Appendix B What is the likely demand for water?

The chapters in Appendix B provide an overview of the different uses of water supplied in our region and an explanation of the methodology we use to make projections of how demand will change over the next 25 years. We make our projections under two scenarios:

- dry year conditions as we are required to do so by the Environment Agency (EA) for water supply planning purposes, and
- average year conditions as we required to do so by Ofwat for revenue planning purposes

The demand scenarios incorporate the policy assumptions specified in the EA's Water Resources Planning Guideline (2012). We also produce our demand projections in two stages:

- a baseline demand forecast
- a final planning demand forecast

The baseline assumes that as a minimum we will continue existing demand management activity and leakage reduction. The baseline demand forecast to 2040 therefore

- assumes a continuation of optional metering at current rates
- maintains leakage at the 2015 level
- assumes a continuation of our AMP5 water efficiency base activity

We then test the costs and benefits of additional leakage reduction and demand management measures to produce our final planning forecast.

We have produced demand forecasts based on assumptions about how water consumption will change over the next 25 years, including an assessment of the impacts of climate change. We have also taken account of Government water efficiency and demand management policies and aspirations. We have used the summary of current Government policies and aspirations presented in the WRMP guiding principles to inform the assumptions incorporated into our forecast of demand. In summary these are:

- Demand trends to be downwards where a company is in an area designated as water stressed, or where it has demand above the national average (147 litres per head per day)

- Where an increase in population or commercial use leads to increases in total demand, the company must ensure that its plan demonstrates a decrease in per capita consumption

- The Government expects water companies to show in their water resources management plans how they will promote efficient water use and the impact that will have.

- The Government has concluded that a blanket approach to water metering is not the right way forward, as the costs and benefits of metering programmes will vary from region to region, depending on the level of water stress and environmental and social factors. However, where a water company is in an area designated as an area of serious water stress, it must consider compulsory metering as part of the feasible options in its options appraisal providing full costs and benefits of its proposals

Appendix B: What is the likely demand for water?

The chapters in Appendix B demonstrate how our plan aims to achieve Government policy targets and aspirations for the demand forecast, and covers the following elements of water demand:

- household consumption;
- non-household consumption;
- leakage;
- other minor areas of demand.

B1 Recent demand for water in the Severn Trent region

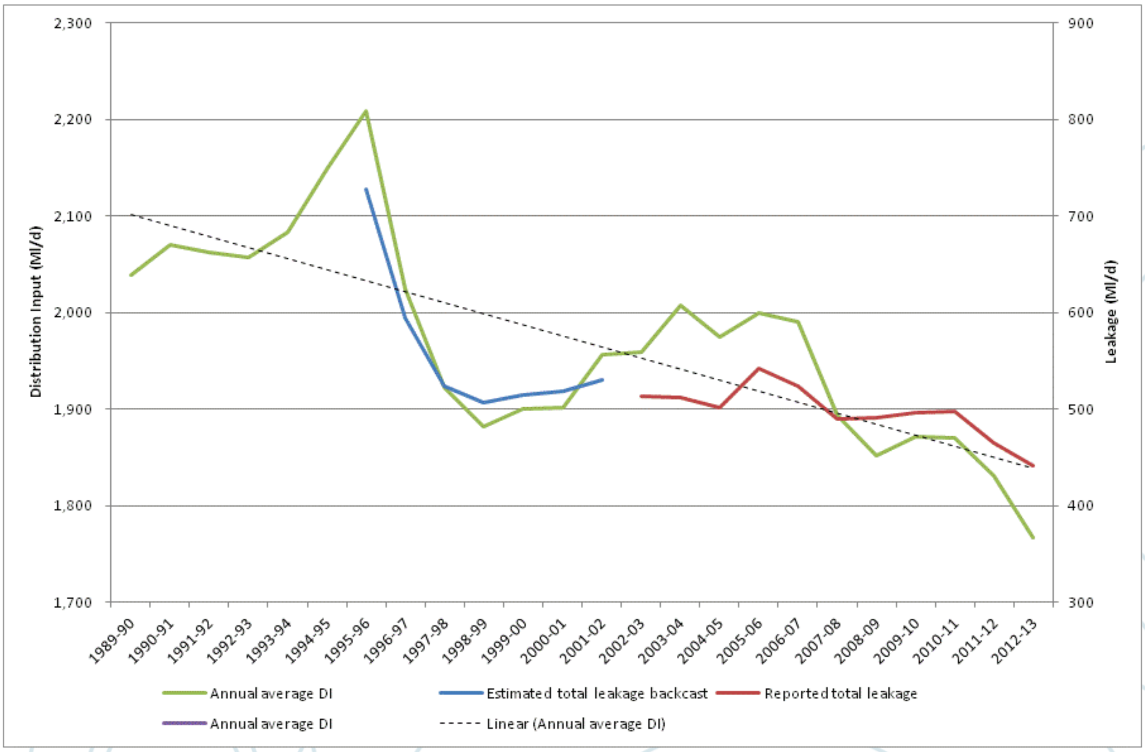
Distribution input is the term we use to describe the total quantity of treated water that we put into supply, and is composed of:

- demand from measured household and unmeasured household customers;
- demand from measured non-household and unmeasured non-household customers;
- leakage from our underground infrastructure, such as mains, distribution systems and communication pipes, the sum of which is known as distribution losses (DL);
- leakage from the underground supply pipes owned by our customers (which is referred to as underground supply pipe losses, USPL);
- minor components , such as water taken unbilled and distribution system operational use

Figure B1.1 shows the record of annual average distribution input in our region as a whole since 1989. The overall trend is one of general decline in average distribution input, but it is punctuated by the significant peak recorded during the mid-1990's. The highest levels of demand recorded in the region were experienced during 1995-96, which was a year of extreme summer temperatures and very low rainfall.

Following 1995-96, there were significant reductions in distribution input, driven by the large scale reductions in water lost through leakage. Between 1995-96 and 1998-99, estimated total leakage fell by around 220Ml/d (30%), and total distribution input fell by around 400Ml/d (15%).

Figure B1.1: Severn Trent Water total distribution input since 1989

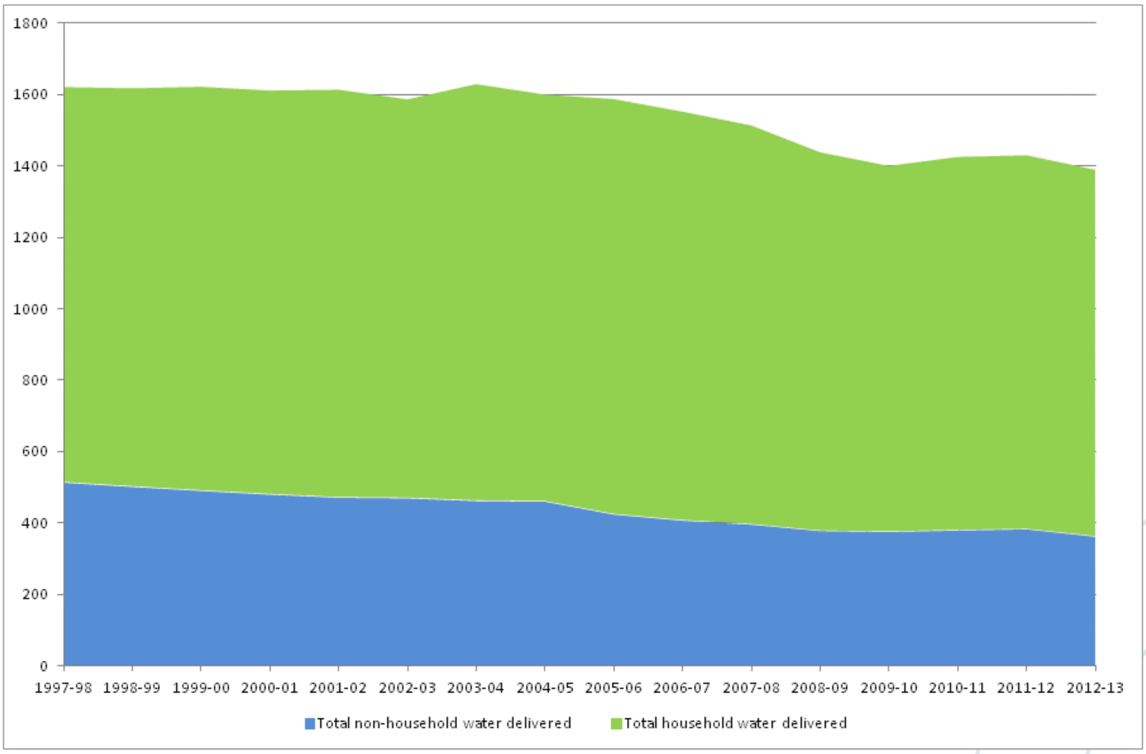


Appendix B: What is the likely demand for water?

Figure B1.2 shows the trends in water demand from household and non-household customers over the last 15 years. The general trends have been that household demand has shown a decrease of 5% since 1997-98, while commercial demand has shown a decline of around 25% over the same period. Despite a growing population and household customer base, the total demand for water has declined over the past 15 years. Household demand has decreased marginally despite population and household number growth and reflects the success of water efficiency efforts by our household customers and impact of metering on consumption. More recently, a series of relatively cool and wet summers has resulted in a steep decline in household consumption.

Non-household demand has steadily declined since the 1990's. Between 2007 and 2010 the rate of decline has been greater due to the economic downturn resulting in less water use as businesses close or reduce output, and continued water efficiency efforts.

Figure B1.2: Severn Trent Water total water delivered (Ml/d) since 1997



Forecasting demand for water

To estimate future distribution input, we produce projections of each component of demand separately, and sum them to derive customers' consumption and total demand inclusive of total leakage. In brief, the methodology for forecasting household customers' consumption entails producing year on year forecasts of population and the number properties to be served, along with year on year forecasts of the annual average unit consumption in each of those property types. We then multiply the property and unit consumption forecasts for each property type.

Appendix B: What is the likely demand for water?

For each of our fifteen water resource zones, we have generated household property and population change projections which have been used to generate a forecast of household water consumption in measured and unmeasured properties to 2040.

Measured and unmeasured household consumption has been forecast using a model of how changes in consumption behaviour, water using appliance technology and other factors all influence demand.

Non household demand is forecast via econometric analysis to identify the historical relationship between water demand and explanatory factors such as industrial output, employment and trends in efficiency of water use. The results of this statistical analysis are combined with forecasts of output and employment by industry sector within the Severn Trent Water Supply Area to provide non-household water demand forecasts.

Our baseline distribution input scenario assumes that, as a minimum, our 2014/15 leakage target is maintained with no decline to 2039/40. It is important to note that simply maintaining this level of leakage over time will require significant investment to offset the underlying leakage breakout rate (LBR) in leakage which results from mains deterioration over time.

These assumptions are consistent with the EA's guidance in respect of the baseline scenario.

B2 Forecasting household demand for water

We forecast the demand for water from households in each of our resource zones and, by aggregation, over the company area as a whole, using the industry-standard component-based forecasting methodology. The key components used in forecasting household demand are:

- Population and household numbers
- Consumption in unmeasured households (i.e. those who do not have a metered supply)
- Consumption in measured households (i.e. those who have a metered supply)

In each case, we determine the current position in a base year, and then forecast changes in each component from that starting year over the following 25 years. We take account of demographic, social, economic, lifestyle, environmental and such other factors as are likely to influence how consumption patterns may change over the next 25 years. We break consumption in measured and unmeasured household down into micro-components which together sum to give the overall consumption total. The micro-components we use are:

- toilet flushing;
- personal washing;
- clothes washing;
- dish washing;
- miscellaneous internal use;
- external use.

We then forecast changes in water consumption at the micro-component level over the planning horizon, by considering changes in water using appliance ownership (O), frequency of use (F) and volume of use (V) as applicable to each micro-component. This allows us to construct a total forecast that considers how and why the individual elements of water consumption may change over time.

We have produced household annual average demand forecasts for each of the following scenarios

- baseline dry year;
- baseline weighted annual average;
- baseline utilisation (where a deficit exists);
- final planning dry year;
- final planning weighted annual average.

The base year for derivation of the PCC forecasts is 2010/11. It was chosen in preference to 2011/12 (for which more recent June Return data is available), because 2010/11 household demand was close to a normal year demand based on an analysis of historic annual average PCCs from our Domestic Consumption Monitor from 1987 to 2012. 2010/11can therefore be used as a normal year without modification, whereas 2011/12 was a drier year. The 50th percentile of ranked DCM PCCs gives the most likely annual average PCC in the record i.e. the normal year PCC. 2010/11 PCC (126.3 litres/head/day) is equivalent to the 50th percentile of ranked historic PCCs demonstrating the likeness of 2010/11 PCC to a normal year PCC. 2011/12 PCC (124.2 litres/head/day) is 2 litres/head/day less that the 50th percentile, hence the choice of 2010/11 as normal year without adjustment for the PCC forecast.

B2.1 Base year population and properties

Base year household population

Base year Resource Zone population estimates have been developed using the latest population estimates from CACI, a specialist demographic data provider, and use a combination of Census 2011 and 2011 Office of National Statistics (ONS) mid year estimates to produce the best available population estimates for the current year. Postcode level estimates are mapped geographically to water resource zones to produce household population estimates at water resource zone level.

Adjustments are made for estimates of additional hidden and transient population, neither of which are accounted for in Census data or ONS estimates. To account for population in properties on private water supplies, private water supply data is gathered direct from local authority records.

Census 2011 data has been used to update our final WRMP.

Base year non-household population

Non-household population data is derived from the Census 2011 communal population (prisons, hospitals etc) data at postcode sector level which is geographically mapped to the water resource zones. Non-household population data is applied only to measured non-households. Unmeasured non-household population is assumed to be zero as all communal establishments will be metered.

Base year household properties

For the base year 2012/13 the numbers of unmeasured household, measured household and void household properties are taken from our company billing system, TARGET. Property records are allocated to Water Resources Zones using their postcodes. These data form the base year numbers from which we forecast property numbers for each future year to 2040.

B2.2 Forecasting population

For estimates of future total population we have used the latest Government projections for England and Wales and have applied these to our base year data. These projections are taken from the 2011 base sub-national population projections for England and Wales from the ONS.. The annual percentage rates of change for local authorities are applied to the base year population estimates at postcode level and then aggregated up to water resource zone level. This gives the underlying change in population due to births, deaths and migration in our region. The ONS 2011 base projections of population extend to 2021 while we are required to project to 2040. 2010 based longer term ONS projections have been used for projections to 2036. To extend the population estimates to the full planning period we have extended population trends in the latter years of the ONS forecast to 2040.

Having derived the overall population trend for our region, we next allocate future population changes across different property categories (unmeasured and measured households) and take account of population movement between these categories.

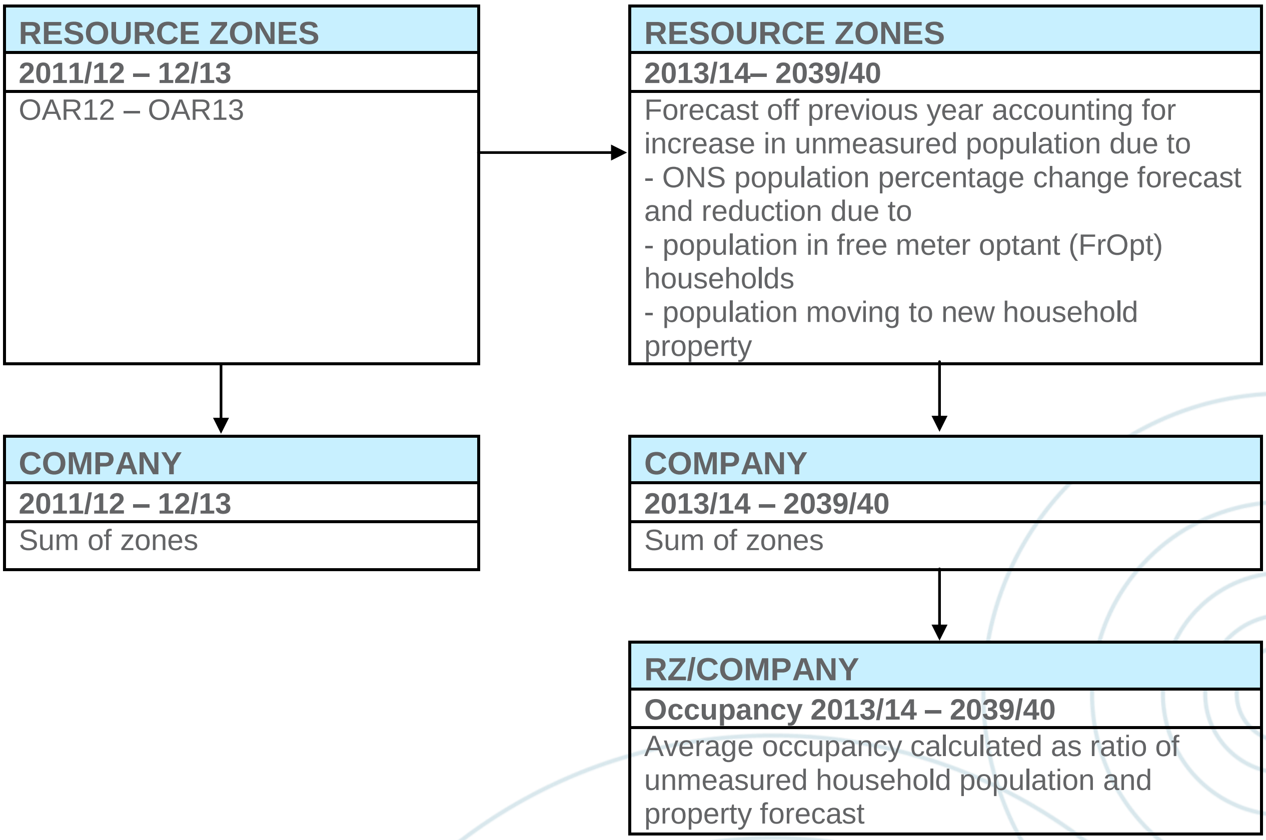
It is necessary to allocate the population forecast between property types as this defines the property occupancies which influence the level of water use in each household.

The following section details the population forecast allocation methodology.

Unmeasured household population forecast

For each resource zone, our starting point is the reported 2012/13 unmeasured household population from the Ofwat Annual Return 2013 (OAR13). The impact of our assumptions for ONS rates of growth, future rates of metering and new property population generates the unmeasured household population forecast for each resource zone. At the company level, base year and forecast year population of unmeasured households are calculated as the sum of the population of unmeasured households in the fifteen resource zones. Figure B2.1 shows how unmeasured property population is forecast.

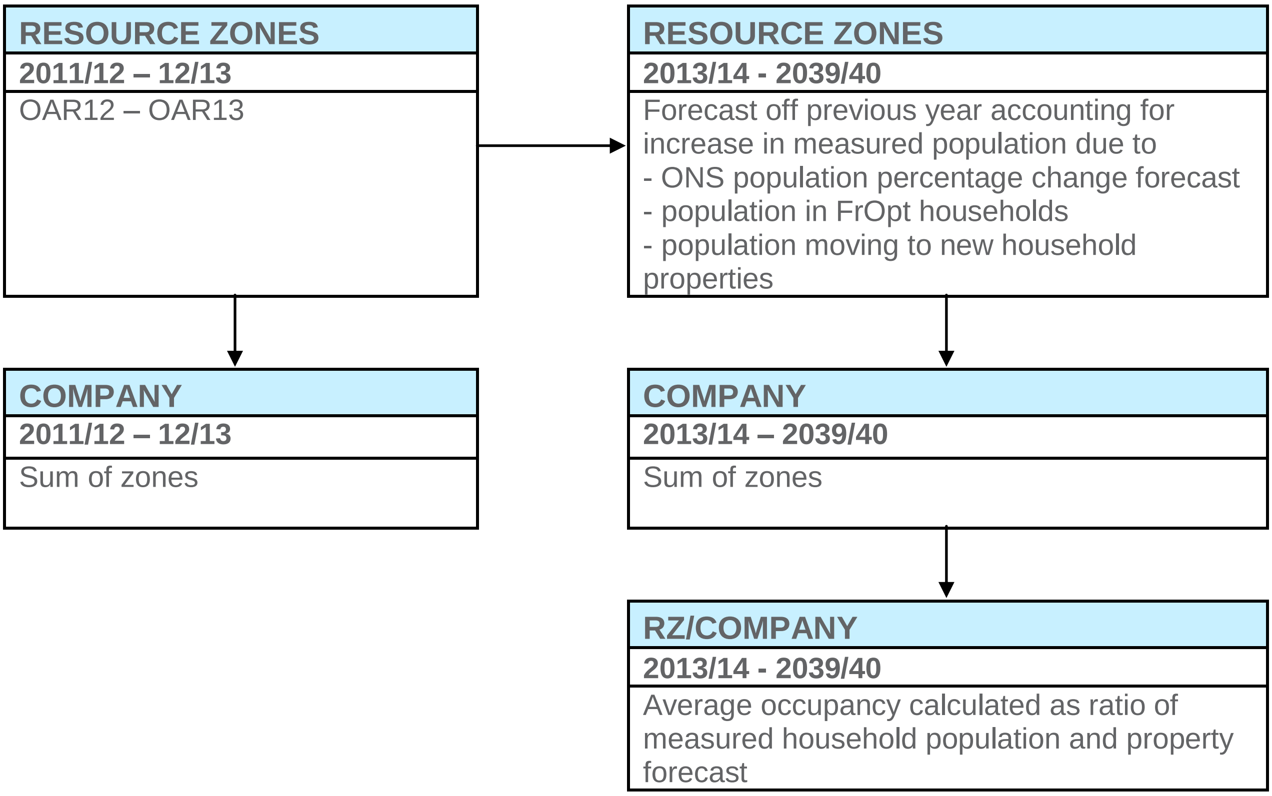
Figure B2.1: Flow chart showing derivation of unmeasured household population forecast



Measured household population forecast

For each resource zone, our starting point is reported 2012/13 number of measured households from OAR13. The impact of our assumptions around future metering uptake, new property builds and demolitions then generates the net measured household numbers forecast for each resource zone. At the company level, base year and forecast year number of measured households are calculated as the sum of the number of measured households in the fifteen resource zones. Figure B2.2 shows how unmeasured property population is forecast.

