whilst the option plans for 10,000 showerheads being distributed each year, it is likely that the programme will be front end loaded, with most showerheads being issued in the first couple of years of a five year period.

The distribution of showerheads would be coupled to an education programme that would enable customers to assess whether they would reduce their water consumption by installing a free showerhead. Therefore this option also includes a customer awareness campaign running for five years.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- Uncertainty around realised water savings.

- Public take up of water efficient showerheads is likely to be influenced by mixer shower ownership variations, and metering levels.

WE 011 - Rainwater harvesting retrofit

A rainwater harvesting system is defined as any system which takes rainwater runoff and cleans it to a standard sufficient for use in toilet flushing or outdoor use. This reduces the amount of water a property takes from the water network, but does not reduce the properties overall water use. The most promising source of runoff water for domestic properties is from roofs.

A programme of rainwater harvesting system retrofitting would involve United Utilities retro-fitting around 50 systems to volunteers' homes a year, with a total of 1,250 systems installed over a 25 year period.

The estimated savings per property is 79 litres per day (based on flush frequency and volume, assumes +90% availability). After five years this would result in a total of 0.02 Ml/d savings, and a 0.06Ml/d saving after fifteen years.

It is assumed that installed systems would be maintained by customers so no decay rate for system usage is included in calculations of water benefits.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.00	0.01	0.01	0.02	0.02	0.04	0.06

This option considers the installation of 1,250 systems to existing properties over a 25 year period. The length of time a rainwater harvesting retrofit takes to install means that the number of installations in the initial five year period may be lower than average. This option also includes a customer awareness and recruitment campaign.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- Increased public health risk due to system failure, and/or future cross connection with potable supplies.
- Uncertainty over public willingness to volunteer to have a rainwater harvesting systems retrofitted to their property.
- Uncertainty around realised water savings, principally due to system down times during drought periods.
- Risk that many volunteers will lack space on their property to install a rainwater harvesting tank.

WE 012 – Promotion of FMO

United Utilities do not promote its Free Meter Option for domestic customers; however if this metering option was actively promoted the number of properties being metered could increase by around 10,000 a year and UU would expect the water consumption at newly metered properties to reduce.

Metering, on average reduces the demand from a domestic property. The installation of an FMO meter typically reduces demand from a property by around 8% (based on UU assessment of unmetered household customers' micro-component usage and metering affects on micro-components).

The estimated savings per property is 19.99 litres per day (in a dry year). This is ≈ 8% of an average optant water consumer's daily demand. Potential points of saving include reduced consumption through bathing, cleaning, garden/ outdoor use, and other miscellaneous use. As the meter would be internally fitted (in line with UU smart meters policies) there would be no supply pipe leak reduction benefits. After five years the estimated savings would total 1.0 Ml/d spread over 50,000 properties.

Water available for use benefit (Ml/d) per a year

Year	2010/11	2011/12	2012/13	2013/14	2014/15	2019/20	2024/2025
Ml/d	0.20	0.40	0.60	0.80	1.00	1.00	1.00

This option assumes the additional optional metering of 10,000 homes a year for 5 years. A total of 50,000 meters would be installed inside domestic properties with AMR capabilities built in.

Scope includes; property identification, meter purchase, meter installation, meter survey, direct customer communication, extra billing costs, and meter replacement.

Also included within the option is the cost of conducting a customer information campaign on the benefits of opting for a meter, and the cost of handling increased customer queries and complaints.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks, and uncertainties are:-

- Logistical practicalities of increased meter installation.
- Uncertainty around actual water savings associated with compulsorily metered customers.
- Potential for increased debt in some vulnerable customer groups.

Leakage control options for the Integrated WRZ

The feasible options that we have assessed in the economic (including environmental) appraisals for the Integrated Water Resource Zone are listed in Table H. The options are described below.