Figure B2.2: Flow chart showing derivation of measured household population forecast



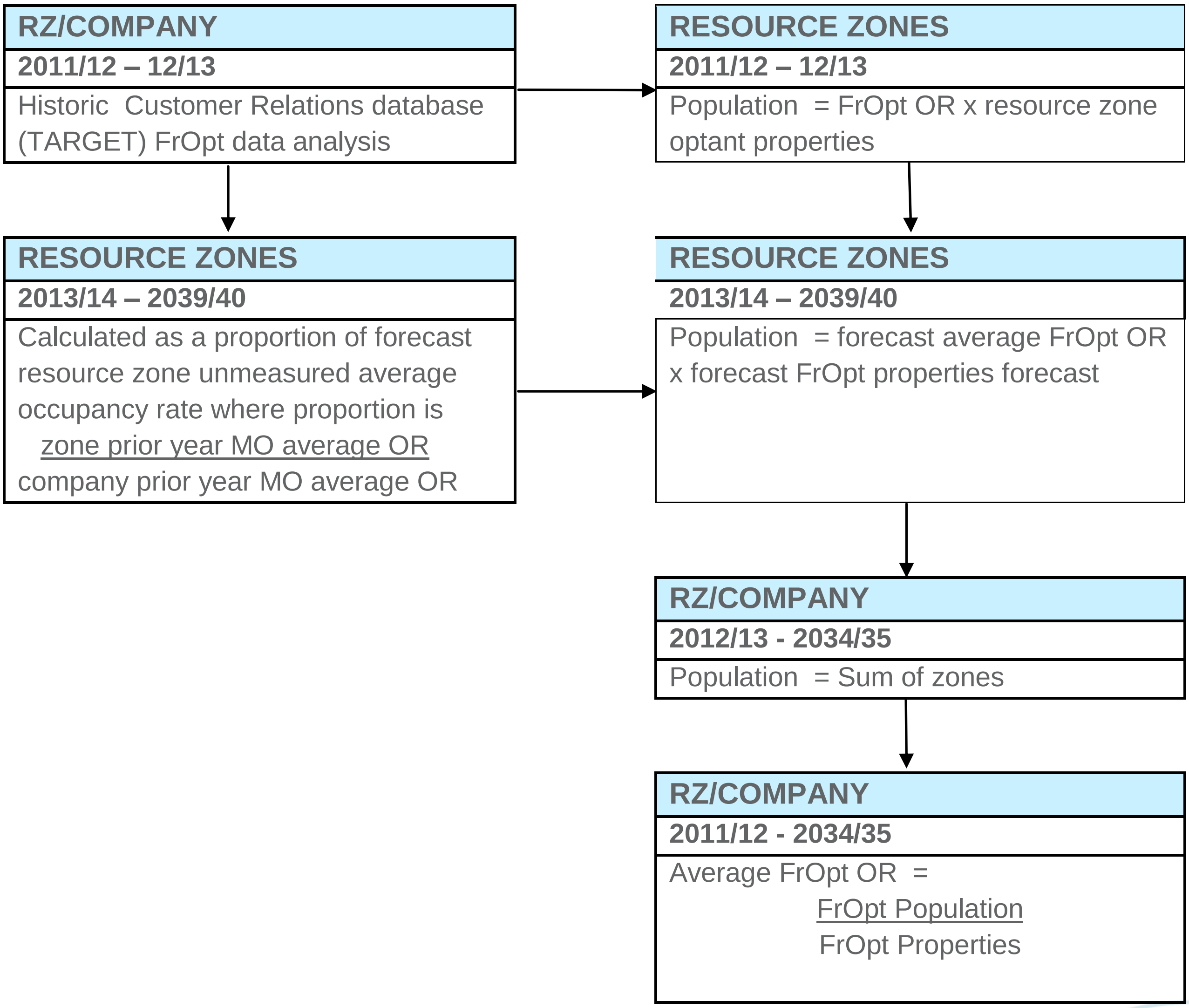
Meter optants population

Customers who opt for a meter do so to reduce their water bills, and they tend to be low occupancy properties with an average household consumption below the average unmeasured household consumption. We have analysed historic meter optant data from our billing system records to derive a base year meter optant average occupancy of 1.47. This is lower than the average unmeasured household occupancy of 2.51.

For our forecast, we have maintained a constant ratio between meter optant average occupancy rate and unmeasured average occupancy rate. As lower than average occupancy unmeasured properties opt for a meter, the average occupancy of the remaining unmeasured customer base will rise. Year on year, the average occupancy rate of unmeasured customers that opt for a meter will also rise (since lower occupancy properties would have opted in earlier years). This ratio approach to forecasting meter optant average occupancy rate captures the changing profile of the unmeasured occupancy rate over time.

Figure B2.3 shows how unmeasured property population is forecast.

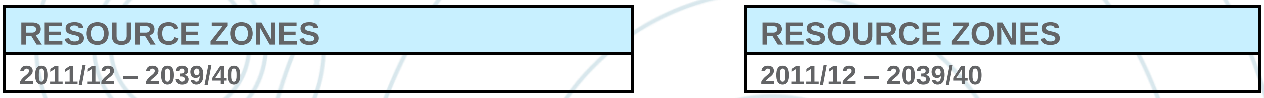
Figure B2.3: Flow chart showing derivation of free meter optant household population forecast



New household property population

Population in new household properties is the product of our forecast of the number of new households, and an assumption for occupancy. The new household property occupancy is calculated each year as the average occupancy of all households (unmeasured and measured) in our region. Figure B2.4 shows how unmeasured property population is forecast.

Figure B2.4: Flow chart showing derivation of new household population forecast



Average Occupancy: for each year, calculated as average of unmeasured and measured household occupancy (% measured properties x average measured occupancy + % unmeasured properties x average un measured occupancy)

→ Population calculated as the product of forecast property numbers and occupancy

↓

COMPANY
2011/12 – 2039/40
Population calculated from sum of zones

←

COMPANY
2011/12 – 2039/40
Average occupancy = $\frac{\text{Population}}{\text{Properties}}$

Non-household population forecast is the base year population held constant over the planning period, as recommended in Section 9.3 of the Environment Agency guidelines 'Methods of Estimating Population and Household Projections: Update 2012' published June 2012.

B2.3 Property forecasts

We forecast household property numbers for two property categories; unmeasured household, that is properties that do not have a water meter fitted and pay for their water on the basis of property rateable value, and measured households that have a water meter fitted. Measured properties include:

- New properties
- Meter optant properties i.e. properties that were previously unmetered and opt to have water meter installed
- Selectively metered properties i.e. properties that were previously unmetered and have water meter installed during a change of occupier

Within the measured category, we forecast new household property (all such properties are metered) numbers and newly metered properties i.e. properties that were previously unmetered and opt to have water meter installed.

It is necessary to forecast each of these property types due to their differing consumption characteristics. The occupancy characteristics of each of these property types combined with differing consumption characteristics defined by forecast behavioural and technological change assumptions, gives rise to differing household consumption forecasts between property types. Aggregating each of the property consumption forecasts gives the overall household demand forecast.

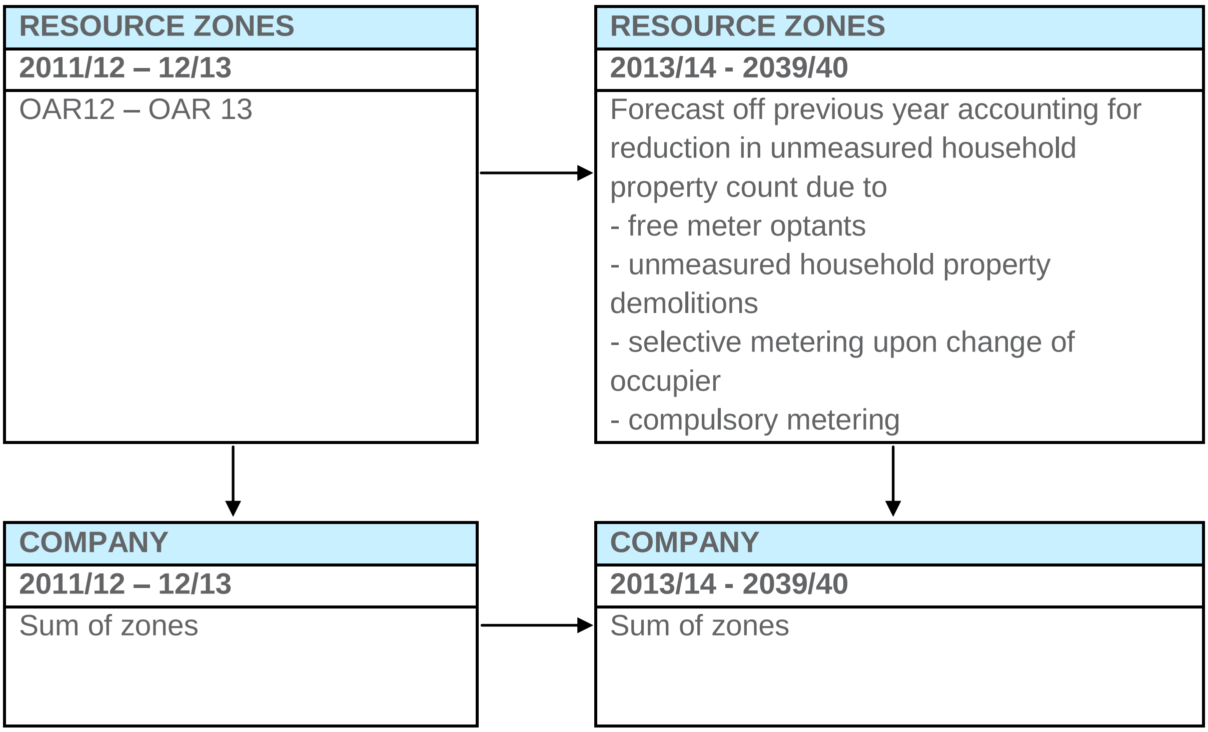
The following section details the property forecast methodology.

Unmeasured household property forecast

Appendix B: What is the likely demand for water?

For each resource zone, our starting point is the reported 2012/13 unmeasured households from the Ofwat Annual Return 2013 (OAR13). The impact of our assumptions around future rates of metering and demolitions then generates the unmeasured household numbers forecast for each resource zone as shown in figure B2.5. At the company level, base year and forecast year number of unmeasured households are calculated as the sum of the number of unmeasured households in the fifteen resource zones.

Figure B2.5: Flow chart showing derivation of unmeasured property forecast

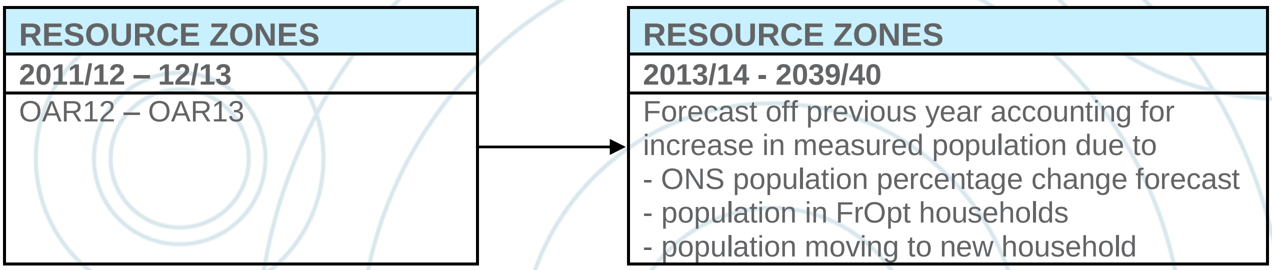


Measured household properties forecast

For each resource zone, our starting point is reported 2012/13 number of measured households from OAR13. The impact of our assumptions around future metering uptake, new property builds and demolitions then generates the measured household numbers forecast for each resource zone. At the company level, base year and forecast year number of measured households are calculated as the sum of the number of measured households in the fifteen resource zones.

Figure B2.6 below shows how measured property numbers are forecast:

Figure B2.6: Flow chart showing derivation of measured household population forecast



properties

COMPANY
2011/12 – 12/13
Sum of zones

COMPANY
2013/14 – 2039/40
Sum of zones

RZ/COMPANY
2013/14 - 2039/40
Average occupancy calculated as ratio of measured household population and property forecast

Property forecast assumptions

In arriving at our property forecast for unmeasured and measured households we make a number of assumptions to derive each profile. The following section sets out the basis for our baseline forecast assumptions for household properties.

Baseline metering

Free meter option

Our baseline demand forecasts assume a continuation of current rates of optional metering of unmeasured households. This section describes the derivation of our baseline metering forecast. For the final Water Resources Management Plan 2009 (WRMP09), our baseline free meter optants (FrOpts) forecast was set at the 2008/09 rate of metering. This was 2% of unmeasured households per annum.

Table B2.1 shows the rate of metering for AMP4 and up to 2012/13. The observed rate of FrOpts has been below our WRMP09 forecast since 2009/10.

Table B2.1: Rate of metering from 2005/06 to 2012/13

	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Unmeasured households opting each year	1.45%	1.75%	1.53%	2.09%	1.98%	1.42%	1.69%	1.85%
	Average annual rate of FrOpts 2005/06 - 2012/13							1.74%

Appendix B: What is the likely demand for water?

Continuing FrOpts uptake at the average rate of 1.74% of unmeasured customers per annum from 2015/16 alongside the projected metering targets for the remainder of AMP5 gives the following profile:

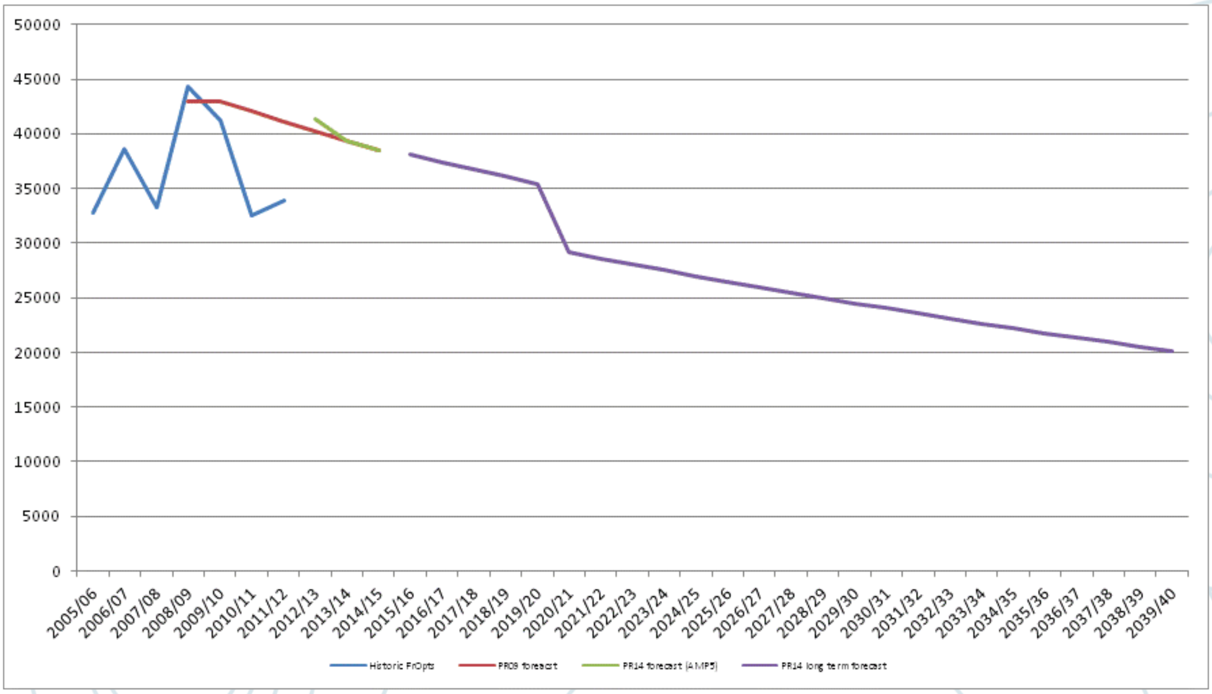
	OAR13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
FrOpt forecast	36,076	39,350	38,490	32,566	31,953	31,351	30,760	30,179

Given the anticipated level of metering for the remainder of AMP5, we have uplifted the 2015/16 household FrOpts volume to current levels and continued the above trend. Additionally, we forecast a further 2,000 FrOpt meters per annum in AMP6 resulting from a pro-active vulnerable customers metering programme. This gives the following profile:

	OAR13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Uplifted FrOpts forecast	36,076	39,350	38,490	36,076	35,397	34,730	34,075	33,432
Vulnerable FrOpts in AMP 6				2,000	2,000	2,000	2,000	2,000
Total FrOpts	36,076	39,350	38,490	38,076	37,397	36,730	36,075	35,432

Figure B2.7 shows the resulting baseline FrOpt metering profile.

Figure B2.7: Historic metering and WRMP14 baseline metering forecast



Our baseline demand forecast for the remainder of AMP5 assumes a continuation of metering activities assumed in price limits at PR09 for 2012/13 to 2014/15. In the long term free meter optants projection, there is a steady fall in the number of meter optants due to the diminishing number of unmeasured properties over time.

Selective metering

As part of our WRMP09, we proposed a change of occupier metering trial during AMP5 to understand the costs, logistics and impacts of carrying out such an activity. We undertook this trial in Leicestershire and while it was expected to last for the full five years, change of occupier activity in the selected area was greater than expected and as a result the pilot was completed in November 2012. In that period 11,000 meters were installed over 16 months at a cost of £2 million. The consumption saving from these meters is estimated at 0.3Ml/day (based on an assumed 8% saving and a per capita consumption of 130l/h/d). We will continue to monitor the consumption of these households over the next 18 months to build upon our current understanding of consumption behaviour of newly metered customers and better inform our forecasting assumptions.

The trial proved the initial concept and it gave us insight to the issues and gaps that would need addressed should a full roll out be considered company wide. These included resourcing, contractor service level agreements, impact on income, legal process to enforce meter fits and the impact on SIM/company reputation. The trial proved highly unpopular with our customers and generated 146 written complaints, which represents 60% of all customer complaints in the geographic area during the trial period. The trial has demonstrated that while change of occupier metering is a feasible way of increasing uptake, it is not the most cost effective means of demand management, for example when compared to water efficiency and leakage management, and has therefore been excluded from the baseline forecast.

Compulsory metering of households is not part of our existing demand management policies and so does not feature in the baseline scenario properties forecast. Our supply region has not been designated as an area of serious water stress by the Environment Agency, and so we do not have legal powers to compulsorily meter household customers.

Demolished household properties forecast

We have reviewed historic household demolition trends for our region to derive our forecast assumption.

Figure B2.8 below shows recent historic household demolitions in the Severn Trent region. There is quite a variation in demolitions, peaking at approximately 4,750 households in 2007/08, then trending downwards to a low of approximately 3,000 in 2012/13. To take account of current levels of demolitions we have set household demolitions at the average rate of 2010/11 to 2012/13.

Figure B2.8: Historic household demolitions and forecast for the Seven Trent region

Appendix B: What is the likely demand for water?

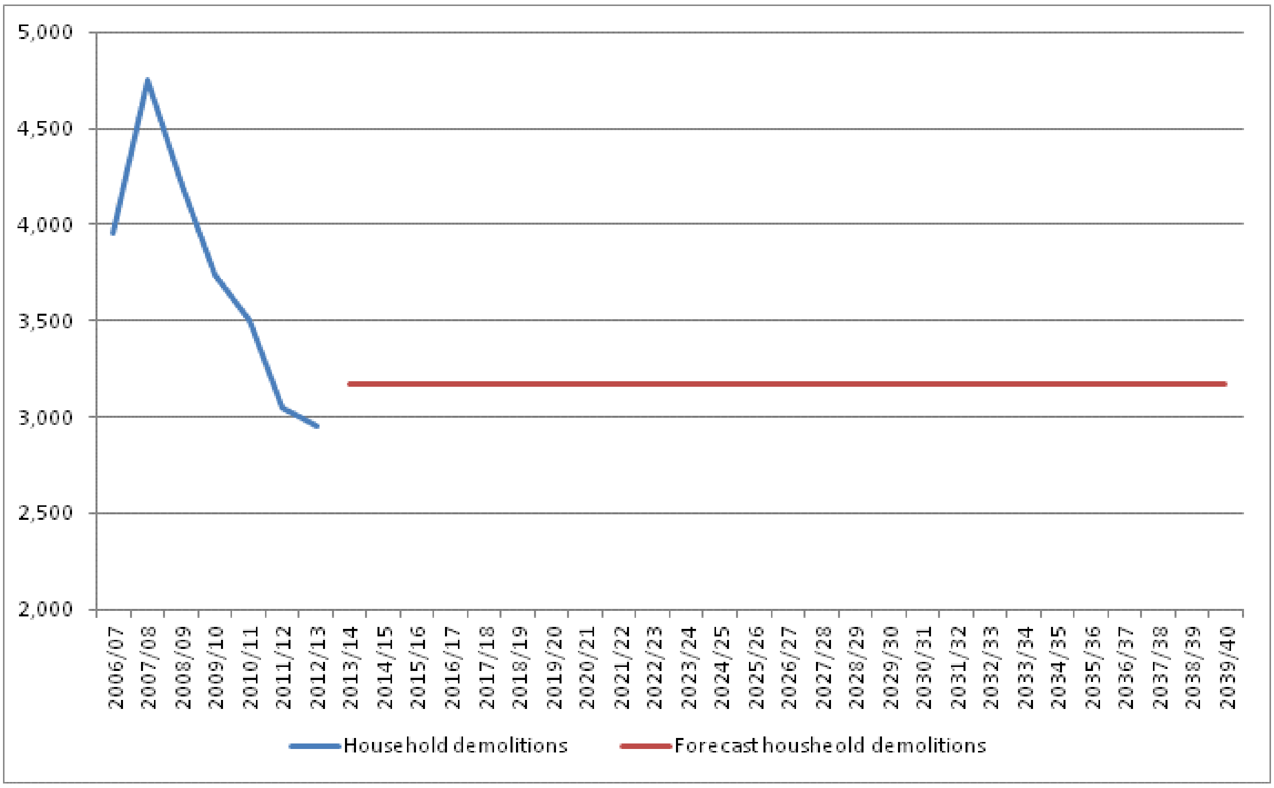
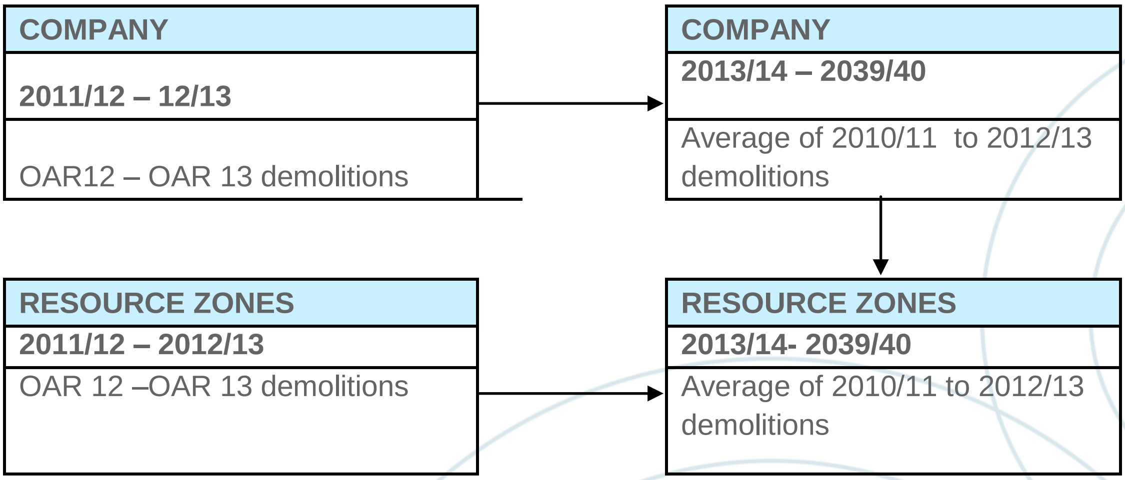


Figure B2.9 shows the derivation of the household demolitions forecast.