Table H. Feasible options appraised for leakage control in the Integrated WRZ

Option Reference	Option Name / Description
INT1001	Mains Replacement Stage 1
INT1002	Mains Replacement Stage 2
INT1003	Mains Replacement Stage 3
INT1004	Leakage Detection Stage 1
INT1005	Leakage Detection Stage 2
INT1006	Leakage Detection Stage 3
INT1007	Leakage Detection Stage 4
INT1008	Leakage Detection Stage 5
INT1009	Pressure Reduction Stage 1
INT1010	Pressure Reduction Stage 2
INT1011	Pressure Reduction Stage 3

INT1001 to INT1003 - Mains replacement

Mains replacement options to further reduce leakage levels comprise the replacement of water mains and communication pipes in district meter areas (DMAs) showing a consistently high level of leakage.

Three phases of mains replacement have been identified for the Integrated WRZ, which target replacement of those mains where water savings due to reduced burst and leakage are expected to be highest. Each Phase must be implemented in sequence i.e. Phase 1 must be completed before Phase 2.

The deployable output benefits are estimated as:

- INT1001: Phase 1: 1.0 Ml/d
- INT1002: Phase 2: 1.0 Ml/d
- INT1003: Phase 3: 1.0 Ml/d

The principal elements of work required are estimated as:-

- INT1001: Phase 1: refurbishment (e.g. sliplining) of 38 km mains in priority DMAs
- INT1002: Phase 2: refurbishment (e.g. sliplining) of 105 km mains in further DMAs
- INT1003: Phase 3: refurbishment (e.g. sliplining) of 149 km mains in further DMAs

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks and uncertainties are:-

- Although predicted leakage savings are based on the results of national research studies, there is uncertainty over actual savings due to the limited scope of the research.
- Leakage reduction is reliant on good quality workmanship, in particular the jointing of polyethylene (PE) pipes. Currently, there is a national shortage of well-trained pipe-layers and this may continue if other utilities expand their capital programmes.
- Mains records are sometimes inaccurate and the scope/lengths of pipe replacement may change. However, there is an opportunity to enhance our records with details of the new mains and services.
- Construction rates are uncertain.
- Other utility services are at risk during construction.

INT1004 to INT1008 - Leakage detection and repair

Leakage detection and repair options to further reduce leakage levels comprise employment of additional trained leak detection personnel, purchase of additional leak detection equipment, and repair of the extra leaks that are detected.

Five phases of leakage detection and repair have been identified for the Integrated WRZ. The current cost curves generated for the economic level of leakage assessment are used to determine costs and resources for each leakage reduction phases. Each Phase must be implemented in sequence i.e. Phase 1 must be completed before Phase 2.

The deployable output benefits are estimated as:

- INT1004: Phase 1: 10 Ml/d
- INT1005: Phase 2: 10 Ml/d
- INT1006: Phase 3: 10 Ml/d
- INT1007: Phase 4: 10 Ml/d
- INT1008: Phase 5: 10 Ml/d

The principal elements of work required are additional leakage detection surveys, by employing additional trained leak detection personnel, so that additional leaks are found and repaired.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks and uncertainties are:-

- There is a risk that the predicted leakage savings will not be achieved.
- There is a risk that suitably qualified leakage detection resources will not be available when required.
- Construction/repair costs are uncertain beyond 2010.
- Other utility services are at risk during repair activity.

INT1009 to INT1011 - Pressure reduction

Pressure reduction options to further reduce leakage levels comprise the fitting of flow/time modulation to existing pressure management valves (PMVs) or in some cases,

new PMVs to control pressure within the mains system and thereby reduce leakage from mains, communication pipes and customer supply pipes.

Three phases of pressure reduction have been identified for the Integrated WRZ, which target pressure reduction in those discrete pressure areas (DPAs) where water savings are expected to be highest. Each Phase must be implemented in sequence i.e. Phase 1 must be completed before Phase 2.

The deployable output benefits are estimated as:

- INT1009: Phase 1: 1 Ml/d
- INT1010: Phase 2: 0.5 Ml/d
- INT1011: Phase 3: 0.3 Ml/d

The principal elements of work required are estimated as:-

- INT1009: Phase 1: 64 flow modulated PMVs and 3 new PMV.
- INT1010: Phase 2: 50 flow modulated PMVs and 17 new PMVs.
- INT1011: Phase 3: 123 flow modulated PMVs and 59 new PMVs.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks and uncertainties are:-

- There is a risk that the predicted leakage savings will not be achieved.
- Construction rates are uncertain beyond the AMP4 period.
- Other utility services are at risk during construction.