Figure B2.9: Flow chart showing derivation of household demolitions forecast

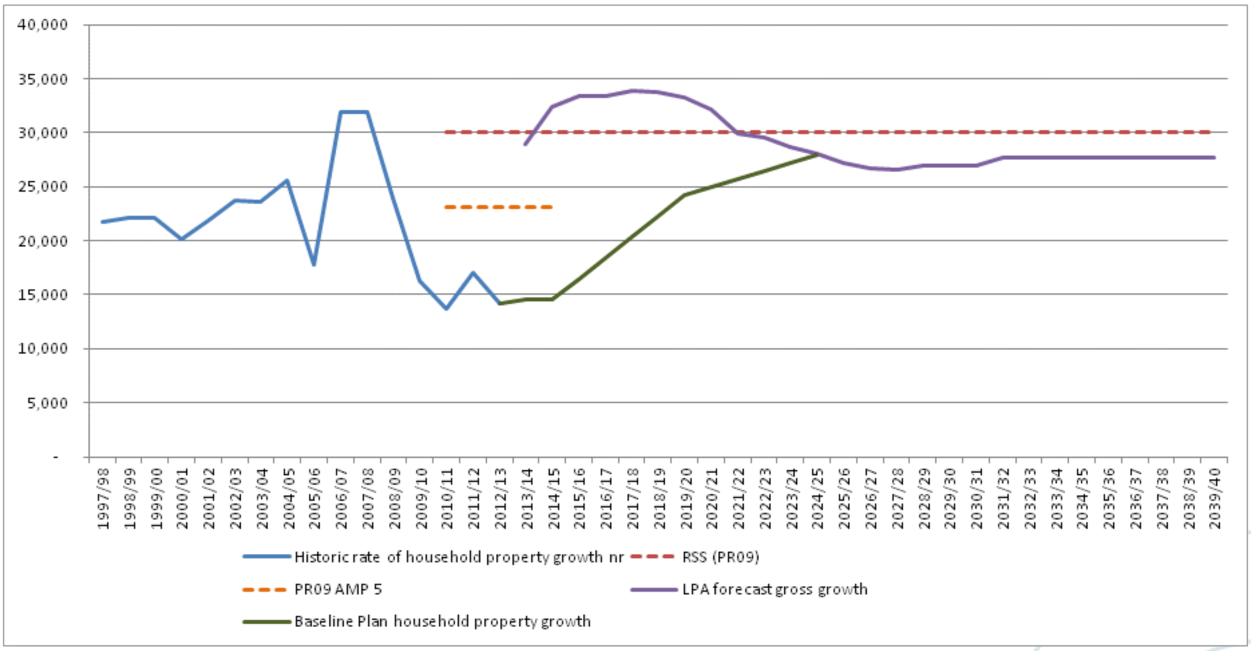


New household property forecast

For England we have gathered each local authority's forecast housing trajectories from their Local Development Framework annual monitoring reports released from December 2012. For Wales we supply an area covered by Powys local authority and we have collected housing projections from the Welsh Assembly Goverment document – Household Projections for Wales (2008 Based). Most local authority housing trajectories provide net additional dwelling numbers until 2026. To forecast for the remaining planning period we have taken the average of the net additional dwelling for the previous 5 years

The local authority forecasts for our region represent a stepped increase in new connections over historically observed numbers. It is unlikely we will realise such a level of growth in the short term given the continued low level of housing development. With a more positive economic outlook for the next AMP, we have assumed steady growth in new household properties to historic average levels by 2020. This will then continue rising to LPA levels over AMP7 after which we revert to the local planning authority forecast. This is displayed in figure B2.10.

Figure B2.10: Historic and forecast new household property trends



We have prepared the new property forecast in consultation with the local authorities across our region. We have an ongoing relationship with local authorities through our Water Strategy Development Team, who regularly discuss local planning requirements with each local authority. The Local Development Framework annual monitoring report housing trajectory data is gathered from local authorities annually and is used in our asset planning.

Following collation of local authority data for net additional dwellings from their local development plans and population data from ONS and Welsh Assembly Government forecasts we consulted all local authorities in the Severn Trent region. In September 2012, we contacted each local authority in our region to share our key assumptions on population and housing growth, and consult on the local authority level data compiled for use in our population and property projections. During a nine week consultation, we asked local authorities to respond with their views on the council development plan and ONS data we were proposing to use for their region in our planning assumptions.

A relatively low response rate to the consultation was received with 11 local authorities responding out of the 63 councils that cover our water supply region. The general response from those authorities who responded indicated that they wish for more recent housing trajectory data to be included. In the majority of cases this is data that was not published in time for collation for our final plan or the data is not yet published. We will continue to gather the latest Annual Monitoring report data from local authority's Local Development Framework annual monitoring reports as it becomes published, and we will seek to incorporate into the final WRMP where possible.

Some local authorities also commented on our assumption to reduce the AMP6 housing data based on recent trends seen. As this was a decision taken at company level to apply it across all water resource zones this is more relevant in some local authority areas than others. Overall, our analysis of historic trends in net additional properties and the local authority council data indicated that many local authorities are expecting high build rates in the next 5-10 years, as per figure 11 above. However, many are significantly higher then recent trends and higher than the maximum seen over the last 5 years including before the effects of recession on the housing market.

B2.4 Forecasting household water consumption

Our approach to household demand forecasting builds a bottom-up consumption forecast using micro-components, and is aligned to EA guidance for household demand forecasting. We have also followed the good practice methodology set out in the 2012 UKWIR report, "*A good practice manual and roadmap for household consumption forecasting"*. The underlying principle of the methodology is "to develop good forecasting practice which can be applied in a manner which suits the circumstances of each company and avoids onerous data requirements especially where these are not critical for analysing the resource position".

The starting point of our approach to household demand forecasting is to understand our customer's current use of water. We do this by first defining a micro-component breakdown of household consumption in the base year by understanding the ownership of (O), frequency of use of (F) and volume per use of (V) water using appliances in the home. Information collected via Company customer surveys about their consumption behaviours and uses of technology informs the base year micro-component breakdown. Forecasts trends in customer behaviour and appliance technology for each micro-component, are combined with forecasts of property types, population & occupancy to derive total forecast consumption. We forecast for a range of scenarios, each of which have a unique O, F and V profile to understand the range of possible future consumption forecasts.

The micro-components used to account for total domestic consumption in our demand forecast methodology are consistent with the EA's Water Resources Planning Guideline and reporting table WRP2:

- Toilet flushing
- Personal washing
- Clothes washing
- Dishwashing
- Miscellaneous internal use (including plumbing losses)
- External use

In some cases sub-components were identified for analysis, where it was important to examine distinctly different characteristics. In particular, baths, showers and washbasins for personal washing, and dishwashers and washing by hand for dishwashing.

We have used both Company data and external data sources to define base year & forecast assumptions and for calculation of micro-component O, F and V values. The main sources of data are as follows:

Severn Trent Water MORI study and Domestic Consumption Monitor (DCM) data

In 2005 MORI undertook a very detailed survey of water use by 2684 unmeasured household customers and 1686 metered household customers in our region. The results provide a very good description of the ownership and use of water using appliances by our customers. It is supported by details available from customers who participate in our ongoing Domestic Consumption Monitor (DCM). The latest DCM surveys for which data are available are the 2008 survey of 1053 metered customers and the 2011 survey of 947 unmeasured customers. The customers surveyed provide a representative sample of the socio-demographic profile of customers I our region.

The numbers of respondents are small compared with the total of some 3.1 million household customers across the region. However, confidence in their reliability can be gained by considering the consistency of the results with each other and with the Market Transformation Programme values from detailed national assessments.

External data sources

”Increasing the value of micro-component data” WRc report 2005

The 2005 WRc report, ”Increasing the value of micro-component data”, records findings from monitoring of micro-component water consumption at 447 unmeasured households across England and Wales during 2000 to 2002. It therefore represents an important source of data on water use behaviour for unmeasured households, although the data is now over 10 years old. Some further studies have been undertaken for other water companies, but no subsequent study of this kind has been undertaken for which the results are available to us.

Market Transformation Programme

The Market Transformation Programme (MTP) is a Defra initiative and examines current and predicted future ownership and use of domestic appliances. They are based on detailed studies of available data from within the water and energy industries, and appliance manufacturers. Therefore they provide authoritative estimates of the ownership and usage of appliances.

Defra (MTP) has published various documents that describe current and future ownership and usage of domestic appliances. The MTP provides projections for three scenarios:-

1. The “Reference Scenario”: This is a projection of what is likely to happen without any new Government policy intervention. The scenario is based on current trends, technology developments and policies that are already in place.

2. The “Policy Scenario”: This scenario estimates what could be achieved through an ambitious but feasible set of policy measures if the agreement of all stakeholders was obtained.

3. The “Earliest Best Practice Scenario” (EBP): This is a projection of what could happen if the best available products and technologies were adopted, coupled with ambitious Government policies

Each of these scenarios has a unique profile of micro-component O, F and V values.

Other external data sources
The UKWIR (2012) report *“Customer behaviour and water use: A good practice manual and roadmap for household consumption forecasting”* provides guidance to water companies on how to undertake micro-components analysis of household water consumptions, and quotes some data from other sources (in particular MTP or WRc). The report has been included in our analysis, because in a few cases it presents data that is not available in the WRc or MTP documents.

Professor Herrington’s 1996 report for the Department of the Environment, “Climate change and the demand for water”, represents one of the first published detailed micro-component studies. Although much of the assessment was based on desk studies and the work is over 15 years old, it remains a useful reference source for elements that are not covered by other sources of information.

The Which? website provides details of the water volumes of the most efficient white goods that are available on the market, which can be used as indicators of possible future trends in water use for washing machines and dishwashers.

The Defra report, *“Climate Change and the Demand for Water”* by Downing et al provides indicative values for the effect of climate change of micro-components of water demand, and so has been used in this study. A more up-to-date assessment is being prepared by UKWIR “Impact of Climate Change on Water Demand” (2012, in preparation) and so can be used instead when available.

B2.5 Approach to forecasting

Our approach to micro-component forecasting for household consumption adopts the tiered methodology set out in the UKWIR CU02 report. The report broadly outlines in three tiers, the levels of data a Company may hold or have access to for the demand forecast, and the drivers for the Company’s demand forecast as shown in tables B2.2 and B2.3.

Table B2.2: Levels of data available

Lowest data tier	Limited data except published sources that is able to support only limited analysis
Intermediate data tier	Data which may be specific to the company or geographical region that can support further analysis
Highest data tier	Extensive data from company surveys and other sources that can support detailed analysis

Table B2.3: Drivers for the demand forecast

Lowest forecasting driver	Where there are limited issues with resources.
Intermediate forecasting driver	Where there is potentially some vulnerability to future supply/demand imbalances that needs to be addressed.
Highest forecasting driver	Where there are serious issues with resources requiring major investment to be considered.

Furthermore, for each component of the demand forecast, CU02 sets out a low, medium and high tier of analysis a company can adopt according to the level of data they hold and level of the forecasting driver.

Table B2.4 below considers the key areas of improvement recommended by UKWIR (2012) for micro-component analysis compared with the approaches generally applied in 2009 WRMPs, and a summary of the approaches adopted in our forecasts.

Table B2.4: Key recommendations identified in the UKWIR (2012) report and the approach we have adopted

Appendix B: What is the likely demand for water?

Principle	UKWIR recommendations for improvement from the general PR09 approach	Approach adopted in this dWRMP
Level of analysis required	Emphasis on the level of analysis being linked to the nature and extent of any supply-demand imbalance.	Intermediate or High tier used where possible, as there is some vulnerability to future supply/demand imbalances. Water company specific customer survey data is available to support this.
Micro-component categories	Standard, high level, micro-component categories are suggested to permit inter-company comparison. Companies may base the analysis on more detailed categories that map to the standard categories.	Components used are those in the EA's Table WRP2. This fully complies with requirements in EA's revised WRP Guideline
Accounting for segment transition (in metering status)	Assessment of the materiality of the changes in PCC estimates arising from properties in transition is suggested. Explicit accounting for the effects of PCC in the forecast is suggested where these are shown to be significant.	Analysis undertaken on each meter status type without further segmentation (i.e. consistent with intermediate tier). The transition of customers from unmeasured to metered status is identified by the movements in property and population numbers for each meter status type.
Assessment of the effect of new Building Regulations	These have been introduced since PR09 and now require assessment of their effect.	Analysis did not explicitly use the 125 l/hd-d standard in the new Building Regulations, as our new connections PCC is already below or near this limit. Also there is concern that actual PCC can vary significantly from the standard.
Comparison of micro-component forecasts against regression-based approaches	A comparison is suggested to provide confidence in company forecasts. The differences, if any, should be considered by water companies and the adopted future consumption scenario explained in the WRMP commentary.	A comparison between the micro-component and trend-based PCC forecasts was undertaken, and reconciliation of the forecasts was considered.
Determining external use component	Alternative approaches for determining external use, not based upon the standard micro-component approach, are described.	We have used customer use data from our surveys and consumption values presented in WRc's CP187 report
Specific identification of the plumbing losses component	Plumbing losses can be significant in unmeasured properties and their analysis is not amenable to the standard micro-component approach. It is therefore suggested to include them in analysis as a distinct component	We included plumbing losses as part of Miscellaneous (internal) use in line with the EA's Water Resources Planning Guideline.

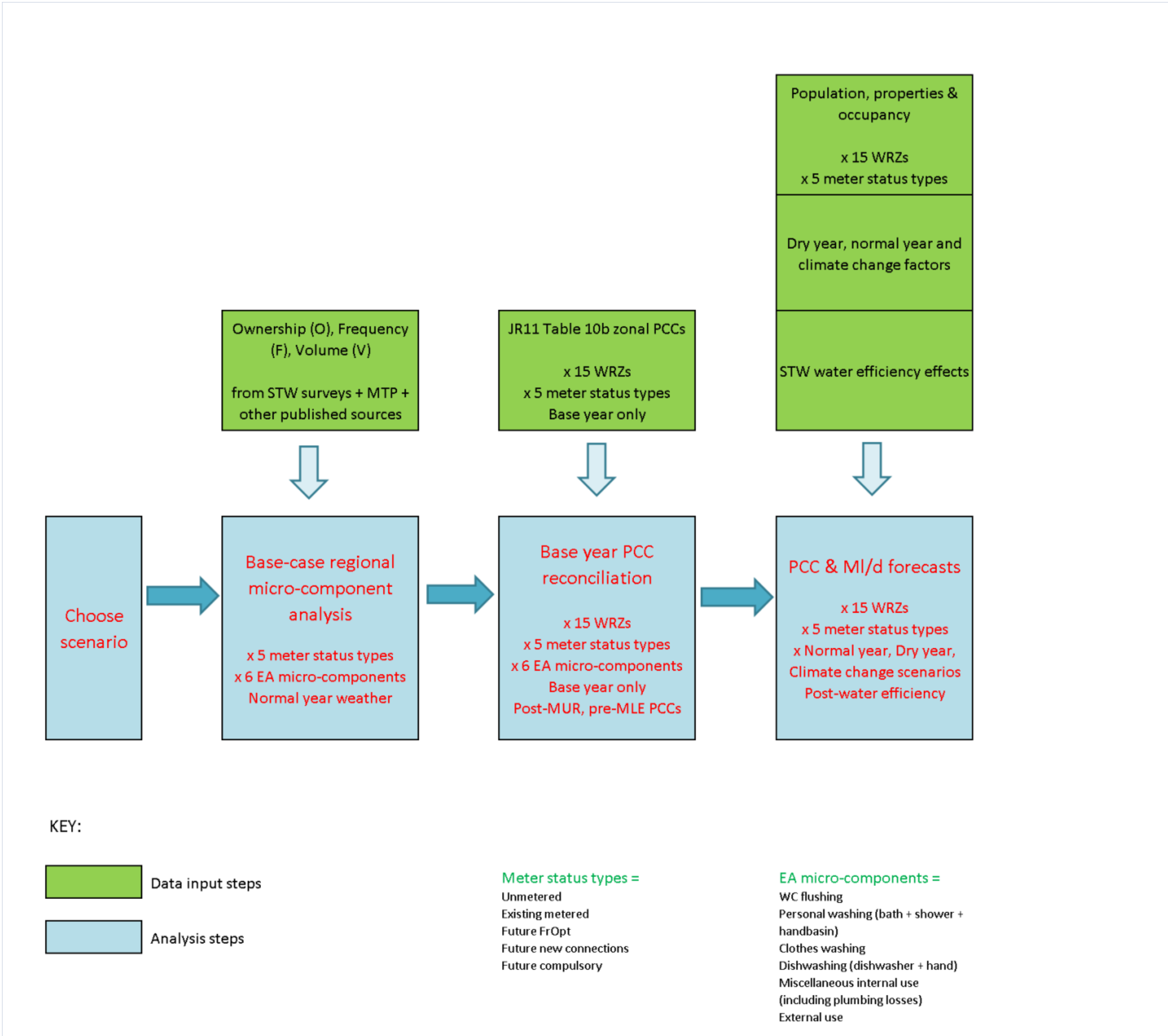
The EA require water companies to report micro-component PCC values for unmeasured households and for metered households. However, as recommended by UKWIR for application of an intermediate tier of analysis, this study has calculated PCC forecasts for each of five meter status categories that are relevant for us, or could become relevant in the future:

- Unmeasured households
- Existing metered households (i.e. all households metered up to 2009/10)
- Future new connections (i.e. from 2010/11 onwards)
- Future free meter options (i.e. from 2010/11 onwards)
- Future compulsory metered (in case we consider this category in the future)

Figure B2.10 sets out the stages in our approach to resource zone micro-component forecasting for different property types. For the chosen MTP scenario, we derive a base year micro-component PCC using company survey and MTP data to define OFV assumptions. For each property type, the base year measured pcc is reconciled to JR11 post MUR, pre-MLE pcc. Any difference is apportioned to micro-components by weighting. This is done at the regional level.

Figure B2.10 Schematic of data and analysis steps for household micro-component forecast.

Appendix B: What is the likely demand for water?



Scenario choice

This stage is to define the scenario choices for which the forecasts are required.

There are three main choices that need to be made:

- The choice of MTP forecast scenario (i.e. Reference, Policy or EBP) specifies which O, F and V values are used in the "Base-case regional micro-component analysis", and the trends in O, F and V that are carried through to the later analysis steps.

- The choice of demand planning scenario (i.e. normal year or dry year, with or without climate change) determines the factors to be applied for weather effect in the "PCC and demand forecasts" stage. Similarly, the choice of which (if any) water efficiency effects to be used determines the water efficiency adjustments to the calculations in the "PCC and demand forecasts" stage.

- The choice of water resource zone, or region, for which forecasts are required.

Base case micro-components analysis

The base micro-component analysis stage derives the base-case O, F and V forecasts, and resulting PCC forecasts, for the chosen MTP scenario. No reconciliation to our reported base year values is undertaken at this stage.

The key steps are to:

- Derive O, F and V values for each micro-component, for each meter status, and for each year from 2010/11 (base-year) to 2039/40, based on the chosen MTP scenario, using the information presented in the preceding sections.
  Note: The O, F and V values remain fixed for the chosen MTP scenario. They are not subsequently adjusted for base-year PCC reconciliation or for calculation of zonal forecasts.

- Multiply the O, F and V values to calculate initial PCC forecasts for each micro-component and each meter status.

These steps are undertaken on company data only and are not affected by the choice of water resource zone.

For the base year, O, F and V have been derived using data from Company surveys and the MTP

The basis for selecting preferred data sources, for base year and forecast, is:-

• In general our survey data are preferred to values from elsewhere because they are considered to better reflect local characteristics. Also, they are comparable with the MTP estimates from national assessments and so they are considered to be robust.

• For metered households, values from the DCM 2008 survey are preferred to values from the MORI 2005 survey because it provides more recent evaluations. The changes suggested in the data for metered households between 2005, based on the MORI survey, and 2008,
based on the DCM survey, are plausible.

• For unmeasured households, values from the DCM 2011 survey are preferred to values from the MORI 2005 survey because it provides more recent evaluations. The changes suggested in the data for unmeasured households between 2005, based on the MORI survey, and 2011, based on the DCM survey, are plausible.

• 100% toilet ownership has been assumed as it is expected that all households have access to a flushing toilet, even if in a very small number of cases it is not located internal to their home.

The key data of most relevance to this study are summarised in Table B2.5, and are compared with values published by the Market Transformation Programme where there is a directly comparable number. The cells that are highlighted blue indicate values that have been used in the study.

Table B2.5: Summary of key data from our customer surveys

Appendix B: What is the likely demand for water?

Item	MORI 2005 UNHH	MORI 2005 MHH	DCM 2005 UNHH	DCM 2005 MHH	DCM 2008 MHH	DCM 2011 UNHH	MTP 2010
GENERAL							
Number of respondents (unweighted)	2684	1686	936	987	1053	947	-
Number of respondents (weighted)	3482	759	-	-	-	-	-
Average total occupancy	2.39	2.29	-	-	2.08	-	2.4
TOILETS							
Toilet ownership %	99.80%	99.70%					100%
Toilet flushes per household per day	8.42	8.01					
Cistern device installed (%)	9%	20%					
Dual flush toilet installed (%)	24%	28%	19.30%	17.50%	27.50%	27.30%	
Number toilets per home	1.27	1.83					
PERSONAL WASHING							
Bath ownership %	92.10%	92.10%	93.30%	90.90%	90.30%	87.50%	94
Bath uses per day	0.71	0.54					0.68
Shower ownership %	76.50%	86.20%	73.30%	88.90%	92.60%	81.40%	81
Shower uses per day	1.43	1.49					1.04 (WRc=1.46)
Number showers installed per home	0.8	1.04					
Jacuzzi ownership (%)	1.00%	2.20%					
Bidet ownership %	2.30%	1.20%	3.40%	7.00%	6.00%	2.10%	
WHITE GOODS							
Washing machine ownership (%)	93.70%	95.70%	93.20%	96.30%	96.50%	92.20%	95%
Washing machine age (years)	4.2	4.8					Lifespan 12.6 yrs
Washing machine uses per day	0.68	0.65					0.71
Dishwasher ownership (%)	25.50%	39.50%	27.60%	39.90%	41.00%	28.20%	37.70%
Dishwasher age (years)	3.9	4.2					Lifespan 13.0 yrs
Dishwasher uses per day	0.67	0.66					0.67
Dishwashing by hand per day	2.12	1.81					
EXTERNAL WATER USE							
Outside tap ownership (%)	57.00%	63.90%	62.20%	70.50%	72.80%	66.10%	WRc = 65%
Watering can ownership (%)	70.50%	74.30%					
Watering can uses per day	0.94	0.88					
Hosepipe ownership (%)	60.90%	63.90%					
Hosepipe uses per day	0.18	0.18					
Hosepipe duration (min)	16	15					
Garden sprinkler ownership (%)	7.50%	12.40%					
Garden sprinkler uses per day	0.15	0.13					
Garden sprinkler duration (min)	39	28					
"Trickle system" ownership (%)	0.50%	0.90%					
"Trickle system" uses per day	0.37	0.49					

Item	MORI 2005 UNHH	MORI 2005 MHH	DCM 2005 UNHH	DCM 2005 MHH	DCM 2008 MHH	DCM 2011 UNHH	MTP 2010
Trickle system duration (min)	15	10					
Pressure washer ownership (%)	10.90%	13.80%					
Pressure washer uses per day	0.05	0.06					
Swimming pool ownership (%)	0.40%	0.50%					
Paddling pool ownership (%)	6.50%	9.70%					

A detailed description of the O, F and V values used in our analysis is given in section B2.12.

Base year Per Capita Consumption reconciliation

Having defined our ownership (O), frequency of use (F) and volume per use (V) assumptions for the base year and forecast years, the next stage is to reconcile calculated base year micro-component PCC to actual Company PCC values for 2010/11 for each water resource zone and each meter status type. The reconciliation of PCC is done against the 2011 Annual Return (inclusive of meter under-registration but before maximum likelihood estimation water balance reconciliation).

The adjustments have been calculated in proportion to the initial PCC values, which is a method recommended by UKWIR. The calculated adjustments are then applied to forecast micro-component PCCs as well as base-year.

It is important to note that the ownership (O), frequency of use (F) and volume per use (V) values are not recalculated during the reconciliation process. The changes to PCC values resulting from the base year reconciliation (or subsequent application of normal year/dry year/climate change effects or water efficiency effects) are not applied to the O, F and V values, as it is difficult to know which values (O or F or V or all three) should be changed.

Selected scenario for baseline household consumption forecast

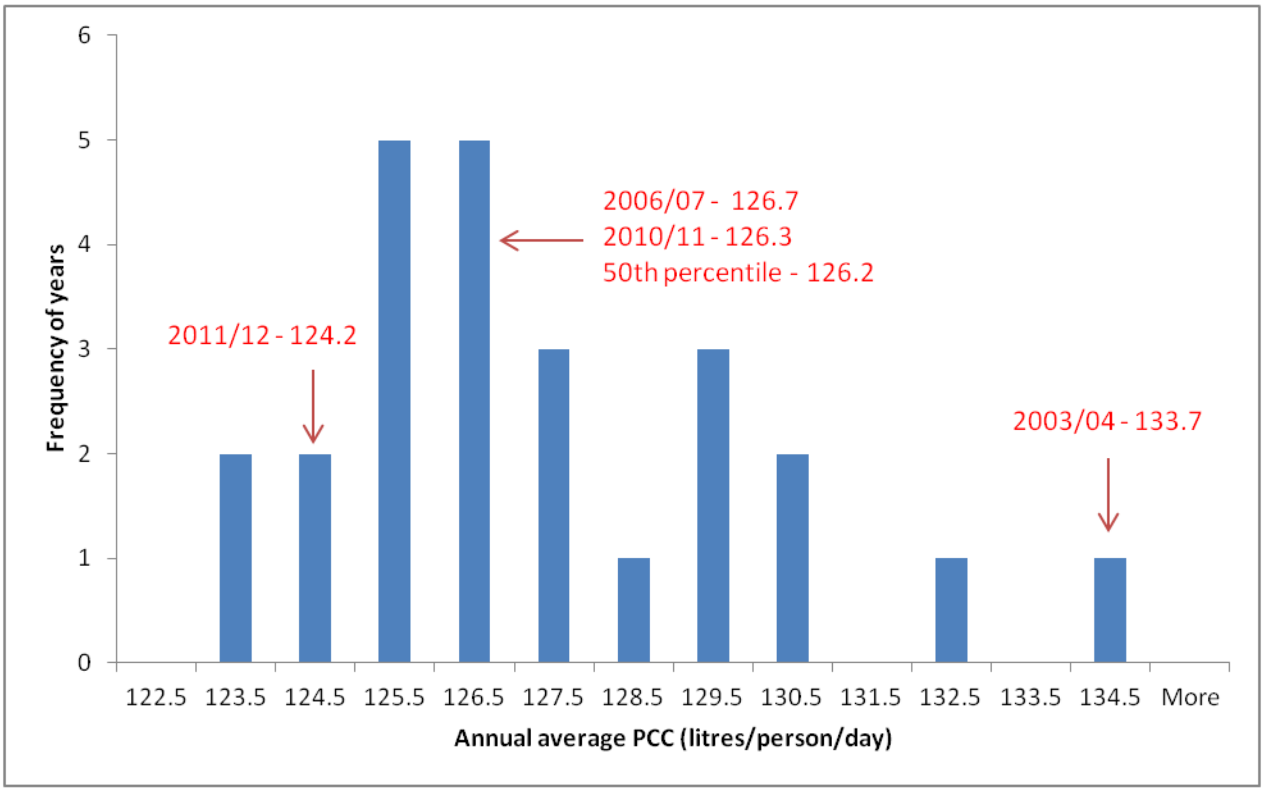
Our baseline consumption forecast assumes PCC forecasts that are the average of those forecast under the MTP Reference and MTP Policy scenario OFV assumptions. This adopted scenario therefore assumes the continuation of current trends, technology developments (as per the Reference scenario) alongside part-implementation of policy measures that achieve lower consumption levels (as per the Policy scenario). This combined scenario assumption offers the most realistic view of future household consumption trends.

B2.6 Normal and dry year demand adjustments

The base year for derivation of the PCC forecasts is 2010/11. It was chosen in preference to 2011/12 (for which more recent Annual Return data is available) because 2010/11 household demand was closer to a normal year demand and so can be used as a normal year without modification. This is demonstrated in figure B2.11 shows a histogram of historic annual average PCCs from our Domestic Consumption Monitor from 1987 to 2012. The 50th percentile of ranked PCCs gives the most likely annual average PCC in the record i.e. a normal year PCC.

2010/11 PCC (126.3 litres/head/day) is equivalent to the 50th percentile of ranked historic PCCs demonstrating the likeness of 2010/11 PCC to a normal year PCC. 2011/12 PCC (124.2 litres/head/day) is 2 litres/head/day less that the 50th percentile, hence the choice of 2010/11 as normal year without adjustment for the PCC forecast.

Figure B2.11: Histogram of Domestic Consumption Monitor annual average per capita consumption 1987 to 2012



Choice of reference dry year

We have selected 2003/04 as our reference dry weather year, from which to derive the dry year adjustment to normal year consumption. Historical weather datasets from 1910/11 to 2011/12 have been analysed to determine our choice of dry year.

We have compared the April to September rainfall and temperature records, along with the annual total rainfall for each year. We have ranked the years according to how warm and dry they were in those summer months and for the year as a whole.

Figure B2.12 shows 2003/04 rainfall was significantly lower than average for the region whereas 2006/07 rainfall was about average over the year as a whole. Figure B2.13 shows April to September 2006 rainfall was slightly below the 102 year average, while total annual rainfall was very close to the 102 year average. 1995/96 and 1996/97 were both drier than 2003/04. However, on the basis of long term average rainfall data 2003/04 is suitable for use as the reference dry year.

Figure B2.14 shows 2006 and 2003 were two years with the hottest April to September period in the 102 year record. 2006/07 temperatures were actually very similar to 2003/04, and both years were well above average. However, the combined impact of hotter and drier than average conditions in 2003/04 led to significantly higher than normal consumption in the DCM during that year as shown in Figure B2.11 by contrast, 2006/07 consumption was not exceptional and was similar to normal year consumption as shown in the same chart. On this basis we have selected 2003/04 as our reference dry year.

Figure B2.12: Annual average rainfall (mm) 1910/11 – 2011/12

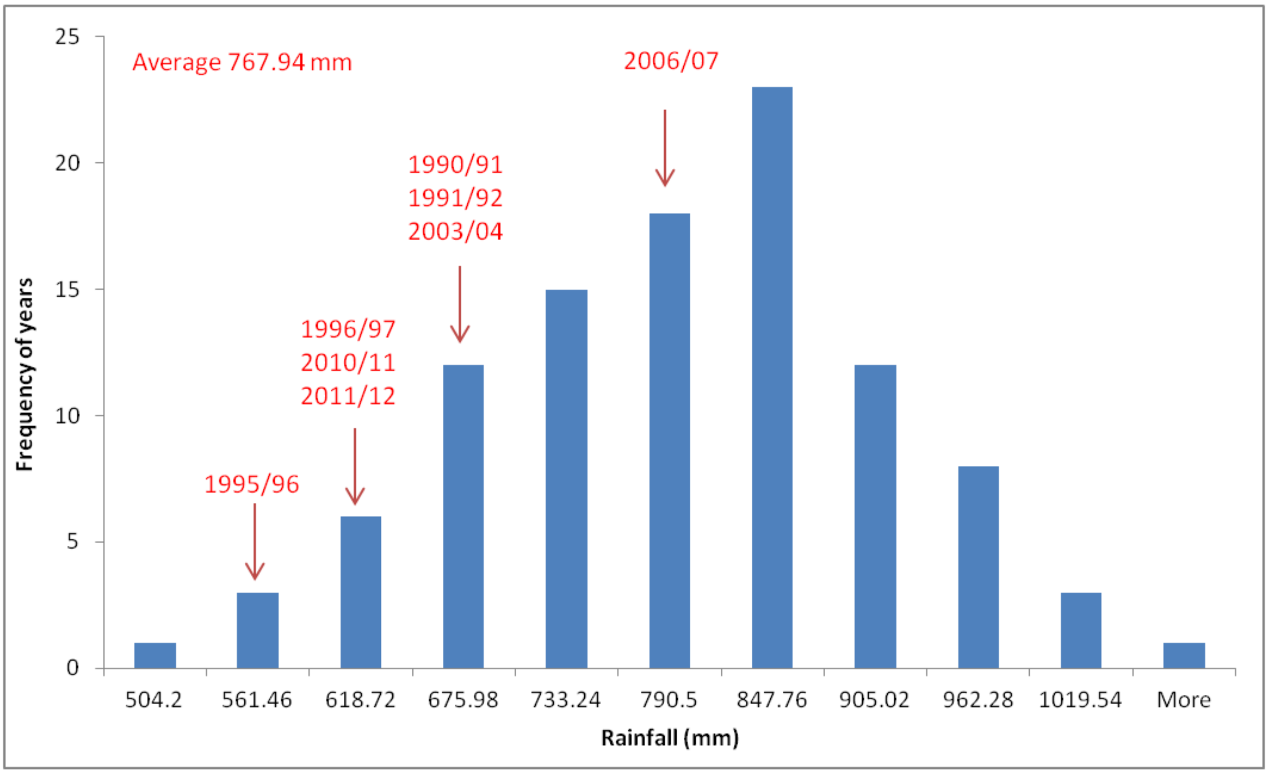


Figure B2.13: Summer (April – September) average rainfall (mm) 1910/11 – 2011/12

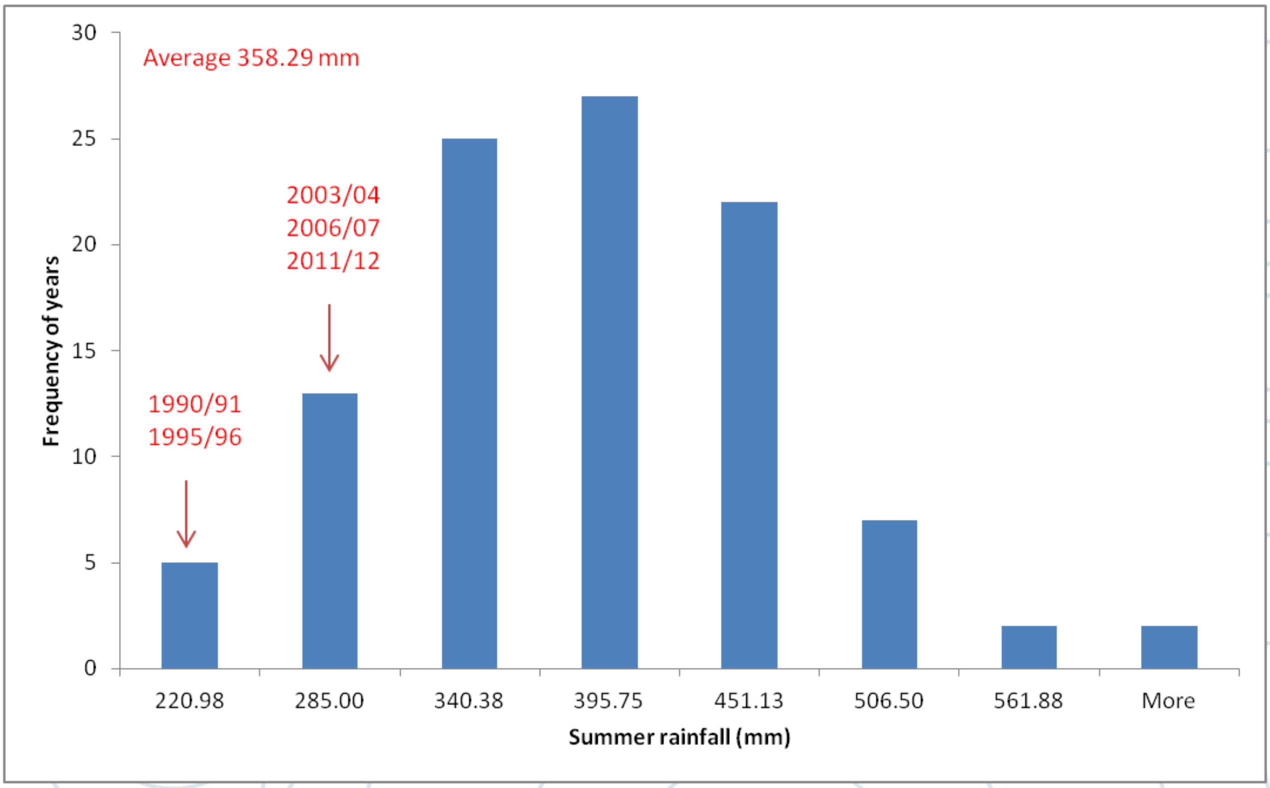
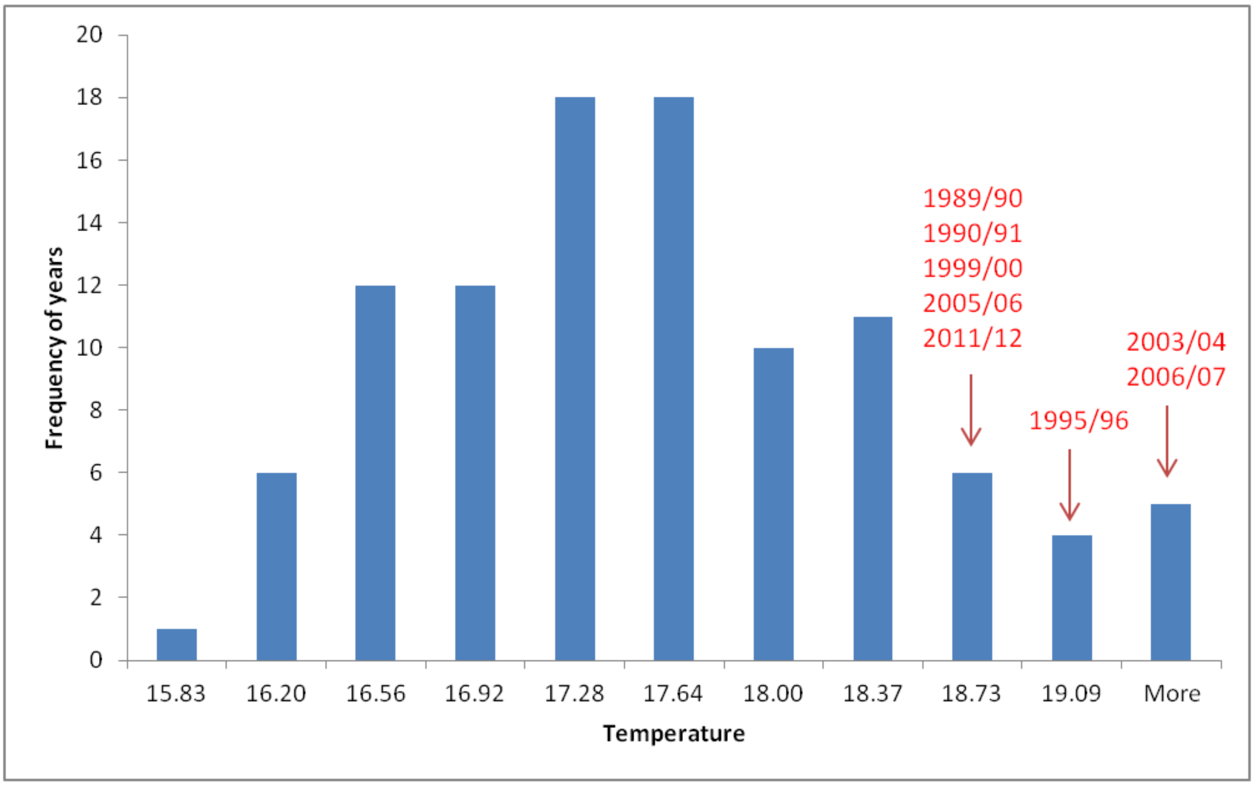


Figure B2.13: Summer (April – September) average maximum temperature (^{O}C) 1910/11 – 2011/12



Dry year consumption adjustments of the normal year forecast are necessary using an estimate of dry year factors. We have estimated the dry year factor using the outputs of a trend analysis of historic PCC, which found the number of peak consumption days in each year of the DCM records of unmeasured household consumption, was a statistically significant explanatory factor for unmeasured household PCC.

The top 20% of ranked daily PHCs from the DCM for the period 2003/04 to 2010/11 were assumed to indicate the number of peak consumption days in the full record. Allocating the peak days to each year in the record we found our reference dry year, 2003/04, had 98 peak days, and a normal year had on average 29 peak days (based on average of the number of peak days in years other than 2003/04). Forecasting trend-based normal and dry year PHCs using these peak and non-peak day factors, it was found the dry year to normal year effect on PHC was 5.2%.

The dry year factor has been applied uniformly to all components of demand in the absence of clear evidence of how the demand for individual components responds to dry weather.

B2.7 Impact of metering on household consumption

To understand the impact of metering on household consumption, we have analysed Domestic Consumption Monitor (DCM) unmeasured properties which have had a meter installed under the free meter optant (FrOpt) scheme. The average consumption of these properties, before having a meter, has been calculated and compared with consumption in similar average DCM households. The comparison shows that FrOpt households are using 76.9% of an average unmeasured DCM household before having a meter fitted. This result is consistent with what might be expected; unmeasured households that opt for a meter are lower than average consumption unmeasured households.

Although FrOpt households are below average users, it does still not explain all of the reductions in use after opting for a meter. There is a metering effect as a result of customers changing their habits to reduce their water charges even further. To estimate this effect, the ACORN profile and occupancy rate of FrOpt properties were input into the a regression-based unmeasured household consumption forecasting model. For the base year this gave a figure of 244.81 litres per property per day compared to the 318.09 litres per property per day for the average unmeasured household. Applying the 'pre-FrOpt' factor of 76.9%, this estimates consumption in FrOpt households to be 188.14 litres per day. This compares to the estimated JR11 FrOpt value, for JR11, of 173.2 litres, which suggests a metering effect of -7.94 per cent.

B2.8 Climate change adjustments

We have assumed an impact of climate change on household demand. For the final WRMP, effects of climate change on PCC were estimated using the Defra (2003) report *"Climate Change and the Demand for Water"*. We now use estimates of future climate impacts from the more recently published (2012/13) UKWIR project, "Impact of Climate Change on Demand", which presents updated estimates of the impact of climate change on water demand. The study analysed UKCP09 climate change scenarios using the 'weather generator' to define possible future changes in weather parameters. These were applied to weather-demand relationships derived from five case study datasets from across the country, and the results used to derive empirical algorithms for forecasting climate change impacts on different demand components to be applied to different parts of the country *(Impact of climate change on water demand, UKWIR 13/CL/04/12 pg 2).*

For the Severn Trent region, the estimated percentage impact on demand to 2040 is as follows:

- External use: 0.92%

B2.9 Maximum likelihood estimate adjustment

Distribution input (DI) is defined as the amount of water entering the distribution system for supply to our customers. DI can also be defined as the sum of the bottom up components of water taken and leakage, water taken being the sum of unmeasured and measured water use in households and non-households. Leakage is the residual based on the difference between measured DI and bottom up estimates of water taken. Leakage can also be estimated directly by analysing minimum night flows (MNF), legitimate night use and consumption allowances. The difference between residual leakage and the MNF estimate of leakage is the balancing error, which is distributed between the components of DI via a statistical method called Maximum Likelihood Estimation (MLE).

We add MLE to our forecast PCCs using the Ml/d volume of MLE reported in the 2012/13 Annual Report water balance. This volume is expressed as a per person MLE adjustment by dividing by the forecast population count to give a forecast PCC MLE adjustment. This is added to the post-reconciliation PCC.

B2.10 Underground supply pipe leakage

Leakage from the underground supply pipes owned by our customers (referred to as USPL) is assumed to remain constant at per property volumes derived for the most recent Ofwat Annual Return 2013. This is derived using the recommended UKWIR methodology using data gathered through a collaborative research project. Data sources include:

- reported and detected supply pipe repairs from our SAP job management system;
- leak run-times (from collaborative research);
- volumes reported in collaborative research; and
- background leakage estimates from our USPL monitors.

For the entire forecasting period, we have assumed the household level of USPL (litres per property) for unmeasured and measured (both internally and externally) household properties remains constant at the levels in table B2.6. Figures are from our 2012/13 annual return.

Table B2.6: Forecast USPL for household property types

		2013-14 to 2039-40
Unmeasured household	litres/property/day	27.73
Measured household (externally metered households)	litres/property/day	25.56
Measured household (internally metered households)	litres/property/day	27.73

The small leakage benefit associated with external metering is based on the assumption that externally metered customers will notice supply pipe leaks via higher metered charges due to elevated consumption volumes and therefore arrange to have the leak repaired.

B2.11 Meter Location

In our final WMRP09 plan, we adopted a policy of maximising the amount of meters installed external to the property. The aim of this change is to reduce the amount of leakage on customers' supply pipes due to the leakage benefit mentioned in the previous section.   Under this future metering policy, we had forecast 72% external meter fits and 28% internal fits in AMP5.

Upon adoption of this strategy during AMP5, in 2013/13, we have found only 50% of properties can be externally metered due to restrictions such as joint supplies. In light of this, for our baseline WRMP forecast, we have revised our forecast as shown in table B2.7.

Table B2.7: Meter location forecast:

	PR09 policy for future AMPs	Observed meter fits in 2012-13	2013-14 to 2039-40
Internal Meters	28%	50%	50%
External meters - existing boundary box	35%	22.5%	22.5%
External meters - without boundary box	37%	27.5%	27.5%

B2.12 Forecast O, F and V assumptions

The following sections examine the available data from our surveys or elsewhere for each micro-component, and give more detail on the choice of values or assumptions for the assessment for PCC. Blue highlights are used to indicate the values that have been used in preference to other available assessments.

Our work to develop micro-component forecasts for the dWRMP included working with UKWIR on the demand forecasting project *A good practice manual and roadmap for household consumption forecasting (CU02)*, part of which looked at future projects to collect micro-component data. We will continue working with UKWIR on projects to collect and develop micro-component information support the forecasts of demand in the next planning period.

Component: Toilet Flushing

For the purpose of micro-components analysis all toilet flushing can be considered as a single category. Although there are a wide range of types of toilet their operation is similar and the frequency of use can be assumed to be the same.

COMPONENT: TOILET FLUSHING	CATEGORY: TOILET FLUSHING

TYPES:

MTP identify a wide range of different toilet types with different flush volumes. For the purpose of our forecast, they have been grouped into the following main types:

- **Old toilets without cistern displacement device** (assumed average of 8 litre) – representing the assumed average volume of old toilets still in use
- **Old toilets with cistern displacement device** (assumed average of 7 litre)
- **6 litre** – installed widely in the early 2000s but declining ownership, as low-volume dual-flush WCs are now preferred
- **6/4 litre** dual flush (i.e. average 5 l) – main type currently being installed
- **6/3 litre** dual flush & **4.5 litre** single flush (i.e. average 4.5 l) – expected to increase in future
- **4/2.6 litre** dual flush & **<4.5 litre** single flush (i.e. average 3.3 l) – expected to increase in future

We have been issuing free cistern displacement devices for many years for use in older toilets. This is demonstrated by the high proportion of households in the MORI 2005 customer survey that reported having installed cistern devices (9% of unmeasured households and 20% of metered households) (see Table B2.5). These cistern devices can be expected to reduce flush volume by about 1 litre in older toilets.

Since 2006, we have distributed 650,000 cistern displacement devices (around 130,000 per year) and estimate that around 50% were installed. The additional 325,000 installations represents 8% of the 4.3 million toilets in the STW region (based on there being 3.1 million household customers in the region with an average or 1.4 toilets per household). Therefore it can be assumed that around 17% of unmeasured households and 28% of metered households have toilets with cistern displacement devices.