Leakage control options for the West Cumbria WRZ

The feasible options that we have assessed in the economic (including environmental) appraisals for the West Cumbria Water Resource Zone are listed in Table I. The options are described below.

Table I. Feasible options appraised for leakage control in the West Cumbria WRZ

Option Reference	Option Name / Description
WC 1001	Mains Replacement Stage 1
WC 1005	Leakage Detection Stage 1
WC 1006	Leakage Detection Stage 2
WC 1007	Leakage Detection Stage 3
WC 1008	Pressure Reduction Stage 1
WC 1009	Pressure Reduction Stage 2
WC 1010	Leakage Detection Stage 4

WC 1001 - Mains replacement

Mains replacement options to further reduce leakage levels comprise the replacement of water mains and communication pipes in district meter areas (DMAs) showing a consistently high level of leakage.

One phase of mains replacement have been identified for the Integrated WRZ, which target replacement of those mains where water savings due to reduced burst and leakage are expected to be highest.

The deployable output benefits are estimated as:

- WC 1001: Phase 1: 0.11 Ml/d

The principal elements of work required are estimated as:-

- WC1001: Phase 1: refurbishment (e.g. sliplining) of 41.3 km mains in priority DMAs

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks and uncertainties are:-

- Although predicted leakage savings are based on the results of national research studies, there is uncertainty over actual savings due to the limited scope of the research.
- Leakage reduction is reliant on good quality workmanship, in particular the jointing of polyethylene (PE) pipes. Currently, there is a national shortage of well-trained pipe-layers and this may continue if other utilities expand their capital programmes.
- Mains records are sometimes inaccurate and the scope/lengths of pipe replacement may change. However, there is an opportunity to enhance our records with details of the new mains and services.
- Construction rates are uncertain.
- Other utility services are at risk during construction.

WC 1005 to WC 1007 and WC 1010 - Leakage detection and repair

Leakage detection and repair options to further reduce leakage levels comprise employment of additional trained leak detection personnel, purchase of additional leak detection equipment, and repair of the extra leaks that are detected.

Four phases of leakage detection and repair have been identified for the West Cumbria WRZ. The current cost curves generated for the economic level of leakage assessment are used to determine costs and resources for each leakage reduction phases. Each Phase must be implemented in sequence i.e. Phase 1 must be completed before Phase 2.

The deployable output benefits are estimated as:

- WC 1005: Phase 1: 1 Ml/d
- WC 1006: Phase 2: 1 Ml/d
- WC 1007: Phase 3: 1 Ml/d
- WC 1010: Phase 4: 1 Ml/d

The principal elements of work required are additional leakage detection surveys, by employing additional trained leak detection personnel, so that additional leaks are found and repaired.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks and uncertainties are:-

- There is a risk that the predicted leakage savings will not be achieved.
- There is a risk that suitably qualified leakage detection resources will not be available when required.
- Construction/repair costs are uncertain beyond 2010.
- Other utility services are at risk during repair activity.

WC1008 to WC 1009 - Pressure reduction

Pressure reduction options to further reduce leakage levels comprise the fitting of flow/time modulation to existing pressure management valves (PMVs) or in some cases, new PMVs to control pressure within the mains system and thereby reduce leakage from mains, communication pipes and customer supply pipes.

Two phases of pressure reduction have been identified for the West Cumbria WRZ, which target pressure reduction in those discrete pressure areas (DPAs) where water savings are expected to be highest. Each Phase must be implemented in sequence i.e. Phase 1 must be completed before Phase 2.

The deployable output benefits are estimated as:

- WC 1008: Phase 1: 0.05 Ml/d
- WC 1009: Phase 2: 0.03 Ml/d

The principal elements of work required are estimated as:-

- WC 1008: Phase 1: 2 flow modulated PMVs and 2 new PMV.
- WC 1009: Phase 2: 19 flow modulated PMVs and 2 new PMVs.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The potential opportunity, risks and uncertainties are:-

- There is a risk that the predicted leakage savings will not be achieved.
- Construction rates are uncertain beyond the AMP4 period.
- Other utility services are at risk during construction.