For our micro-component forecast, old toilets without cistern devices have been grouped into a single “8 litre” category and old toilets with a cistern device have been grouped into a single “7 litre” category. These include the following types:

- 9 litre syphon operated WCs – very widely installed in the past but illegal to install since 1990s. The actual flush volume can vary very widely. Some have a cistern device installed.
- 7.5 litre WCs – illegal to install since 2001. Some were dual-flush. Some have a cistern device installed.

MTP assume that the average replacement rate for toilets is 1 in 15 years, and have used this assumption in their modelling of future ownership of different toilet types.

TOILET OWNERSHIP (%)

Values observed or reported:						
STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
99.8%	99.7%	-	-	100%	100%	100%

Appendix B: What is the likely demand for water?

Values chosen:

A few households in the MORI surveys have not recorded having a toilet which we assume is an omission and we have assumed all homes have a toilet in our micro-component forecast.

Approximately 17% of unmeasured homes and 28% of metered homes are estimated to have a cistern device installed. MTP estimate that there are old toilets in approximately a third of homes. So it has been assumed that at 2010:

- 17% of unmeasured households have the “7 litre” type and 16% have the “8 litre” type
- 28% of metered households have the “7 litre” type and 5% have the “8 litre” type

The estimated stock levels and forecasts in each of MTP’s Reference, Policy and EBP scenarios for a wide range of toilet types have been used to derive the following estimates and forecasts of ownership for each toilet group:-

Unmeasured households

	Scenario ownership											
	Reference				Policy				EBP			
Toilet type	2010	2020	2030	2040	2010	2020	2030	2040	2010	2020	2030	2040
“8 litre”	16%	2%	0%	0%	16%	2%	0%	0%	16%	2%	0%	0%
“7 litre”	17%	2%	0%	0%	17%	2%	0%	0%	17%	2%	0%	0%
“6 litre”	23%	9%	3%	0%	23%	9%	1%	1%	23%	6%	0%	0%
“6/4 litre”	44%	81%	80%	80%	44%	58%	22%	22%	44%	43%	9%	9%
“6/3 litre + 4.5 litre”	0%	6%	14%	14%	0%	23%	56%	56%	0%	25%	27%	27%
“4/2.6 litre”	0%	0%	3%	6%	0%	6%	21%	21%	0%	24%	64%	64%
All types	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Metered households except future new connections

	Scenario ownership											
	Reference				Policy				EBP			
Toilet type	2010	2020	2030	2040	2010	2020	2030	2040	2010	2020	2030	2040
“8 litre”	5%	1%	0%	0%	5%	1%	0%	0%	5%	1%	0%	0%
“7 litre”	28%	3%	0%	0%	28%	3%	0%	0%	28%	3%	0%	0%
“6 litre”	23%	9%	3%	0%	23%	9%	1%	1%	23%	6%	0%	0%
“6/4 litre”	44%	81%	80%	80%	44%	58%	22%	22%	44%	43%	9%	9%
“6/3 litre + 4.5 litre”	0%	6%	14%	14%	0%	23%	56%	56%	0%	25%	27%	27%
“4/2.6 litre”	0%	0%	3%	6%	0%	6%	21%	21%	0%	24%	64%	64%
All types	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Slightly different ownership profiles have been assumed for future new connections, as they will have 6 litre maximum flush volumes installed. For future new connections the study has assumed the same profile as above for current and future toilet types, but have re-allocated the 8 litre and 7 litre % values to the 6/4 litre type:-

Appendix B: What is the likely demand for water?

Future new connections

	Scenario ownership											
	Reference				Policy				EBP			
Toilet type	2010	2020	2030	2040	2010	2020	2030	2040	2010	2020	2030	2040
"8 litre"	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
"7 litre"	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
"6 litre"	23%	9%	3%	0%	23%	9%	1%	1%	23%	6%	0%	0%
"6/4 litre"	77%	85%	80%	80%	77%	62%	22%	22%	77%	45%	9%	9%
"6/3 litre + 4.5 litre"	0%	6%	14%	14%	0%	23%	56%	56%	0%	25%	27%	27%
"4/2.6 litre"	0%	0%	3%	6%	0%	6%	21%	21%	0%	24%	64%	64%
All types	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

TOILET FREQUENCY OF USE (use/person-d)

Values observed or reported:						
STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
3.52	3.50	-	-	4.68	4.71	4.71

Values chosen:

The MTP value of 4.71 uses/person-d is based on data from various water companies and WRc micro-component studies. It is close to the WRc measured value. UKWIR quote the MTP value.
The MORI survey of customers recorded average flush frequencies of 8.42 per household-day for unmeasured households and 8.01 per household-day for metered households. These are equivalent to 3.52 per person-day for unmeasured households and 3.50 per person-day for metered households, by taking account of the average occupancies in the MORI survey of 2.39 and 2.29, respectively. The MORI survey is more representative of STW customers, and as the values are close for both types of customer an average of 3.51 flushes/person-day has been used for both unmeasured and metered households. Our forecast has adopted the MTP assumption that the flush frequency will not change over time.

TOILET VOLUME PER USE (l/use)

Values observed or reported:						
STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
-	-	-	-	9.4	Ave 5.06	-

This study has assumed the average flush volume for each toilet type considered: 8 litre, 7 litre, 6 litre, 5 litre, 4.5 litre and 3.3 litre, respectively.

Appendix B: What is the likely demand for water?

Component: Personal Washing

Personal washing can include washing by shower, bath, basin or bidet. Our customer surveys indicate that there are small numbers of households that use a bidet or jacuzzi. The quantities of water involved are not well understood and are relatively very low because of low ownership levels. Therefore, the use of bidets or jacuzzis has been included in miscellaneous internal use rather than being specifically estimated as part of Personal washing. Hot tubs are considered under external use.

The categories of personal washing analysed for this study are: showers, baths and washbasins.

COMPONENT: PERSONAL WASHING	CATEGORY: SHOWERS

TYPES:

MTP identify 3 main types of shower: electric shower, gravity mixer shower and pumped shower.

SHOWER OWNERSHIP (%)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
76.5%	86.2%	81.4%	92.6%	85.2%	81%	-

Values chosen:

The survey % ownership level for unmeasured households is very close to the 81% estimated by MTP. Our company value has been assumed as being more representative of ownership in the region.

MTP present current estimates and forecast future ownership of each shower type for the MTP's Reference, Policy and EBP scenario's, and are as follows for unmeasured and measured property types:

Unmeasured households

	Scenario ownership			
	Reference/Policy/EBP			
Type of shower	2010	2020	2030	2040
Electric	39%	46%	48%	48%
Gravity mixer	22%	24%	25%	25%
Pumped	20%	21%	21%	21%
Total	81%	91%	94%	94%

Appendix B: What is the likely demand for water?

The MTP forecasts suggest that the percentage of homes with a shower will increase to a "saturation point" of 94% by 2030 has been used as the basis for the forecasts for metered households in this study using the DCM (2008) survey values, as shown below:

Metered households

	Scenario ownership			
	Reference/Policy/EBP			
Type of shower	2010	2020	2030	2040
Electric	47%	47%	48%	48%
Gravity mixer	25%	25%	25%	25%
Pumped	21%	21%	21%	21%
Total	93%	93%	94%	94%

SHOWER FREQUENCY OF USE (use/prop-d)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
1.43	1.49	-	-	1.46	1.04	-

Values chosen:

The MORI survey of customers recorded average usage rates of 1.43 and 1.49 per household-day for unmeasured and metered households, respectively. These are both close to the WRc observed an average of 1.46. The frequency of use of showers by metered households is higher than for unmeasured households, which is consistent with the use of baths by metered households. This study has assumed a value of 1.46 per household-day as it is an average of the MORI values, and is consistent with the WRc value.

MTP estimate the average frequency of showering as 1.04 per household-day in 2010, rising to 1.21 per household-day in 2020 and to 1.33 per household-day in 2030. This study has applied these MTP rates of increase. The frequency of use profile for Reference, Policy and EBP scenarios assumed is:

	2010	2020	2030
Frequency (use/household-day)	1.46	1.63	1.75

Appendix B: What is the likely demand for water?

SHOWER VOLUME PER USE (l/use)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
-	-	-	-	25.7	26.5 (Elec.) 38.2 (Grav.) 62.7 (Pump.)	

For unmeasured households the MTP projections for the Reference, Policy and EBP scenarios are:

	Scenario volume per use (litres)											
	Reference				Policy				EBP			
Type of shower	2010	2020	2030	2040	2010	2020	2030	2040	2010	2020	2030	2040
Electric	26.5	27.9	27.9	27.9	26.5	26.7	26.6	26.6	26.5	23.4	22.4	22.4
Gravity mixer	38.2	38.8	38.4	38.4	38.2	38.5	37.8	37.8	38.2	30.1	28.9	28.9
Pumped	62.7	63.7	63	63	62.7	63.2	62.1	62.1	62.7	49.4	47.5	47.5

It has been assumed that the average volume per use in metered households is 7.94% lower; this is equivalent to the metering effect derived for metered households.

COMPONENT: PERSONAL WASHING	CATEGORY: BATH

TYPES:

Although there are a wide range of styles of bath available, with different volumes, this study has assessed them as a single type as their operation is similar and the frequency of use can be assumed to be the same.

BATH OWNERSHIP (%)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
92.1%	92.1%	87.5%	90.3%	88.1%	94%	-

Values chosen:

Bath ownership levels according to the our customer surveys are slightly less than the national average of 94% estimated by MTP. Survey values have been assumed in this study as being more representative of ownership in the region.

MTP estimate the ownership of baths in 2010 at 94%, and assume that it will reduce to 91% in 2020 and 83% in 2030. The reducing trend is based on the general increasing use of showers for washing. We have therefore assumed that bath ownership in metered and unmetered households will reduce by 3% by 2020, by 11% by 2030 and by an estimated 16% by 2040.

Appendix B: What is the likely demand for water?

	Scenario ownership			
	Reference/Policy/EBP			
	2010	2020	2030	2040
Unmeasured households	87.5	84.5	76.5	71.5
Measured households	90.3	87.3	79.3	74.3

BATH FREQUENCY OF USE (use/prop-d)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
0.71	0.54	-	-	0.95	0.68	-

Values chosen:

Bath frequency of use levels according to the MORI survey for unmeasured households are slightly higher than the national average of 0.68 estimated by MTP, and for metered households are lower than the MTP value. Our customer surveys have been assumed in this study as being more representative of use in the region.

MTP estimate that the average frequency of use was 0.68 per household-day in 2010, and assume that it will reduce to 0.55 per household-day in 2020 and 0.46 per household-day in 2030. This reflects the expectation that in the future more people will use showers instead of baths for washing.

We have therefore assumed that the frequency of use will reduce by 0.13 use/household-day by 2020 and by 0.22 use/household-day by 2030, subject to a minimum level of 0.46 use/household-day for unmeasured households and 0.41 use/household-day for metered households:

	2010	2020	2030	2040
Unmeasured	0.71	0.58	0.49	0.46
Metered	0.54	0.41	0.41	0.41

BATH VOLUME PER USE (l/use)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
-	-	-	-	73.3	84.5	-

Values chosen:

MTP estimate that the average volume per use was 84.5 litres per use in 2010, and assume that it will reduce to 2030. This is in line with assumed increased use of showers in the future. The MTP assessment has been used for this study for unmeasured households as it has been based on a wider survey of reported bath usage than the WRc study.

Appendix B: What is the likely demand for water?

	Volume per use (litres)			
	2010	2020	2030	2040
Reference	84.5	85	85	85
Policy	84.5	80.6	80.6	80.6
EBP	84.5	77.2	76.3	75.4

It has been assumed that the average volume per use at metered households is 7.94% lower; this is equivalent to the metering effect derived for metered households.

COMPONENT: PERSONAL WASHING	CATEGORY: WASHBASIN

TYPES:

Although there are a wide range of styles of washbasins available, with different types of tap, we have assessed them as a single type as their operation is similar and the frequency of use can be assumed to be the same. This is consistent with the information presented by MTP (ref K).

WASHBASIN OWNERSHIP (%)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
-	-	-	-	100.0%	100.0%	-

Values chosen:

In line with MTP it is assumed that all homes include access to a washbasin for personal washing including shaving and teeth cleaning.

WASHBASIN FREQUENCY OF USE (use/prop-d)

Values chosen:

The only authoritative information available is that presented by MTP. They estimate that the average frequency of washbasin use is 8 per person-day (i.e. 19.2 per household-day in 2010, assuming the MTP average occupancy of 2.4). MTP assume that this will remain unchanged in the future.

WASHBASIN VOLUME PER USE (l/use)

Values chosen:

The only authoritative information available is that presented by MTP. They estimate that the average volume per washbasin use was 2.27 litres in 2010, and is forecast to reduce to 2.13 litres in 2020 and then stay at that volume (according to the MTP Policy scenario). The reductions arise due to the assumed installation of lower flow-rate taps in the future.

Appendix B: What is the likely demand for water?

	Volume per use (litres)			
	2010	2020	2030	2040
Reference	2.3	2.3	2.3	2.3
Policy	2.3	2.1	2.1	2.1
EBP	2.3	2	2	2

It has been assumed that the average volume per use at metered households is 7.94% lower; this is equivalent to the metering effect derived for metered households.

Component: Clothes Washing

Clothes washing can be undertaken by washing machine (including washer-driers), by hand or at laundrette. Clothes washing by hand is very infrequent and there is limited data to quantify its use, and so it has been assumed to be part of the Miscellaneous internal use component. Clothes washing at laundrettes is not part of household water use and so is not considered for micro-component analysis. Therefore the only category of water use in clothes washing that has been assessed is for washing machines.

COMPONENT: CLOTHES WASHING	CATEGORY: WASHING MACHINE

TYPES:

We have not sub-divided washing machines into various types, instead it uses a single average volume that changes with time. This is consistent with the data presented by MTP.
MTP estimate that the average lifespan of a washing machine is 12.6 years, and have used this assumption in their modelling of future replacement of washing machine with lower water using versions. The average ages of washing machines in the company survey (see Table xx) are consistent with the MTP estimated lifespan of 12.6 years.

WASHING MACHINE OWNERSHIP (%)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
93.7%	95.7%	92.2%	96.5%	93.7%	95%	>90%

Values chosen:

Washing machine ownership levels recorded in our surveys are close to the 95% level estimated by MTP and have been used as being representative of ownership in the region.
MTP assume that washing machine ownership will remain at current levels. We have therefore assumed no change in future.

WASHING MACHINE FREQUENCY OF USE (use/prop-d)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
0.68	0.65	-	-	0.81	0.71	-

Values chosen:

Our company survey average usage rates for washing machines are lower than the MTP estimated average of 0.71, or the WRc estimate of 0.81. The MTP assessment has been based on a wider survey of reported washing machine usage than the WRc study. But our values have been assumed in this study as being more representative of usage in our region, and reflect the anticipated lower use by metered customers who have a financial incentive to use water wisely.

MTP report that the average frequency of use of washing machines has reduced from 274 per year (i.e. 0.75 per household-day) in 2000 to 260 per year (i.e. 0.71 per household-day) in 2010, and is expected to remain at this level. We have therefore assumed that frequency of use will remain at current levels.

WASHING MACHINE VOLUME PER USE (l/use)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
-	-	-	-	61	-	~60

Values chosen:

MTP do not estimate the average water use by washing machines, but document MTP predict that the average energy consumption per wash will reduce to the typical value of a current "A" graded washing machine. Which? identifies that the current lowest water using washing machine uses 31 litres per cycle.

We have assumed that, for each MTP scenario, the average volume per use will reduce from 60 litres in 2010 to the following volumes per use:

	Volume per use (litres)			
	2010	2020	2030	2040
Reference	60	48	33	33
Policy	60	45	31	31
EBP	60	35	24	24

Component: Dishwashing

Dishwashing includes washing of dishes using a dishwasher or by hand. Both categories have been assessed by this study.

COMPONENT: DISHWASHING	CATEGORY: DISHWASHER

TYPES:

MTP estimate that the average lifespan of a dishwasher is 13.0 years, and have used this assumption in their modelling of future replacement of dishwashers with lower water using versions. The average ages of dishwashers in our company survey (see Table B2.5) are consistent with the MTP estimated lifespan of 13.0 years.

DISHWASHER OWNERSHIP (%)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
25.5%	39.5%	28.2%	41.0%	37.0%	36%	-

Values chosen:

Dishwasher ownership levels according to the company customer surveys are different to the 36% level estimated by MTP. Our company survey values have been used as being representative of ownership in the region.

MTP estimate that 36% of UK households owned a dishwasher in 2010, and predict that this will increase by 4% to 40% at 2020, and stay at that level. Therefore we have assumed that dishwasher ownership by unmeasured and metered households will increase by 4% by 2020. It is assumed that as ownership by unmeasured households would still be below the MTP “saturation level” of about 40%, it will continue to increase at this rate after 2020.

	Scenario ownership			
	Reference/Policy/EBP			
	2010	2020	2030	2040
Unmeasured	28.2	32.2	36.2	40.2
Measured	41	45	45	45

DISHWASHER FREQUENCY OF USE (use/prop-d)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
0.67	0.66	-	-	0.71	0.67	-

Values chosen:

The average usage rates for dishwashers according to the MORI customer survey are close to the MTP estimated average of 0.67, and have been assumed as being representative of usage in the region.

MTP estimate that average household dishwasher usage has reduced from 250 per year (i.e. 0.68 uses per household-day) in 2000 to 245 per year (i.e. 0.67 uses per household-day) in 2010, and assume that it will reduce to 236 per year (0.65 uses per household-day) at 2030. This decline takes into account potential for less frequent use in smaller households and the increase in capacity of future dishwashing machines. Therefore we have assumed that dishwasher frequency of use by unmeasured and metered households will decrease each decade by 0.01 uses per household-day.

	Scenario frequency of use (uses/property/day)			
	Reference/Policy/EBP			
	2010	2020	2030	2040
Unmeasured	0.66	0.65	0.64	0.63
Measured	0.67	0.66	0.65	0.64

DISHWASHER VOLUME PER USE (l/use)

Values observed or reported:

STW (MORI) (2005)		STW (DCM) (2011 / 2008)		WRc (2002)	MTP (2010)	UKWIR (2012)
Unmeasured	Metered	Unmeasured	Metered	Unm.	-	-
-	-	-	-	21.3	-	~20

Values chosen:

MTP do not estimate the average water use by dishwashers, and we have assumed that the average volume per use is 20 litres as quoted by UKWIR (2012), which is more recent than the WRc survey report.

Which? identify that the current lowest water using dishwasher uses 10 litres on its main programme and 7 litres on its eco-programme.

MTP predicts that the average energy consumption per wash will reduce from 2010 to 2030. The predominant use of electricity by dishwashers is in heating water. If it is assumed that water consumption efficiency will follow energy efficiency trends, this would imply that the volume per use will reduce as follows for each of the three MTP scenarios. We have used this assessment as MTP have undertaken detailed assessments of future energy use.

	Volume per use (litres/use)			
	2010	2020	2030	2040
Reference	20	18.6	17.2	15.8
Policy	20	17.1	14.3	11.5
EBP	20	15.7	11.4	7.1

Appendix B: What is the likely demand for water?

COMPONENT: DISHWASHING	CATEGORY: WASHING BY HAND

It is assumed that all households that do not own a dishwasher wash their dishes by hand. However, even households with a dishwasher will usually wash some items by hand.

UKWIR (2012) have estimated that the average volume of water used is 9 litres/household-day. This is consistent with the MTP estimate that average total kitchen tap water use is 20.9 litres/person-day (across homes with or without a dishwasher). The Water Efficiency Calculator assumes 4.5 l/head-d (i.e. 10.8 l/household-d for an occupancy of 2.4) for dish washing where a dish washer is not supplied – although UKWIR recommend that this should be normalised to 4.1 l/head-d (i.e. 9.8 l/household-d for an occupancy of 2.4). Stamminger et al (ref R) observed an average use (across 113 volunteers) of 103 litres for manual dish-washing for a 12-place 3-course dinner, i.e. an average of 8.6 l/place. The only other estimate found in the literature is 28.6 litres/household-day by Herrington (ref P), based on a study in the 1970s, for homes not using a dishwasher. For this study the UKWIR value is used as they have recently reviewed the various data sources available.

We therefore assume that the average volume of water used (for unmeasured households) for hand washing of dishes is 9 litres/household-day. It is assumed that this value remains constant through time.

For metered households, it is assumed that the average volume of use is 7.94% lower; this is equivalent to the metering effect derived for metered households.

Component: Miscellaneous Internal Use

Internal tap use by washbasins has been included in personal washing and internal tap use for hand-washing of dishes has been included in dishwashing. Miscellaneous internal water use comprises all other water uses, in particular water drawn from taps at the kitchen sink, bidets or utility room sink. This may include: washing of clothes, floors, kitchen surfaces or other household items; plumbing losses; drawing off water from taps to obtain hot water; water softeners; waste disposal units; animal use; indoor watering of plants; DIY; hobbies; medical; Jacuzzis; or future new water uses.

COMPONENT: MISCELLANEOUS INTERNAL USE	CATEGORY: MISCELLANEOUS INTERNAL USE

It is assumed that all households use water for miscellaneous internal water uses.

WRc report an average internal tap use of 87.2 l/household-d and an average use for water softeners of 1.1 l/household-d, giving a total of 88.3 l/household-d.

Richter and Stamminger have recently monitored water use in the kitchen at 81 urban households across four European countries including 20 homes in the UK. Average UK water use was observed to be 19.8 l/household-day, of which over 50% was for dishwashing. This is similar to the MTP assessments (see below).

MTP estimate average water use at internal taps in 2010 as:

- Washbasin: 8 uses/hd-d x 2.27 l/use = 18.2 l/hd-d
- Kitchen: 9 uses/hd-d x 2.28 l/use = 20.5 l/hd-d
- i.e. a total of 38.7 l/hd-d, which is equivalent to 92.9 l/household-d assuming an average occupancy of 2.4, and so is similar to the WRc assessment.

MTP have forecast that kitchen tap use will stay flat for the Reference scenario, but reduce for both the policy and EBP scenarios between 2010 and 2030, due to efficiency measures such as wider use of low flow-rate taps.

Internal tap use for washing dishes by hand (estimated as 9 l/prop-d, see Section 3.6) has been included in the Dishwashing component, and so the values used for each year must be deducted. Plumbing losses are not included in internal tap use calculations and so need to be added. STW estimate plumbing losses at 12 l/prop-d, based on Managing Leakage (2011), and assume that half of this (6 l/prop-d) is internal to the home.

Herrington defined this component slightly differently, but forecast that miscellaneous use would grow by 0.247 l/hd-d per annum, in particular due to the growth in minor water uses and introduction of new ways customers would use water in the future. This would be equivalent to an increase of 11.9 l/household-d between 2010 and 2030. An example of growing internal water use is the increasing installation of combi-boilers that require the drawing-off of some litres of water before hot water is produced.

For metered households, it is assumed that the average volume of use is 7.94% lower; this is equivalent to the metering effect derived for metered households.

Appendix B: What is the likely demand for water?

The following table shows the effects (l/prop-day) of combing these elements:

	Scenario volume (litres/property/day)											
	Reference				Policy				EBP			
Type of shower	2010	2020	2030	2040	2010	2020	2030	2040	2010	2020	2030	2040
Kitchen tap use	50.2	50.2	50.2	50.2	50.2	45.6	43.9	42.2	50.2	44.2	40.8	37.4
Hand-washing dishes	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9
Plumbing losses	6	6	6	6	6	6	6	6	6	6	6	6
Increase in uses	0	6	11.9	17.8	0	6	11.9	17.8	0	0	0	0
Total	47.2	53.2	59.1	65	47.2	48.6	52.8	57	47.2	41.2	37.8	34.4

Component: External Water Use

External use includes water used externally for garden watering, car washing and other uses.