Supply-side options for the Integrated Water Resource Zone

The feasible options that we have assessed in the economic (including environmental) appraisals for the Integrated Water Resource Zone are listed in Table J. The options are described below.

Table J. Feasible options appraised for source enhancement in the Integrated WRZ

Option Reference	Option Name / Description
INT 003	Huntington WTW Upgrade
INT 006	River Ribble Abstraction
INT 009b	Manchester Ship Canal Abstraction (potable)
INT 051	Mid-Cheshire Groundwater
INT 052	Widnes Groundwater
INT 054	Southport Groundwater
INT 061	Ribble Valley Groundwater
INT 072a	North Warrington Groundwater
INT 073a	Warrington Groundwater a
INT 073b	Warrington Groundwater b
INT 101	Oldham Groundwater
INT 079	Desalination from Mersey Estuary
INT 105	Raw water transfer from Keilder Water

Note: WTW = water treatment works

INT 003 – Huntington WTW Upgrade

This option consists of the construction of a new 4th treatment stream at Huntington WTW which is supplied from the lower River Dee. A three stage treatment process would enable treatment of raw waters from River Dee up to the existing abstraction licence limits. The additional supplies will enhance the existing flow from the operational WTWs at Huntington.

Major external works are envisaged including some external connections that could be required and opportunistic capital maintenance on other downstream connecting components.

The potential opportunity, risks, and uncertainties are:

- UU possess an Abstraction Licence for this site. The proposed facility utilises some of the existing available abstraction licence capacity.
- Sufficient land ownership is available to construct a new building.
- The operation would be within existing abstraction limits and so would not require any change to the Dee General Direction which assumes full licence take.
- It would assist with the future maintenance programme for the Vyrnwy LDTM.
- The deployable output benefit is dependent on future reductions in industrial water demand in our non-potable and raw water supplies in the long-term

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 30 Ml/d.

INT 006 – River Ribble Abstraction

This option consists of abstracting water from the River Ribble and to transfer the supplies at times of high river flow via a new pumping station and new pipeline to nearby reservoirs for storage before treatment at existing WTWs.

A new abstraction licence will be required for the River Ribble. Water would not be abstracted during periods of low flow in the river.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- There is surplus water available within the River Ribble during high flow.
- Water quality variability of the water from River Ribble could require up-grading of existing WTWs. However dilution within the stored waters at reservoirs could be sufficient to eliminate the need for treatment enhancement.
- Significant stakeholder interest would make this a difficult option to promote.
- There is uncertainty regarding the exact yield of this scheme in practice.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 17 Ml/d.

INT 009b – Manchester Ship Canal Abstraction (potable)

This option consists of the provision of a new abstraction facility from Manchester Ship Canal (MSC) downstream of the outlet from Davyhulme Waste Water Treatment Works in Urmston to a new WTW.

This option will require a new intake structure at Manchester Ship Canal with a new raw water pump station delivering the flow into the new WTW. The treated water would then be transferred via a new trunk main to the Manchester area. Some additional connecting distribution mains could also be required to link to the existing trunk mains

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- Effect on the operation of the Manchester Ship Canal will need to be understood.
- Treatment will be complex as the Manchester Ship Canal water carries the variable run-off water from the River Irwell including large parts of the urbanised area of Manchester.
- Provides an alternative source during the planned maintenance programme for the Manchester Ring main.
- Customer contacts could increase within the supply area noting the change in water taste from the usual Lakes water to the new river water.
- Raw water quality issues and other potential abstractions may constrain the volume and timing of abstraction from the canal.

- The owners of the canal may impose additional abstraction charges (above and beyond those charged by the EA) for use of canal water.
- Could be affected by the Surface Water Abstraction Directive (expires 2008).
- Drinking Water Inspectorate (DWI) would require a full project appraisal investigation to be carried out.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 10 Ml/d.

INT 051 – Mid-Cheshire Groundwater

This option consists of returning to service boreholes in mid-Cheshire that are covered by an existing abstraction licence. An existing WTW will be upgraded to provide additional treatment to accommodate known quality drivers from the existing boreholes.

The treated water could then be pumped to a local service reservoir to supplement the local network. However, as the existing local demand is satisfied from other local supplies, the entire new output could also be pumped directly into nearby trunk mains to supplement regional supplies.

The potential opportunity, risks, and uncertainties are:

- UU possess an abstraction licence for this site.
- Known water quality issues with the existing boreholes may degrade further

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 5 Ml/d.

INT 052 – Widnes Groundwater

This option consists of returning to service the Widnes boreholes group in Merseyside. These facilities are owned by UU and are covered by existing abstraction licences.

All the raw waters from the boreholes will be collected into a new break tank and then pumped via a new pipeline to a nearby WTW for treatment. As part of the refurbishment this option will also require testing for yield and water quality constraints at each borehole.

There are no additional water quality drivers involved with this option and therefore no additional treatment facilities are required.

The potential opportunity, risks, and uncertainties are:

- UU possess Abstraction Licences for these sites.
- As a result of this work there are a number of maintenance requirements at existing UU sites that can be completed in conjunction with this option, at a cost lower than would normally be expected.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 22.7 Ml/d.

INT 054 – Southport Groundwater

This option consists of returning to service boreholes in Southport area that are owned by UU and have current valid abstraction licences. This option will also require duty/stand by boreholes at new sites. A new abstraction licence will be required for these new boreholes.

All the raw waters will be collected and transferred to a new WTW via new pumps and pipelines. The treated water will then be transferred to a local service reservoir to be blended with other local source waters.

The potential opportunity, risks, and uncertainties are:

- UU possess Abstraction Licences for most of these sites.
- Groundwater from this aquifer is naturally hard and there is the potential for an increase in customer contacts resulting from a greater proportion of the water supplied to customers containing borehole waters.
- As a result of this work there are a number of maintenance requirements at existing UU sites that can be completed in conjunction with this option, at a cost lower than would normally be expected.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option will be 22.5 Ml/d.

INT 067 – Ribble Valley Groundwater

This option consists of returning to service the existing spring sources owned by UU with abstraction licences in the Ribble Valley. This option includes reinstatement of supplies which still have valid abstraction licences and transfer of the raw waters for treatment at a local WTW.

There are no additional water quality drivers involved with this option and therefore no additional treatment facilities are required.

The potential opportunity, risks, and uncertainties are:

- UU possess Abstraction Licences for the spring sites.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 3.1 Ml/d.

INT 072a – North Warrington Groundwater

This option consists of the refurbishment of the UU owned boreholes located North of Warrington, and to transfer all available raw water to a nearby existing WTW where there are existing treatment facilities. All the raw water collected and treated at this WTW can be fed directly into the local distribution network.

The refurbishment of one of these sites will include the drilling of two new boreholes. At another existing borehole site there is a need to replace the existing connecting main with a larger main to allow for the full abstraction flow to be transferred.

All the existing operational assets at the North of Warrington boreholes site will need to be refurbished and testing will be carried out to check abstraction flows and water quality.

The potential opportunity, risks, and uncertainties are:

- UU possess current abstraction licences for this site.
- Sufficient land ownership is available to re-drill the boreholes.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 3 Ml/d.

INT 073a – Warrington Groundwater a

This option consists of returning to service an existing borehole near Walton, south of Warrington, owned by UU. This borehole has a valid abstraction licence.

This existing borehole has existing disinfection facilities and pipework linking the borehole to a local service reservoir. All the existing assets will need to be refurbished and will require testing to confirm yield and water quality constraints as part of the asset refurbishment. In addition to satisfy disinfection requirements, a duplicate length of main linking the existing borehole to the local service reservoir will be needed. The treated water will be transferred to the local service reservoir to be blended and fed into the Warrington supply system.

The existing disinfection dosing at the boreholes is adequate therefore no additional treatment facilities are required for this option.

The potential opportunity, risks, and uncertainties are:

- UU possess Abstraction Licences for this site.
- Groundwater from this aquifer is naturally hard and there is the potential for an increase in customer contacts resulting from the reintroduction of this source.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option will be 3.5 Ml/d.

INT 073b – Warrington Groundwater b

This option consists of returning to service an existing borehole near Daresbury, south of Warrington, owned by UU. This borehole has a valid abstraction licence.

As the existing borehole has inadequate disinfection facilities a new WTW will be constructed within the site containing the borehole. This option will also require a new pipeline to transfer the treated water from the new WTW to an existing water main. As part of the refurbishment this option will also require testing for yield and water quality constraints.