COMPONENT: EXTERNAL WATER USE	CATEGORY: EXTERNAL WATER USE

MTP identify the following outdoor uses of water but provide limited details of the average quantities of water used:-

- Garden watering (e.g. by hosepipe, sprinkler or watering can)
- Filling/topping-up of ponds and water features
- Pressure washers (for outdoor cleaning)
- Recreational water use (e.g. by swimming pools, hot tubs or paddling pools).

Two alternative approaches to estimating external water use have been considered:

- Consideration of each sub-component of external water use
- Based on ownership of external tap

Sub-component assessment

MTP suggest that, based on information from the British Swimming Pool Federation, average water use by swimming pools is 66 l/d and by hot tubs is 36 l/d. Ownership levels are very low: the MORI 2005 customer survey suggests current ownership levels of approximately 0.5% for swimming pools, and MTP estimate 0.4% ownership nationally for hot tubs. These suggest estimated average water uses (across all homes) of 0.33 l/household-day for swimming pools and 0.14 l/household-day for hot tubs. The quantities involved are not well understood.

The MORI 2005 survey data on ownership and use of external water-using appliances is summarised as follows for unmeasured households:-

Appliance	Ownership (%) (from MORI)	Number of uses per day (from MORI)	Assumed volume per use	Estimated daily water use (all year) (l/household-d)
Watering can	70.5	0.94 (summer)	10 l/can	3.3
Hosepipe	60.9	0.18 (summer)	16 min (MORI) * 10 l/min	8.8
Sprinkler	7.5	0.15 (summer)	39 min (MORI) * 10 l/min	2.2
Trickle system	0.5	0.37 (summer)	15 min (MORI) * 5 l/min	0.1
Swimming pool	0.4	-	66 l/d (MTP)	0.3
Paddling pool	6.5	-	500 l / year	0.1
Hot tub	-	-	-	0.1
Pressure washer	10.9	0.05 (all year)	50 l/use	0.3
Total				**15.2**

The estimated average external water use of 15.2 l/household-d derived from examining the sub-components is subject to several assumptions about usage rates and the reliability of customer assessments on infrequent uses of such appliances, and is likely to miss other types of external water use. It provides a useful benchmark, but it is considered that estimation by consideration of the % ownership of an external tap and the average volumes observed by WRc Identiflow studies is probably more reliable.

Ownership of external tap assessment

WRc reported on water use from external taps, and found that 65% of homes used an external tap on an average of 0.89 times a day, with an average use of 46.7 l/household-d. We have assumed that unmeasured households with an external tap use 46.7 l/household-d but that metered households use 7.94% less.

Our customer surveys found that 66.1% of unmeasured households (DCM 2011) and 72.8% of metered households (DCM 2008) own an external tap. These are similar to the WRc value of 65%, but our survey values have been assumed in this study as being representative of the our region.

Based on this information, we have assumed that for a normal year, average external water use can be estimated as:

- 66.1% ownership * 0.89 use/day * 46.7 l/household-d for unmetered households
- 72.8% ownership * 0.89 use/day * 43.0 l/household-d for metered households

It has been assumed that this will not change in the future.

The increase in water use in hot, dry weather is predominantly due to increased external water use. Therefore the external water consumption rates will be significantly increased for dry year or climate change scenarios.

B3 Forecasting non-household demand for water

We have worked with Experian, a leading economic information and analytical services provider, to produce forecasts of non-household water demand (NHWD) to 2040. The forecasts have been derived using econometric models that relate NHWD to measures of economic activity (output and employment) in our supply region, in addition to trends in water demand that are unrelated to economic conditions and reflect trends in the efficiency of water use by non-household consumers. The models explicitly link future water demand to expected changes in economic activity by industry sector and capture trends in efficiency over time.

B3.1 The non-household demand modelling approach

The 25 year non-household water demand forecasts have been constructed using econometric models that relate non-household water demand to measures of economic activity (output and employment) in our region. We also take account of trends in water demand that are unrelated to economic conditions and reflect secular trends in the efficiency of water use by non-household consumers. These models follow the best practice guidelines laid out by the Environment Agency in developing water demand forecast for the next twenty five years.

The econometric models are constructed on an industry sector basis for which we classify industries by a Standard Industry Classification (SIC) code, a code classification for categorising business activity. We relate historical trends in non-household water demand for each of 30 SIC- based industries to local economic conditions in those sectors. This approach maximises the ability of the forecast models to incorporate industry-specific relationships between economic activity and non-household water demand. We vary the economic measures used (output or employment) and the coefficients relating economic measures to water consumption for each industry to reflect differences in the sensitivity of industry water consumption to economic conditions. An industry-by-industry approach also allows for different trends in water use efficiency for each industry sector.

Since the draft WRMP forecasts, modifications have been made to Experian's commercial demand forecasting models which, together with our newly available consumption data for financial year 2011/12 and partial data for 2012/13, justify making changes to the long run commercial demand forecasts. These changes are the result of:

- Updated NHWD data from our billing system covering the full financial year 2011/12 and partial year data for 2012/13 (together with economic outcome data for the same period). This provides a substantial expansion to the historical data available with which to fit the forecast models which would be expected to result in improved predictive accuracy.

- Revision of the industrial classification used within the NHWD models from the 2003 to the 2007-vintage Standard Industrial Classification (SIC2007). This results in changes to the definitions of individual industrial sectors that form the basis for the time series econometric analysis.

These updates to our modelling approach mean that we have revised our projections of non-household demand for water for our final WRMP. We have updated Appendix B3 to describe the changes made since the draft WRMP was originally published. These updates cover:

- The nature of and reasons for the changes made to the long-run demand forecasting models.
- The impact on the long-run commercial demand forecasts of updated historical demand data and changes to the forecast models.
- The final long-run commercial demand forecasts derived from the revised models.

B3.2 Non-household data

The NHWD forecasting model has been developed using historical water demand data from our billing system for non-household customers in our region. Account level consumption data for non-household customers on a financial year basis between 2005/06 – 2011/12 consisted of individual customer records showing the

- Unique ID
- Location (post code)
- Water usage (Ml/day)
- Industry (SIC)
- Consumption Band
- Tariff Group

To produce a consistent time-series of water demand, a number of checks were applied to the dataset.

- Checking to ensure no duplicate records were included in compiling the water usage data for modelling
- Checking for consistency of samples between annual datasets,
- Checking for consistent SIC industry coding, and other characteristics (name and address details, location details, consumption and tariff details) of individual accounts.

In addition, we aggregated individual accounts into appropriate industry groupings with similar economic characteristics to increase the robustness of the data. Aggregating the data on this basis helps to smooth out volatility in consumption patterns for individual accounts or fine SIC industries. Such volatility is unlikely to be related to economic conditions. The industry groupings used are based on aggregations of SIC industries to the 30 sector industry classification within Experian's UK regional economic forecasting models. These sector groups are defined so as to group together more detailed SIC industries with similar characteristics in terms of main outputs, historical output and employment growth trends and patterns of purchases and sales as indicated within the ONS UK National Accounts 'Input-Output Supply and Use Tables'.

The SIC has evolved through various vintages as the economy has developed. It was first introduced in 1948 with revisions in 1958, 1968, 1980, 1992, 1997, 2003 and 2007, so that new types of activities emerge (e.g. computer-related services) while others become less important or disappear (some more traditional extraction and manufacturing activities). Typically, following the introduction of a new SIC, the ONS will re-estimate historical data for the new sector definitions and then cease publication of data under the old SIC. This makes it increasingly difficult to continue to carry out analysis of economic data on the basis of the old SIC as time elapses from introduction of the new classification.

The NHWD forecast models used to produce the original draft WRMP long-run demand forecasts were constructed based on SIC2003 industry sector definition as this provided the best compromise between the classification of business units within the STW billing datasets and the historical economic data available at the time when the models were first estimated. Also, when the models were first build, Experian's UK and regional industry-level forecasts for output and employment were based on SIC2003 due to the significant time lag between publication of the SIC2007 definitions by ONS and the production of official UK and, particularly, regional economic data under the new classification. This approach has become increasingly untenable as ONS have transferred all of their economic statistics over to SIC2007 and ceased publication of SIC2003-based data.

Experian moved all of their economic forecasting models across to SIC2007 during 2012. That produced a tension between the SIC2003-based NHWD forecasting models used for the draft WRMP and the historical and forecast economic data required to drive those models. Resolving this problem requires re-aligning the forecast models and economic data/forecasts so that they are both based around the same SIC. Experian assessed two possible approaches:

1. Continue to use the SIC2003 based NHWD forecast models, but map the historical and forecast economic data from SIC2007 back to SIC2003.
2. Recast the NHWD forecast models to SIC2007 – by re-aggregating the STW NHWD data to the newer SIC and re-estimating the econometric models - and then work directly with the SIC2007-based economic data.

The latter approach is preferred because the industry-level NHWD data are compiled directly from account-level data from the non-household billing system. Although the account-level SIC coding is not based on SIC2007, it is sufficiently detailed to allow a good match to the broader SIC-based industry groupings that form the basis for the NHWD models. It is therefore possible to compile SIC2007-based industry sector water demand estimates for the Severn Trent region and WRZs with a relatively high level of precision and accuracy. In contrast, the economic data are only available on a relatively aggregated basis and mapping the economic data from SIC2007 to SIC2003 necessarily involves making some relatively simple assumptions about sector definitions and shares. This approach therefore results in a weaker alignment between the model sectors and the economic data, and one that is likely progressively to deteriorate over time.

In addition, the availability of updated historical NHWD data justified re-estimation of the forecast equations in any case, so that combining the remapping of the models from SIC2003 to SIC2007 with this re-estimation process produces a significant improvement in the quality and in the sustainability of the forecasting process.

We have aggregated account-level non-household consumption data to provide estimates of total consumption by industry sector. These sector consumption trends provided the primary basis for estimating econometric models relating non-domestic water consumption to economic conditions as a basis for forecasting future consumption.

The historical estimates for the EA sector groupings are presented, on a financial year basis, in table B3.1.

Table B3.1 Non-household water demand by EA sector, 2005/06-2011/12 (Ml/day)

Description	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Agriculture & Extraction	46.8	47.7	44.3	41.5	42.2	43.3	42.2	36.5
Manufacturing	112.0	106.5	100.0	92.0	89.0	88.5	87.2	84.9
Utilities	9.8	9.5	8.4	9.4	9.9	9.9	8.9	9.0
Construction	2.3	2.6	2.6	2.6	2.6	2.8	2.8	2.7
Distribution	31.1	27.9	27.9	28.0	28.5	28.9	28.2	26.7
Accommodation & Food	35.9	37.0	36.5	37.0	38.7	39.4	39.3	37.6
Transport & Communications	8.4	8.3	8.7	8.3	8.4	8.3	7.6	6.8
Financial & Business Services	18.3	19.5	19.5	19.9	20.5	20.8	21.4	21.1
Public Administration	23.5	23.7	23.2	22.6	22.2	21.7	19.7	18.0
Education	29.1	28.8	28.3	28.5	28.4	29.6	29.8	29.5
Health	21.8	22.3	22.3	22.2	22.7	23.3	22.6	22.0
Other Services	27.3	28.6	27.7	27.2	27.7	27.8	27.2	25.6
Unclassified	20.9	19.2	16.2	11.6	7.5	4.9	4.8	5.9
ALL	387.2	381.6	365.4	350.8	348.3	349.2	341.7	326.5

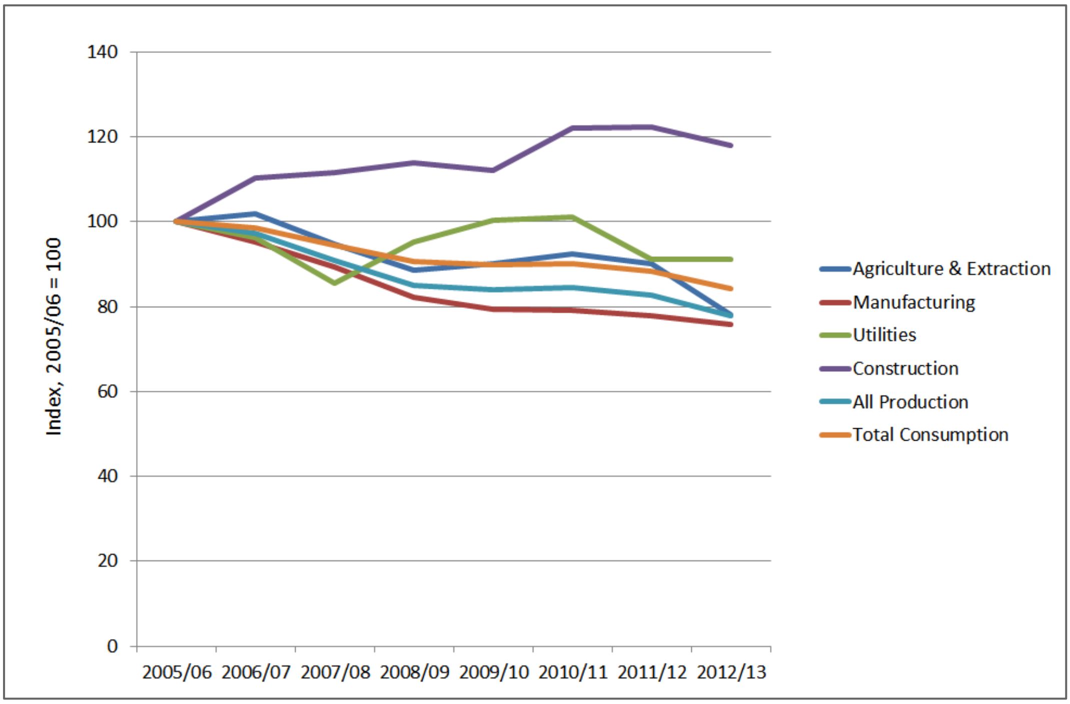
Source: Severn Trent Water, Experian

B3.3 Trends in non-household water demand

The remainder of this section discusses trends in water demand within these EA industry sectors against the background of economic trends in those sectors within our region. The forecast models are based on formal econometric analysis of correlations between industry-level economic activity non-household water consumption.

Figure B3.1 shows trends in water demand within the STW supply region by production and construction industries – here defined to include Agriculture, Forestry & Fishing; Extraction; Manufacturing; Utilities; and Construction industries. In all cases, demand in each financial year is shown on an index basis relative to demand during 2005/06 (=100).

Figure B3.1 Historic non-household Water Demand by Production Sectors, (Ml/day)



Most industry sectors showed declining water demand over the period 2005/06 to 2011/12. The largest declines were in manufacturing and activities related to mineral extraction. The exception was construction, where demand rose during the early part of the period but declined from 2008/09 onwards reflecting the economic cycle of growth and decline over the period. In the case of manufacturing and extraction sectors, trends in water demand correlated with trends in industry sector economic output within our region, with higher levels of industry output being associated with higher levels of water demand. For industries within these groups, the historical trends in water demand were consistent with a combination of an ongoing declining trend moderated, or amplified, by rises or falls in industry economic output. No evidence of links between water demand and industry output or employment could be found for Agriculture, Utilities and Construction sectors, however, using financial year data. In these cases the historical financial year water demand data was most consistent with a long-term output trend independent of economic conditions.

Figures B3.2 and B3.3 show trends in water demand within ‘mainly private’ and ‘mainly public’ services sectors, again as financial year indices relative to 2005/06. In both cases, water demand has remained much more stable over this period than was the case with demand by production and construction activities. This stability was related both to generally more stable economic conditions within these activities and to weaker secular declines in water demand.

Appendix B: What is the likely demand for water?

Figure B3.2 Non-household Water Demand by Private Services Sectors, (Ml/day)

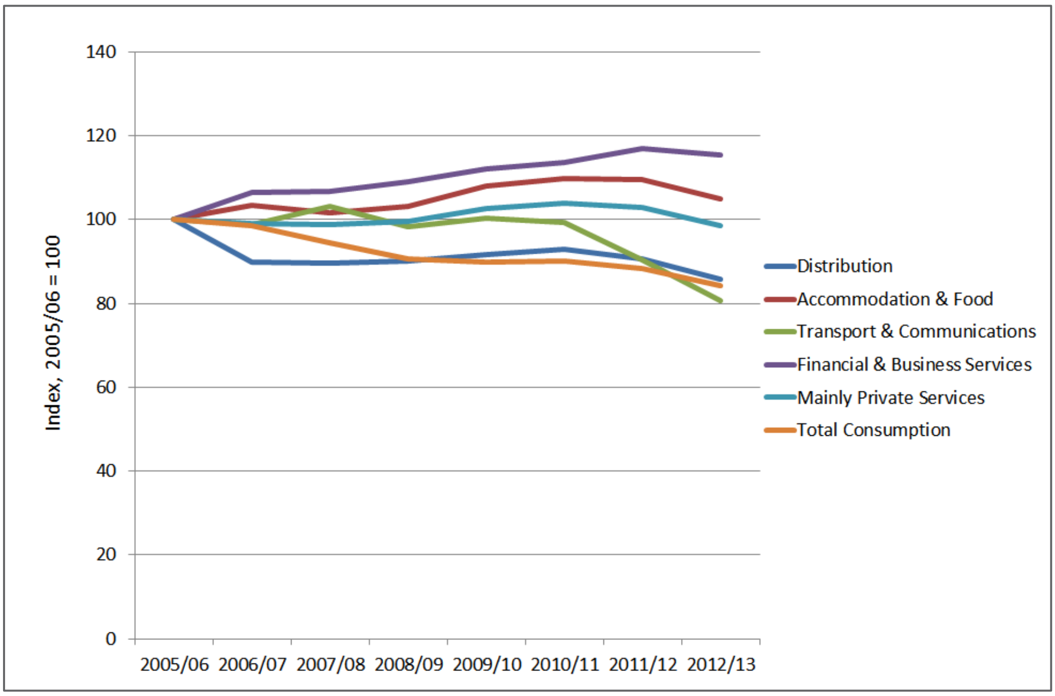
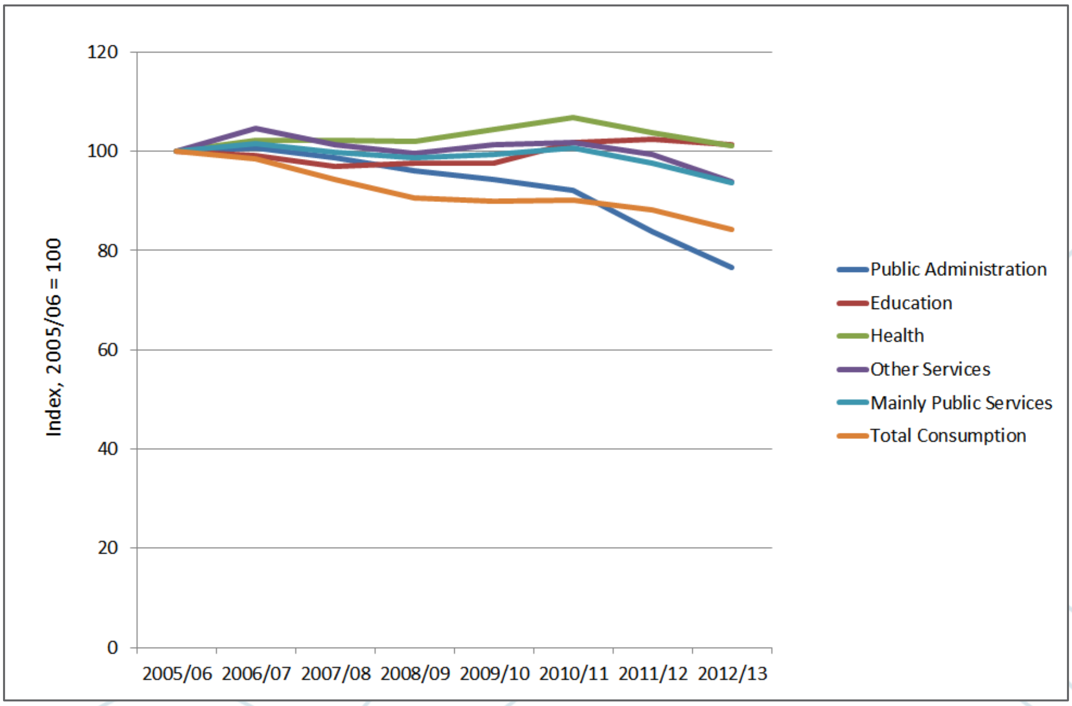


Figure B3.3 Non-household Water Demand by Public Services Sectors, (Ml/day)



Our econometric analysis identified links between water demand and industry economic activity (either output or employment) for many elements of private services within the financial year data – the exceptions being transport services, business services and elements of financial services. In general, public services water demand appears less sensitive to economic activity levels than does private sector demand. The exception is for demand by health services, where a relatively strong relationship was found between water demand and sector output.

B3.4 Economic forecasts

Experian's standard UK Regional Planning Service (RPS) provides detailed data and forecasts for the UK regions, their constituent counties and local authority districts for the period 1982-2026. The headline indicators of GVA and employment are provided for 30 SIC industry sectors which draw on official datasets and Experian's own proprietary data. To ensure our forecasts are consistent, a 'top-down' approach is used, in that the global macro view is set first. The global macro scenario is then filtered down to the regions and cities via regional models. The drivers of regional and city-level economic activity and employment are:

- National performance – incorporates specific structural factors which effect all regions
- Demographics – particularly growth/decline in the working-age population
- Industrial structure – Do regions have high/low concentrations in strongly/weakly performing industries?

UK Economic Prospects within the Central Forecast and Alternative Scenarios

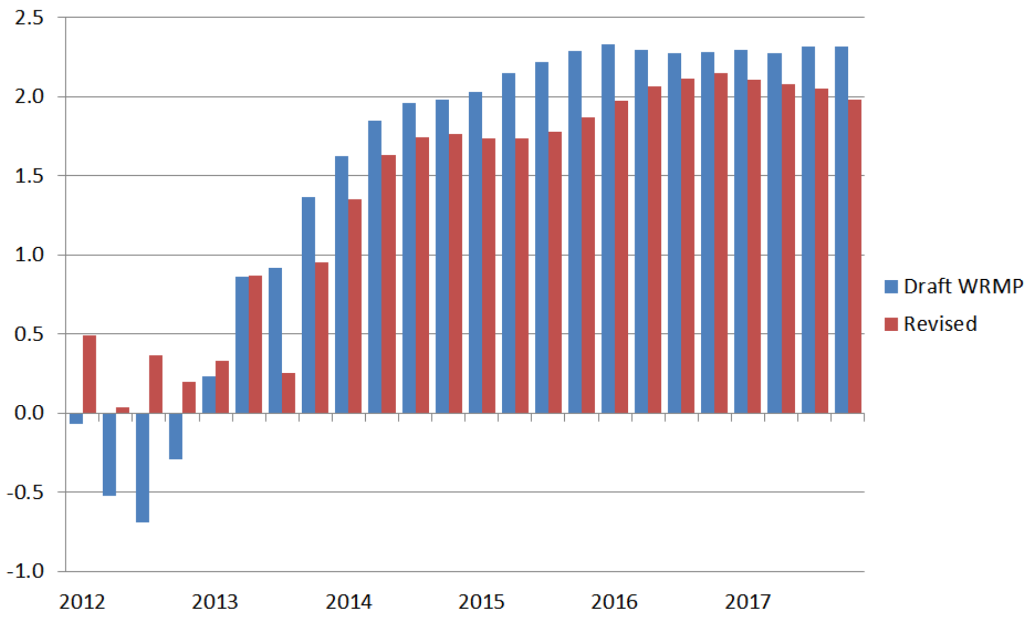
The central economic forecast underlying the long-run non-household water demand forecasts was the published Experian UK macroeconomic forecast from Autumn 2012. That forecast envisaged a weak UK economy over the short term, with weak output and employment growth and high unemployment during 2012 and 2013, followed by a gradual recovery in economic prospects from 2014 onwards. Overall output growth was not, however, expected to return to pre-recession levels – since growth during the period up to 2007 had been artificially inflated by the boom in debt and unsustainable growth in household and government consumption and in property market activity. The main assumptions underlying the long-term forecast are presented in figure B3.4 together with the equivalent assumptions for the alternative 'high' and 'low' growth scenarios.

Figure B3.4 UK economic forecasts, central, high & low growth scenarios

	2012-2020		
	Central	High	Low
GDP Growth Rate (%)	1.8	2.3	1.4
Unemployment Rate (ILO/LFS)	7.4	6.6	8.3
RPI Inflation Rate (%)	3.1	4.9	0.8
	2020-2040		
	Central	High	Low
GDP Growth Rate (%)	2.5	2.9	2.2
Unemployment Rate (ILO/LFS)	4.8	3.8	6.1
RPI Inflation Rate (%)	2.7	4.8	-0.1
	2012-2040		
	Central	High	Low
GDP Growth Rate (%)	2.3	2.7	1.9
Unemployment Rate (ILO/LFS)	5.5	4.6	6.7
RPI Inflation Rate (%)	2.8	4.8	0.2

In addition to updating and revising the historical NHWD data, Experian also incorporated updated SIC2007-based output and employment data for our supply region, including estimates for financial years 2011/12 and 2012/13 based on ONS data for the UK as a whole and for the government office regions which contain the STW supply region. These estimates point to weaker economic conditions during 2012 in our region than were envisaged in the economic projections underlying the draft WRMP long run forecasts. The short run economic growth forecast within the revised NHWD baseline forecast is also generally weaker than that included within the draft WRMP projections (figure B3.5).

Figure B3.5: Baseline Forecasts for UK GDP growth rate (%)



We have used Experian regional economic forecasting models to translate the central scenarios into industry output, and employment forecasts for the central scenario into assumptions about output & employment growth for industries within the our region. A simpler approach was used for the 'high' and 'low' growth scenarios. In those cases, regional output and employment growth trends for the central scenario were adjusted upwards or downwards in line with the differences in aggregate output and employment growth for the UK for those scenarios. The scenarios therefore maintain the underlying central assumptions concerning the future patterns of output and employment growth by region and industry, but raise or lower industry growth assumptions in line with assumed changes in the aggregate growth rate for the UK economy as a whole. The growth assumptions underlying the central view are presented in following section.

Output and employment forecasts for the region

Our water resource zones do not follow standard administrative boundaries, but comprise parts of several UK standard regions: West Midlands, East Midlands, Wales, South West and Yorkshire & the Humber. The bulk of the supply area sits within West Midlands, East Midlands and South West regions. Figure B3.5 summarizes the assumptions concerning economic growth prospects for each of these regions within the central economic forecast. Generally all regions, particularly the West Midlands, are expected to underperform relative to the UK as a whole in terms of output and employment growth over the long-term forecast period.

Figure B3.5: Annual average growth of output and employment by sector for Severn Trent Water supply area

	Industry Structure	Demographic Trends	Economic Growth Prospects
West Midlands	Relatively highly concentrated in manufacturing, consumer services and public services. Lower exposure to high growth high value service activities - including business and information services.	Population growth is relatively subdued. Working age population grows more slowly than UK as a whole (0.4% p.a. Vs. 0.6% p.a.)	Overall long term growth prospects are substantially lower than recent (pre-recession) history and lag significantly behind UK as a whole.
East Midlands	Highly concentrated in manufacturing, consumer services and construction activities. Public services share higher than UK as a whole. Lower exposure to high growth high value service activities.	Population growth is expected to be relatively high. Working age population expected to expand more rapidly than for UK as a whole (1.0% p.a.)	Long term growth prospects more recent than recent (pre-recession) history but are close to those for the UK as a whole.
South West	Similar to the UK as a whole, but marginally higher shares in manufacturing, consumer services and public services offset by lower shares in high value, high growth private services. Business services dominated by lower-value consumer and hospitality with modest growth prospects.	Population growth is expected to be higher than UK as a whole, but older demographics dominate, and working age population is expected to expand by around only marginally faster than UK (0.7% p.a.)	Both output and employment growth marginally underperform relative to the UK as a whole over the longer term.

Experian's standard economic forecasts at regional and local authority levels extend to 2026, which for the purposes of this project were trended out to 2040, providing a 29 year forecast horizon. Estimates of economic variables for the STW region as a whole were derived from the standard Experian geographies by weighting relevant standard areas according to their share in STW NHWD for each of the 30 industry sectors. This approach was used to create time series of economic activity indices (for total industry output (GVA) and employment (FTE) for the Severn Trent Water supply area.

B3.5 Model specification

The model construction needs to take into account economic theory to identify variables which can be used to forecast future water demand. The updated SIC2007-based forecast models share the same structure as the models used to produce the draft WRMP forecast, being made up of separate industry-level equations relating NHWD to industry activity (output and/or employment) within the STW catchment region.

Water is demanded by industry because it is an important input into the productive process. Depending on the industry in question, water may be used directly in production as a raw material. Alternatively, water may be used indirectly in that it is consumed by people in the working environment. Accordingly, the demand for water should vary with output or employment.

Time-series regression specifications

For each of 36 SIC2007-based industries the model specification used was of one of the following forms:

Appendix B: What is the likely demand for water?

$$\mathrm{dlog}\left(\mathrm{NHWD}_{i,t}\right) = \alpha + \beta_i \mathrm{dlog}(\mathrm{X}_{it}) + \varepsilon \qquad (1)$$

or

$$\log\left(\mathrm{NHWD}_{i,t}\right) = \alpha + \beta_i \log(\mathrm{X}_{it}) + \varepsilon \qquad (2)$$

where NHWD is non-household water demand, X refers to the economic activity index (for either output (constant price GVA) or employment (FTE), whichever provided the best fit to the historical data), log is the natural logarithm of the relevant variable, dlog the change in the log since the previous period, i and t index by industry sector and time period respectively, α and β are parameters to be estimated, and ε is a random error term.

In variant (1), above, the equation attempts to capture the relationship between growth of NHWD and growth in economic activity, while the 'constant' term, α, incorporates a constant trend growth rate for NHWD independent of economic conditions. So, in this specification, consumption in the relevant sector is tending to increase (or decline, α is generally negative) at a constant exponential growth rate but this trend growth rate is increased or decreased depending on the strength of the local economy (measured by either output growth or employment growth). This variant was used for most industry sectors.

In variant (2), the level of NHWD is related to the level of local economic output or employment in the relevant industry sector. The log operator means that the coefficient, β, relating water consumption to economic activity is an 'elasticity'. It measures the percentage change in water consumption by that industry consequent upon a 1 percent increase in either output or employment. This specification was considered in cases where there was no evidence of a trend in NHWD unrelated to economic conditions.

In some cases no significant relationship could be found between NHWD and industry economic activity (either output or employment) over the historical data period (so that the estimated value of β was effectively zero). In those cases the forecast equation was reduced to

$$\mathrm{dlog}\left(\mathrm{NHWD}_{i,t}\right) = \alpha + \varepsilon$$

which simply extrapolates the secular trend in NHWD from the sample period for that industry sector.

Figure 1 (below) shows the estimated coefficients for the annual (financial year) econometric model.

Table B3.2: Estimation Results – Annual (FY) data model

Industry Sector	Constant (trend growth rate, %)	Output Growth (% change GVA)	Employment Growth (% change FTE)
1 Agriculture, Forestry & Fishing	-0.941	0.000	0.000
2 Extraction & Mining	-4.787	0.356	0.000
3 Food, Drink & Tobacco	-1.682	0.324	0.000
4 Textiles & Clothing	-3.085	0.000	0.087
5 Wood & Paper	-1.848	1.298	0.000
6 Printing and Recorded Media	-6.079	0.390	0.000
7 Fuel Refining	-0.508	0.131	0.000
8 Chemicals	-3.736	0.000	0.625
9 Pharmaceuticals	0.982	0.000	0.413
10 Non-Metallic Products	-4.841	0.000	0.693
11 Metal Products	-2.732	0.553	0.000
12 Computer & Electronic Products	-4.482	0.241	0.000
13 Machinery & Equipment	-5.515	0.374	0.000
14 Transport Equipment	-7.447	0.320	0.000
15 Other Manufacturing	-0.331	0.000	0.623
16 Utilities	-1.188	0.000	0.000
17 Construction of Buildings	4.336	0.625	0.000
18 Civil Engineering	0.000	0.079	0.000
19 Specialised Construction Activities	1.167	0.677	0.000
20 Wholesale	-1.095	0.000	0.000
21 Retail	-2.066	0.000	0.874
22 Land Transport, Storage & Post	-1.576	0.000	0.000
23 Air & Water Transport	-2.537	0.696	0.000
24 Accommodation & Food Services	-0.832	0.000	0.000
25 Recreation	0.602	-0.473	0.000
26 Media Activities	-1.904	0.000	0.000
29 Finance	-0.804	0.000	0.000
30 Insurance & Pensions	-0.845	0.000	0.000
31 Real Estate	2.717	0.000	0.000
32 Professional Services	-0.301	0.081	0.000
33 Administrative & Supportive Services	2.827	0.000	0.000
34 Other Private Services	-0.133	0.123	0.000
35 Public Administration & Defence	-2.422	0.000	0.461
36 Education	0.212	0.000	0.215
37 Health	-0.880	0.473	0.000
38 Residential Care & Social Work	-1.586	0.000	0.000

Source: Severn Trent Water, Experian

B3.6 Water resource zone non-household demand forecasts

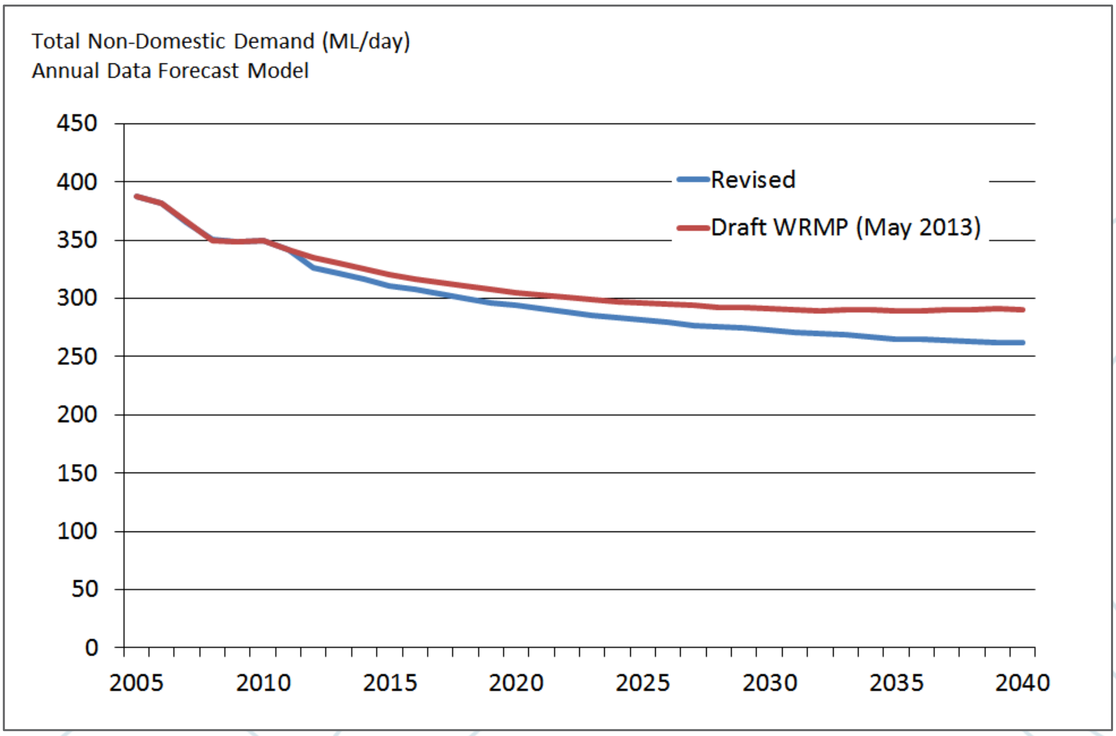
The final stage of the forecast process was to provide non-household water consumption forecasts for each Water Resource Zone. The method used was to allocate water demand forecasts across the WRZs using the WRZs share of economic activity in that industry. This means that the WRZ area forecasts reflect the composition of water demand in those areas by industry sector, and the industry sector demand forecasts for the company region as a whole. No attempt was made to adjust WRZ area forecasts for local economic conditions in the WRZ relative to those for the STW region.

Total non-household water demand

The final WRMP forecasts predicted a continuing fall in non-household demand over the forecast period. However, the decrease in demand was predicted to be fastest at the start of the forecasts between 2011/12 and 2019/20 after which time the rate of decline was expected to slow. By the late 2020s water demand was forecast to level off and remain broadly constant from 2026/27 until 2040/41. This primarily reflects the increasing economic dominance of services activities with more stable water demand relative to manufacturing and other production activities for which demand is expected to decline. The revised forecasts suggest a slightly more rapid rate of decline of total NHWD within the STW supply region throughout the forecast period, and particularly after 2025 when demand is now forecast to continue to decline through the remainder of the forecast horizon rather than to stabilize.

The revised forecast presented in the final WRMP has only a marginally higher average annual rate of decline in total NHWD, but this accumulates to a substantial reduction in demand at the end of the forecast period relative to the draft WRMP forecasts. Thus, NHWD is now forecast to decline at an average annual rate of around 0.8% a year compared to 0.5% a year in the draft forecasts, but this results in a 6.8% reduction in total NHWD by 2040/41.

Figure B3.6: Draft & Revised Long-run NHWD Forecasts: Total Demand



Services water demand

Figure B3.7 shows the revised long-run forecast for NHWD for services industries within the STW region. This shows an essentially flat demand profile compared to the modest growth predicted by the draft WRMP forecasts. The revised forecast profiles for private and public services are highly similar, with both predicted to have essentially constant demand over the long-run.

The revised overall services demand forecast results from revised growth profiles at a more detailed sub-sector level. Whilst it is important to note that changes to sector definitions make precise like-for-like comparisons between the draft and final forecasts difficult at an individual sector level,

Figure B3.7: Services non-household water demand

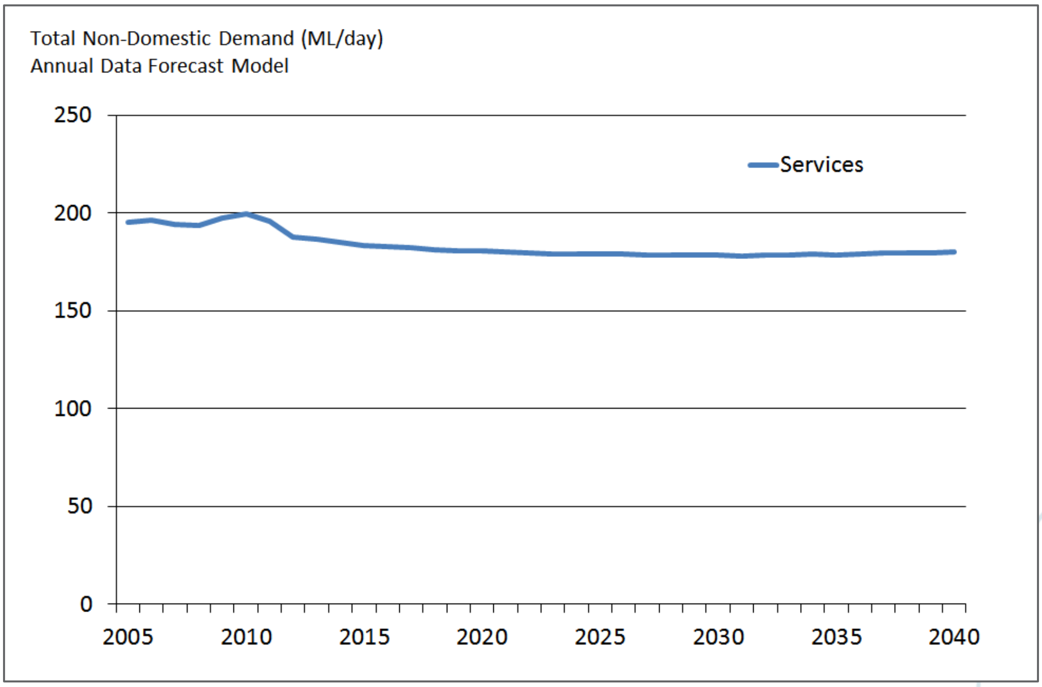


Table B3.3 and figure B3.9 show significant revisions in long-run growth rates (or rates of decline) for commercial services demand by sector, with particularly large swings in demand forecasts for accommodation & food (previously hotels & catering), transport & communications, and public administration & defence activities. These are primarily due to the addition of new data within the model estimation, rather than to changes in sector definitions.

Appendix B: What is the likely demand for water?

Table B3.3: Comparison of revised and draft NHWD forecasts for service sectors

	Revised					Draft WRMP
	2005/06	2011/12	2020/21	2030/31	2040/41	*2040/41*
Distribution	31.1	28.2	24.0	20.5	17.6	*11.5*
Accommodation & Food	35.9	39.3	35.2	32.4	29.8	*56.6*
Transport & Communications	8.4	7.6	6.0	5.1	4.4	*10.3*
Financial & Business Services	18.3	21.4	24.7	30.5	38.2	*35.6*
Public Admin & Defence	23.5	19.7	13.5	10.6	8.4	*34.0*
Education	29.1	29.8	30.1	31.5	32.9	*19.2*
Health	21.8	22.6	21.9	23.6	25.3	*19.1*
Other Services	27.3	27.2	25.2	24.4	23.7	*28.6*
Total Services	**195.4**	**195.8**	**180.6**	**178.6**	**180.3**	***215.0***

Source: Severn Trent Water; Experian

Note: Changes to sector definitions mean sector-level preliminary and revised forecasts are not fully consistent

Figure B3.8: Private and Public Services NHWD, ML/day

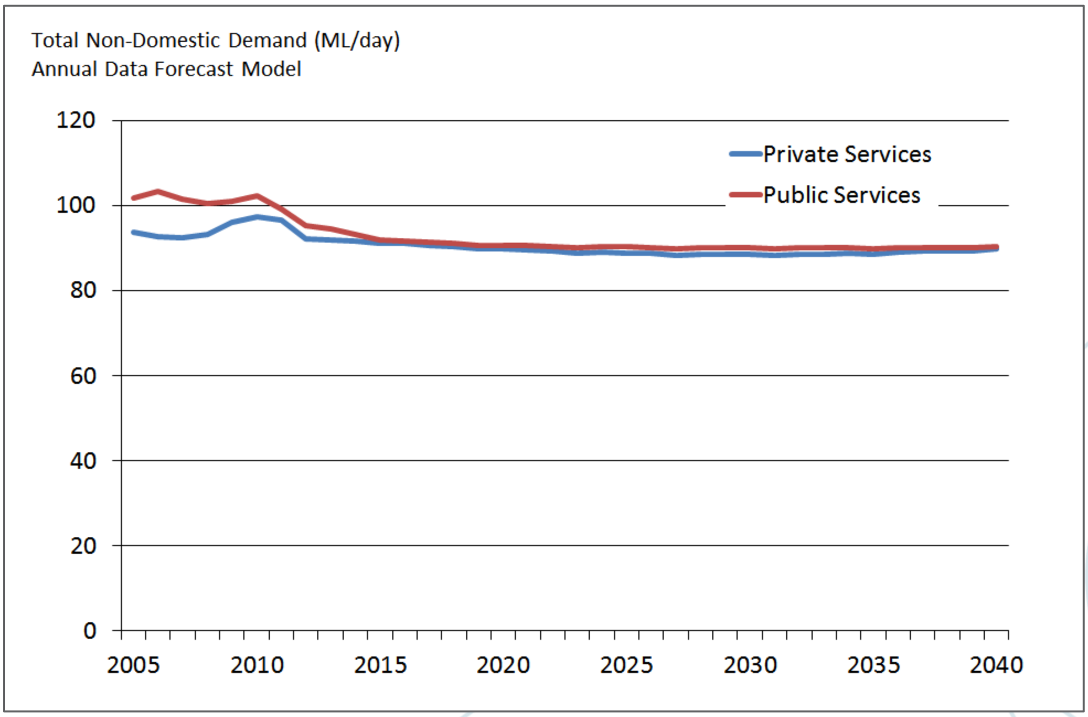
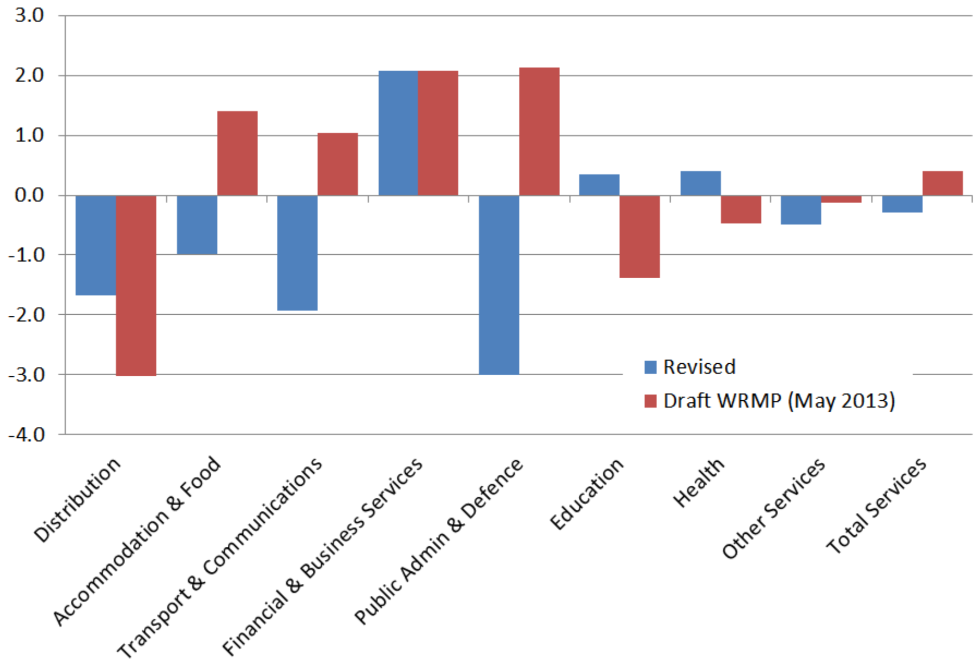


Figure B3.9: Revisions to services sector NHWD forecast average growth rates (% p.a.)



Non-services water demand

In contrast with services demand, the final WRMP forecasts are for a marginally slower rate of decline in NHWD among non-services companies than did the draft WRMP forecasts. Non-services demand is now projected to decline to around 80 Ml/day by 2040/41 compared to 60 Ml/day in the draft forecast. This again, however, reflects only a marginal change in the forecast annual rate of decline – from 2.7% a year in the draft forecast to 1.9% a year in the revised forecast.