The treated water will be transferred to a local service reservoir and provide supplies into the Warrington supply system.

The potential opportunity, risks, and uncertainties are:

- UU possess Abstraction Licences for this site.
- Groundwater from this aquifer is naturally hard and there is the potential for an increase in customer contacts resulting from the reintroduction of this source.
- Aquifer depletion is likely to cause a possible long term resource sustainability issue.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option will be 3.4 Ml/d.

INT 101 – Oldham Groundwater

This option consists of using the substantial overflow system of an existing mine shaft near Oldham. The source waters from this new source and the raw waters from another nearby mine shaft would be collected within a new chamber and transferred to a local impounding reservoir near Ogden. UU have a current abstraction licence for one of the mine shafts but not for the other .

This option includes a new raw water pipeline, a new collection chamber, a pump station, and a new raw water pipe to transfer the water to the impounding reservoir. The additional raw water will blend with the impounded waters within the impounding reservoir for treatment. This option would also require a new abstraction licence for the shaft.

As there are no additional water quality drivers involved with this option no additional treatment facilities are required at the WTW.

The potential opportunity, risks, and uncertainties are:

- UU does not possess Abstraction Licences for this site.
- Water quality from the mine adit source will need to be investigated further.
- Need to purchase additional land for the new pump station and collection chamber.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 2.5 Ml/d.

INT 079 – Desalination

This option consists of construction of a new desalination plant on North Mersey shore-line within an existing industrial land use area in Liverpool.

This option includes the provision of an inlet structure and on-shore pipeline. The treated waters will be transferred to an existing service reservoir to be blended with other waters.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- The advantages and disadvantages of desalination technology are relatively untested in the UK water supply industry.
- The scheme will need to be able to discharge high concentration of saline treatment waste into the River Mersey.
- The proposed desalination plant will be developed within the docks areas on the north side of the Mersey and have minimal visual impact.
- This option may not gain support from key environmental stakeholders.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 20 Ml/d.

INT 105 – Raw water transfer from Kielder Water

This option involves the transfer of raw water from Kielder Water in Northumbria to an existing WTW in South Cumbria. This option includes a new pumping main with a pumping station near the source and an intermediate booster station to transfer the raw water for treatment. There are no additional water quality drivers involved with this option and therefore no additional treatment facilities are required.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- Agreement with Northumbrian Water would be required.
- Technically this option is potentially very challenging to implement, increasing the likelihood of project costs increasing significantly.
- Operational cost would be high.
- There would be significant planning and environmental issues associated with the development of this option.
- This option is unlikely to gain support from key environmental stakeholders.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 50 Ml/d

Supply-side options for the West Cumbria Water Resource Zone

The feasible options that we have assessed in the economic (including environmental) appraisals for the West Cumbria Water Resource Zone are listed in Table K. The options are described below.

Table K. Feasible options appraised for source enhancement in the West Cumbria WRZ

Option Reference	Option Name / Description
WC 002	River Derwent Abstraction
WC 006b	South Egremont Groundwater (4.6Ml/d)
WC 006c	South Egremont Groundwater (6.4Ml/d)
WC 007	Roughton Gill mine adit
WC 008a	Waverton Groundwater
WC 008b	Thursby Groundwater
WC 013	Raw Water from Third Party
WC 014	Compensation flow control

WC 002 – River Derwent Abstraction

This option involves use of part of an existing abstraction form the River Derwent. Currently the raw water abstracted from River Derwent is partially treated to provide supplies to industrial customers.

The option would include a take-off from the existing pumped raw water pipeline to a new WTW with subsequent transfer via a new pipeline to a local service reservoir. The additional potable water would supplement the supplies to North Allerdale.

No change to existing abstraction licence volumes would be required as the water abstracted would be within existing licence conditions.

The potential opportunity, risks, and uncertainties are:

- UU possess an abstraction licence for this site.
- EA are currently reviewing the abstraction licence and so water availability may be reduced.
- It is likely that there would be opposition from environmental and angling groups and so this option would be difficult to promote.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 3 Ml/d.

WC 006b – South Egremont Groundwater (4.6 Ml/d Option) and Hayborough reinforcement

This option consists of developing boreholes to the south of Egremont and would be used to support the supplies from Ennerdale to the Copeland area, and make some water available for transfer to the Allerdale area.

This option will require new mains to be laid from each borehole site to a new tank and pump station with a pipeline to a new WTW (5 Ml/d capacity) constructed adjacent to an existing service reservoir near Whitehaven.

As part of this scheme there would also be the need for a new pipeline between Hayborough and Crosby (to the north of Workington) to reinforce supplies to Aspatria in the North Allerdale area, which will be impacted by the Dash Beck sustainability reduction. The South Egremont groundwater part of scheme would make water available to the Copeland area to support supplies from Ennerdale and make more water available for transfer to North Allerdale provided the Hayborough reinforcement main is installed.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- Sufficient land is available to construct a new WTW at a local service reservoir.
- There is potential uncertainty regarding the exact yield that can be achieved.
- Discussions with the EA have identified this as a potentially acceptable new water source for West Cumbria.
- Further environmental assessment is required as the abstraction could impact flows in the River Ehen, downstream of the Special Area of Conservation, designated under the EU Habitats Directive.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 4.6 Ml/d.

WC 006c– South Egremont Groundwater (6.4 Ml/d Option) and Hayborough reinforcement

This is very similar to option WC006b, but with additional abstraction, transfer and treatment capacity (7 Ml/d instead of 5 Ml/d).

The deployable output for this option is expected to be 6.4 Ml/d.

WC 007 - Roughton Gill Mine Adit

This option consists of refurbishing the mine adit at Roughton Gill and to provide a transfer raw water main to a local impounding reservoir to increase the raw water supply to local WTWs and to improve supplies to the North Allerdale area. The refurbishment of this site will include the replacement of the existing mains and a new gravity main to an existing impounding reservoir. A new delivery chamber will also be required.

The potential opportunity, risks, and uncertainties are:

- UU possess an abstraction licence for this site, which has been unchanged by the EA review of consents for the River Eden Special Area of Conservation.
- The source was in regular use until a few years ago and so the deployable output is well understood.
- Water quality from the mine adit may require further investigation.
- The pipeline would cross part of the Lake District National Park.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 1.4 Ml/d.

WC 008a – Waverton Groundwater

This option consists of development of new boreholes near Waverton, South West of Carlisle, and to transfer the collected raw water to a local WTW. This additional source will assist in the required increase in the supply into West Cumbria.

This option will require a new raw water main from the borehole site to connect into the existing raw water mains in the area.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- There is no additional water treatment facility required for this option.
- The EA are concerned about the potential for impacts on surface flows.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 0.7 Ml/d.

WC 008b – Thursby Groundwater

This option consists of development of new boreholes near Thursby, South West of Carlisle, and to transfer the collected raw water to a local WTW. This additional source will assist in the required increase in the supply into West Cumbria.

This option will require the provision of a new borehole with a new raw water main from the borehole site to the existing breakwater tank at the WTW.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- There is no additional water treatment facility required for this option.
- The EA are concerned about the potential for impacts on surface flows.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 1 Ml/d.

WC 013 – Raw Water from Third Party

This option requires the negotiation of the provision of raw water (potentially a mix of lake, river and borehole water) from a third party, within existing abstraction licence limits. The source waters would be collected and transferred to a new WTW at a local service reservoir. It would be used to support the supplies from Ennerdale to the Copeland area, and make some water available for transfer to the Allerdale area.

This option will require a new treatment works, a new pump station, and a long water pipeline to convey the water to a UU service reservoir site. The new WTW would need to be capable of treating a mix of lake, river and borehole water.

The potential opportunity, risks, and uncertainties are:

- No new abstraction licence is required.
- It would require the agreement of a third party, and would be dependent on adequate spare water being available for use by UU.
- Complex water treatment and long pipeline would be required.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 10 Ml/d.

WC 014 – Compensation Flows

This option consists of a new compensation flow regulator at Crummock Water. Currently the facility to control the compensation waters at Crummock Water is inefficient so that more water is being passed from the lake to the River Cocker than required by the abstraction licence.

This option requires equipment and controls to provide a facility to release more accurate compensation flows, thereby allowing more water to be retained in Crummock Water and to be available for abstraction and treatment.

The potential opportunity, risks, and uncertainties are:

- Efficient compliance with existing abstraction licence agreements.
- The accuracy of control that is practically achievable is uncertain.
- In-river works would be required at the Crummock outlet weir, within a Special Area of Conservation and a highly visited part of the Lake District National Park.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 2.5 Ml/d.

Supply-side options for the Carlisle Water Resource Zone

This section describes the most likely feasible supply option to potentially increase water available for use (WAFU) within the Carlisle WRZ. Although there is no predicted supply-demand deficit in the Carlisle water resource zone, UU has been asked by the EA to indicate the type of option that might be considered if a deficit were to occur.

CAR 001 Kirklinton Groundwater

This option consists of developing new boreholes near Kirklinton, North of Carlisle.

This option will require the development of new boreholes, a new WTW located at the new borehole site and a connecting main to a local service reservoir. This option will aid supplies to the North Carlisle area and reduce the supply from other WTWs that will be impacted by local resource reductions.

The potential opportunity, risks, and uncertainties are:

- A new abstraction licence from the EA would be required for the development of this option.
- Water quality data available from this water source suggests that there are no significant problems.
- The exact output of this scheme will be defined following yield testing.
- Unlikely to have any significant regulatory issues.

The economic appraisal, including environmental and social effects is summarised in Chapter 11, and the strategic environmental appraisal is presented in Chapter 12.

The deployable output for this option is expected to be 1 Ml/d.

Utilisation-based AISCs of supply-side options

Table L presents "utilisation-based" average incremental social costs (AISCs) for supply-side schemes as requested by the EA. In the case of demand-side options utilisation-based AISC values are the same as the "capacity-based" AISCs presented in Chapter 11.

The utilisation-based AISCs compare options according to the quantity of water used. In Chapter 11 we have presented capacity-based AISCs, which compare options according to the quantity of water that a scheme can deliver. The capacity-based AISC values more accurately reflect the relative cost-efficiency of options in our economic analyses to determine the best combinations of options that overcome the future supply-demand deficits.

Table L. Utilisation-based AIC and AISC values for supply-side options

Option title, reference and summary description	WAFU benefit (Ml/d)	AIC (p/m^3)	Env & social cost (p/ m^3)	AISC (p/m3)
Huntington WTW Upgrade (INT 003)	5.89	210.25	49.03	259.27
River Ribble abstraction (INT 006)	3.34	401.11	60.53	461.65
Manchester Ship Canal abstraction (potable) (INT 009b)	1.96	447.01	17.21	464.22
Mid Cheshire Groundwater (INT 051)	0.98	236.47	0.77	237.24
Widnes Groundwater (INT 052)	4.46	119.61	2.39	122.00
Southport Groundwater (INT 054)	4.42	155.90	2.98	158.88
Ribble Valley groundwater (INT 061)	0.61	316.11	0.35	316.46
North Warrington Groundwater (INT 072a)	0.59	443.37	1.55	444.93
Warrington Groundwater a (INT 073a)	0.69	311.96	3.01	314.97
Warrington Groundwater b (INT 073b)	0.67	358.11	3.09	361.19
Desalination from Mersey Estuary (INT 079)	3.93	249.60	382.80	632.41
Oldham groundwater (INT 101)	0.49	145.28	5.53	150.80
Raw water transfer from Kielder Water (INT 105)	9.82	404.93	196.45	601.38
River Derwent Abstraction (WC 002)	0.56	667.09	107.65	774.74
South Egremont groundwater (4.6 Ml/d) + Hayborough reinforcement (WC 006b)	0.87	448.74	40.10	488.85
South Egremont groundwater (6.4 Ml/d) + Hayborough reinforcement (WC 006c)	1.20	336.33	30.28	366.61
Roughton Gill mine adit (WC 007)	0.26	210.29	2.07	212.36
Waverton groundwater (WC 008a)	0.13	604.11	42.09	646.20
Thursby groundwater (WC 008b)	0.19	847.75	34.24	881.99
Raw water from third party (WC 013)	1.71	449.37	100.23	549.60
Compensation flows (WC 014)	0.28	106.02	36.65	142.66

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