Figure B3.10: Non-services non-household water demand, 2005/06 – 2040/41

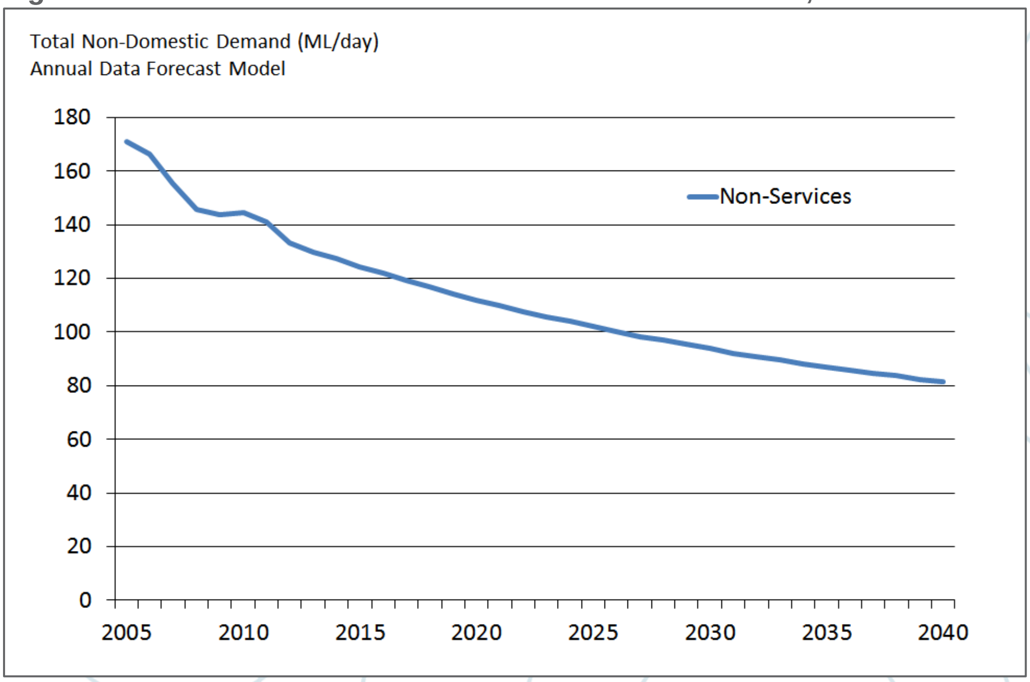


Table B3.5: **Comparison of final and draft NHWD forecasts for non-service sectors**

	Revised					Draft WRMP
	2005/06	2011/12	2020/21	2030/31	2040/41	*2040/41*
Agriculture & Extraction	46.8	42.2	33.2	29.7	26.7	*17.9*
Manufacturing	112.0	87.2	67.1	51.6	40.5	*40.3*
Utilities	9.8	8.9	8.1	7.2	6.4	*0.3*
Construction	2.3	2.8	3.6	5.3	8.0	*0.5*
Total Non-Services	**170.9**	**141.2**	**112.0**	**93.8**	**81.6**	***215.0***

Source: Severn Trent Water; Experian

Note: Changes to sector definitions mean sector-level preliminary and revised forecasts are not fully consistent

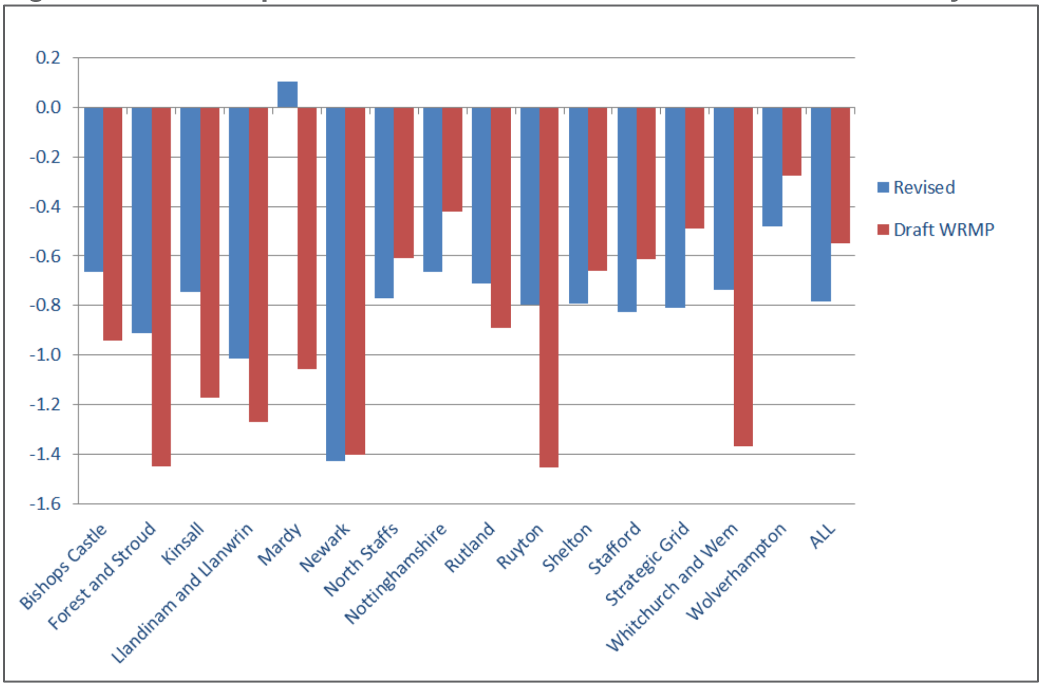
Non-Household Demand by WRZ

Table B3.6 shows forecasts for NHWD by STW water resource zone under the central economic scenario assumptions. As in the draft WRMP forecasts, these revised forecasts are based on allocating the industry-level water demand forecasts to WRZs based on the most recent share of WRZ demand within total demand for the STW region within that industry. The WRZ demand forecasts therefore reflect changes in industry output, employment and water demand patterns within the STW region and the industrial concentration of non-household water demand within each WRZ. Figure 16 shows the forecast annual rate of growth (or decline) in total NHWD by WRZ within the final and draft WRMP forecasts.

Table B3.6: Non-household water demand by STW WRZ, 2005/06 – 2040/41

	Revised				Draft WRMP
Daily Consumption by WRZone (Ml/day)	2011	2020	2030	2040	2040
Bishops Castle	0.5	0.5	0.4	0.4	0.4
Forest and Stroud	10.5	8.8	8.1	7.5	6.8
Kinsall	1.1	1.0	0.9	0.8	0.8
Llandinam and Llanwrin	3.2	2.8	2.5	2.3	2.2
Mardy	0.7	0.6	0.7	0.7	0.5
Newark	2.8	2.3	2.0	1.8	1.9
North Staffs	21.0	18.1	16.8	16.2	17.6
Nottinghamshire	43.0	37.8	35.5	34.4	38.0
Rutland	2.1	1.8	1.7	1.6	1.6
Ruyton	1.6	1.4	1.3	1.2	1.0
Shelton	22.2	19.1	17.7	16.9	18.3
Stafford	5.1	4.4	4.0	3.8	4.2
Strategic Grid	217.4	186.1	172.2	165.5	188.9
Whitchurch and Wem	2.4	2.1	2.0	1.9	1.6
Wolverhampton	8.1	7.1	6.8	6.8	7.4
ALL	341.7	293.9	272.6	262.0	291.3
Source: Severn Trent Water; Experian					

Figure B3.11: Comparison of Final & Draft WRMP NHWD forecasts by WRZ



B3.7 Alternative forecasts based on quarterly frequency econometric models

We also provided Experian with data on non-household water demand at an account level compiled on a quarterly frequency. A quarterly frequency forecast model was estimated linking this water demand data to historical economic data at the same frequency, and this was used to generate alternative long-run non-household demand forecasts for the STW area. The quarterly frequency model was estimated using a similar approach to that used for the financial year model presented above. The quarterly frequency model also included seasonal 'dummy' variables to control for any regular seasonal patterns in industry level water consumption.

The use of quarterly data provides more data points with which to calibrate relationships between NHWD and economic activity within each industry sector, albeit over the same short historical time window as for the annual data models. However, this increase in available data points has to be offset against reduced accuracy for each historical consumption estimate, due to practical issues of deriving quarterly estimates from billing systems that do not always accurately record consumption for individual accounts at that frequency. There are also likely to be larger estimation errors for the relevant economic data when measured at a quarterly rather than an annual frequency.

The quarterly frequency models can therefore be seen as complementary to the annual frequency models in that they are exposed to opposing risks regarding the emphasis they give to economic and trend effects – with the annual frequency models tending to under-estimate economic effects (due to lack of data and variation) while the quarterly models may sometimes over-estimate such effects (since in these simple time series models, there is a risk that any variation in measured demand is incorrectly assigned to economic conditions.

Overall, this suggests that there may be a benefit in terms of forecast accuracy in averaging across the results from the annual and quarterly frequency models.

As with the financial year models, the following model specification used for each industry (SIC) group was of one of the following forms:

$$\mathrm{dlog}(\mathrm{NHWD}_{i,t}) = \alpha + \beta_i \mathrm{dlog}(X_{it}) + \mathrm{dlog}(\mathrm{NHWD}_{i,t-1}) + \varepsilon \qquad (1)$$

where NHWD is non-household water demand, X refers to the economic activity index (for either output (constant price GVA) or employment (FTE), whichever provided the best fit to the historical data), log is the natural logarithm of the relevant variable, dlog the change in the log since the previous period, i and t index by industry sector and time period respectively, α and β are parameters to be estimated, and ε is a random error term.

In some cases no significant relationship could be found between NHWD and industry economic activity (either output or employment) over the historical data period (so that the estimated value of β was effectively zero). In those cases the forecast equation was reduced to

$$\mathrm{dlog}(\mathrm{NHWD}_{i,t}) = \alpha + \varepsilon$$

which simply extrapolates the historical trend in NHWD from the sample period for that industry sector.

The resulting quarterly frequency econometric models generally suggest somewhat stronger relationships between economic activity measures (output or employment by sector) and NHWD, which reduces the influence of historical trend extrapolation within the models and subsequently alters the forecast profiles. The estimated model coefficients are presented in the table B3.7, while Figures B3.12 – B3.15 compare the resulting forecasts to those from the annual data model discussed above.

Appendix B: What is the likely demand for water?

Table B3.7: Estimation Results – Quarterly data model

Industry Sector	Constant (trend growth rate, %)	Output Growth (% change GVA)	Employment Growth (% change FTE)	Autoregressive term (AR1)
1 Agriculture, Forestry & Fishing	-1.350	0.022	0.000	0.906
2 Extraction & Mining	-2.734	0.044	0.000	0.689
3 Food, Drink & Tobacco	-1.151	0.295	0.000	0.611
4 Textiles & Clothing	0.638	0.717	0.087	0.753
5 Wood & Paper	-1.632	0.852	0.000	0.714
6 Printing and Recorded Media	-6.333	0.518	0.000	0.798
7 Fuel Refining	0.824	0.182	0.000	0.071
8 Chemicals	-2.112	0.000	0.863	0.475
9 Pharmaceuticals	0.120	0.620	0.000	0.513
10 Non-Metallic Products	-5.905	0.495	0.000	0.361
11 Metal Products	0.132	0.608	0.000	0.837
12 Computer & Electronic Products	-3.244	0.563	0.000	-0.072
13 Machinery & Equipment	-6.315	0.361	0.000	0.681
14 Transport Equipment	-8.225	0.512	0.000	-0.116
15 Other Manufacturing	0.371	0.549	0.000	0.749
16 Utilities	-1.502	0.271	0.000	0.731
17 Construction of Buildings	4.416	0.826	0.000	0.510
18 Civil Engineering	0.000	0.308	0.000	0.712
19 Specialised Construction Activities	1.656	0.533	0.000	0.439
20 Wholesale	-2.332	0.000	0.406	0.831
21 Retail	0.038	0.000	0.460	0.834
22 Land Transport, Storage & Post	-2.684	0.000	0.417	0.791
23 Air & Water Transport	-2.113	0.210	0.000	0.691
24 Accommodation & Food Services	0.223	0.000	0.000	0.754
25 Recreation	-0.614	0.000	0.253	0.555
26 Media Activities	-2.051	0.251	0.000	0.265
29 Finance	-0.674	0.000	0.314	0.757
30 Insurance & Pensions	-0.714	0.322	0.000	0.494
31 Real Estate	2.489	0.000	0.024	0.670
32 Professional Services	-1.852	0.224	0.000	0.738
33 Administrative & Supportive Services	1.692	0.354	0.000	0.545
34 Other Private Services	-0.785	0.130	0.000	0.605
35 Public Administration & Defence	-4.145	0.192	0.000	0.812
36 Education	0.502	0.445	0.000	0.376
37 Health	-0.825	0.422	0.000	0.400
38 Residential Care & Social Work	-1.293	0.000	0.110	0.746

Source: Severn Trent Water, Experian

Figure B3.12: Long-run services NHWD – Alternative Forecasts, Ml/Day

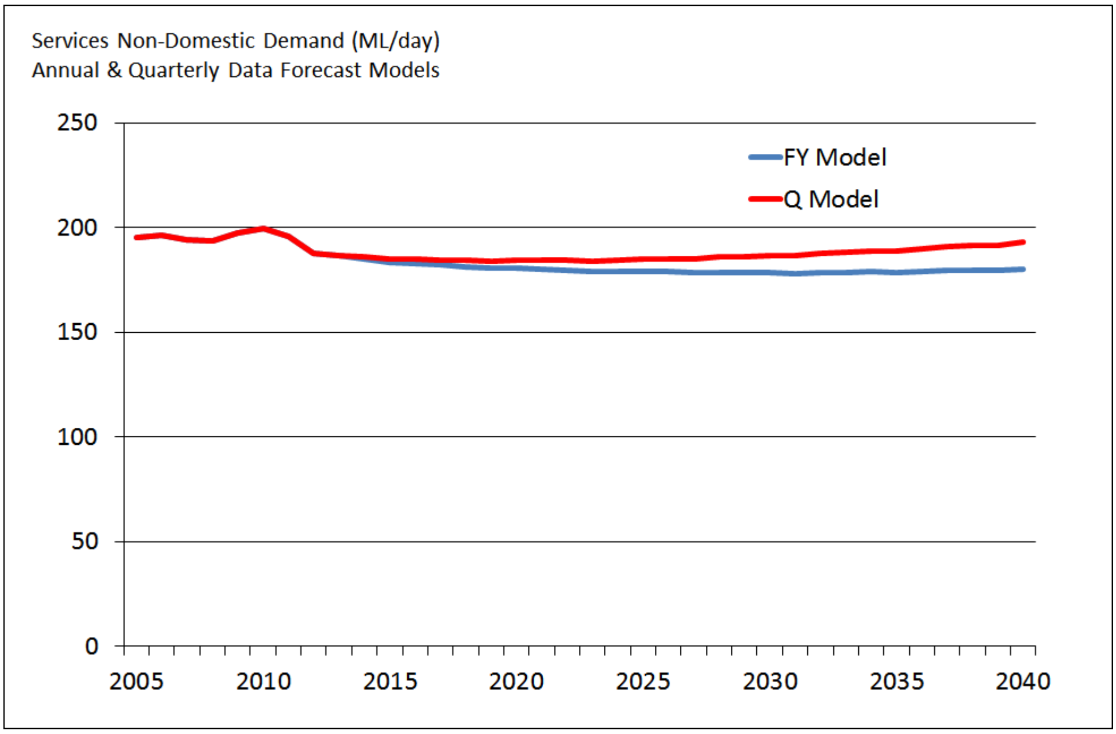


Figure B3.13: Long-run non-services NHWD – Alternative Forecasts, Ml/Day

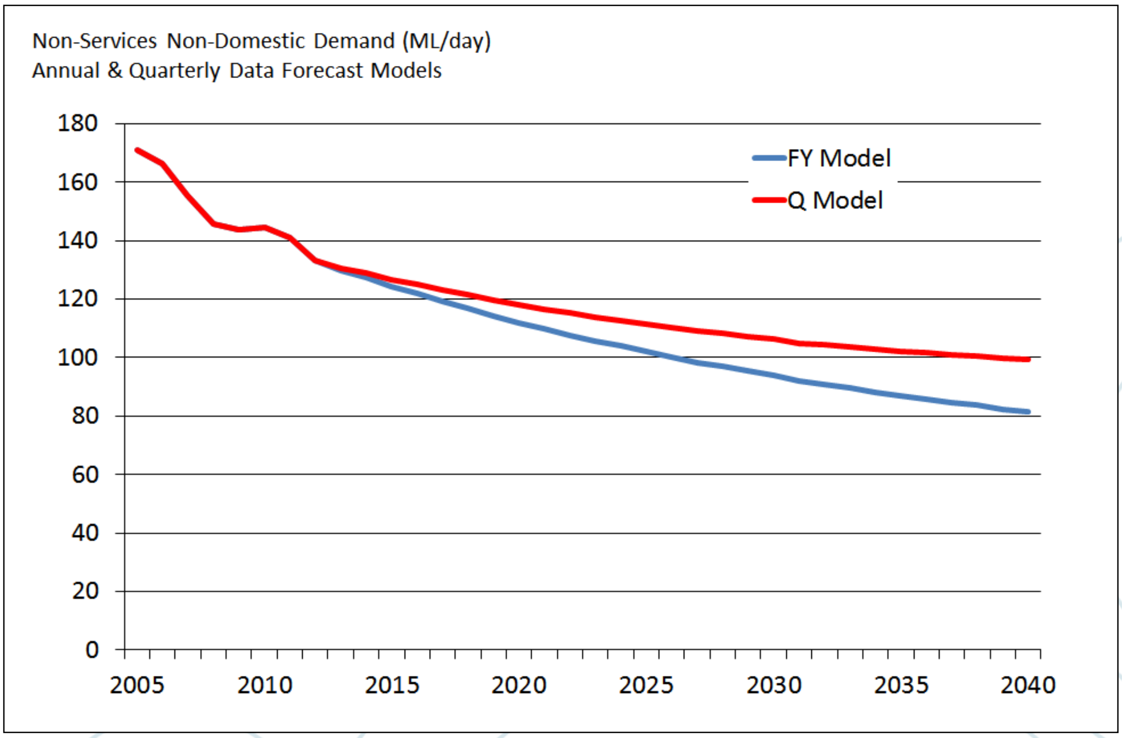


Figure B3.14: Long-run Total NHWD – Alternative Forecasts, Ml/Day

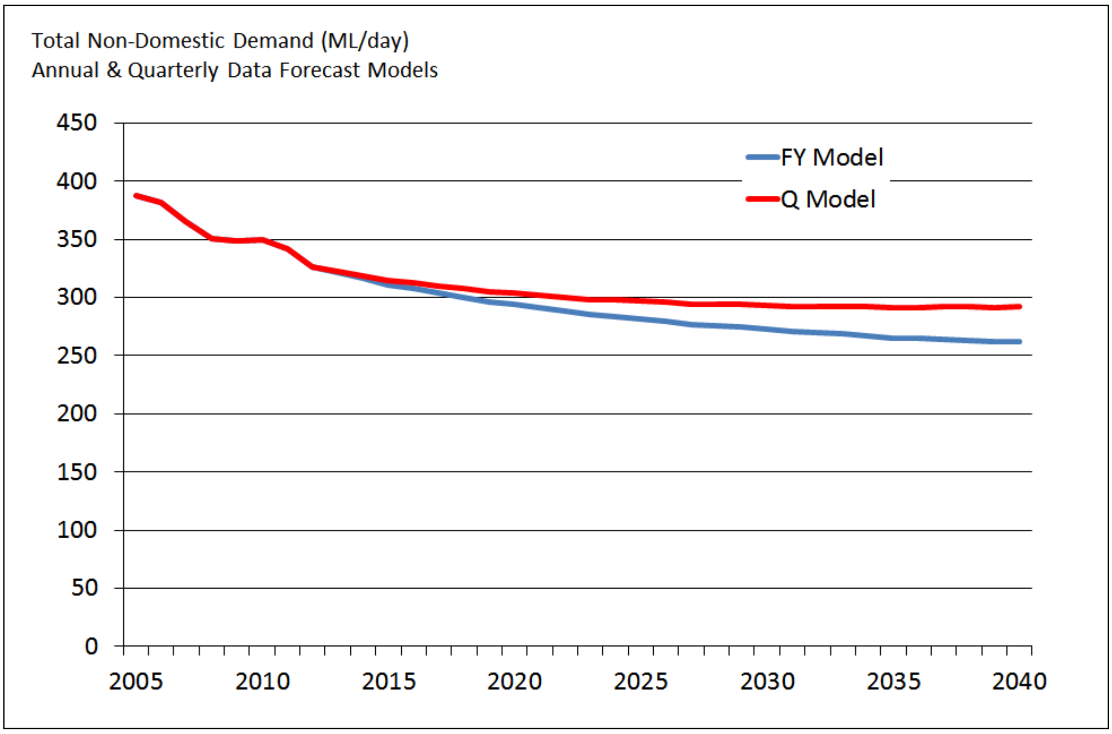
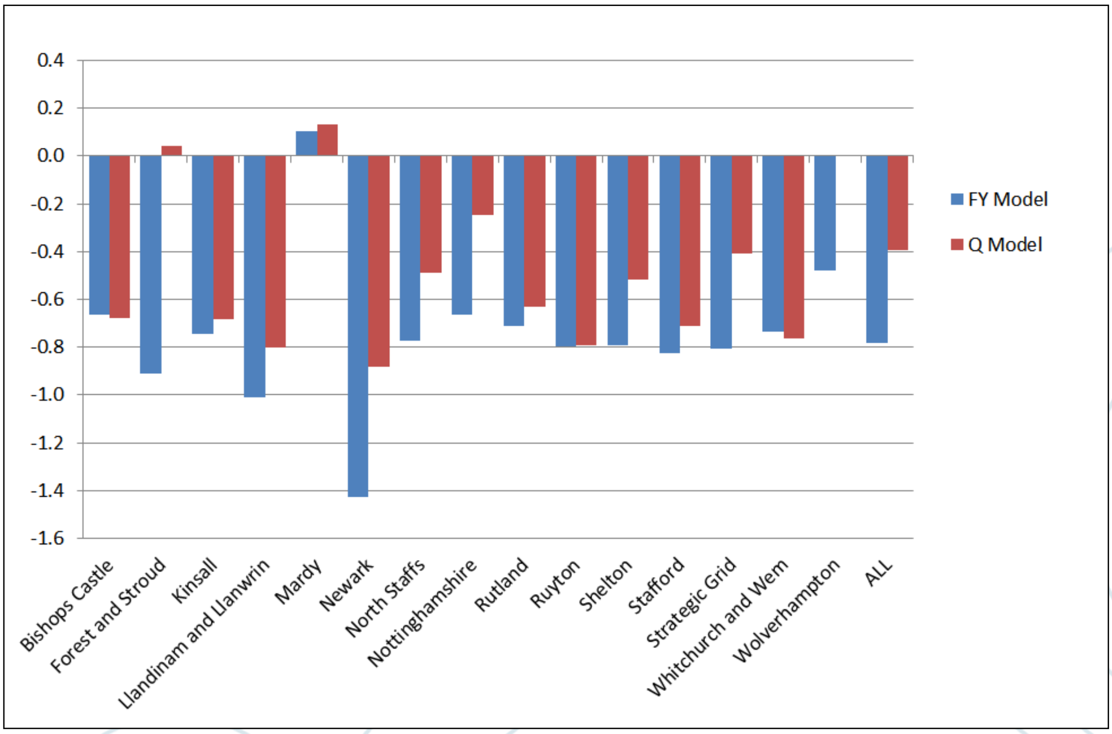


Figure B3.15: Comparison of long-run annual and quarterly NHWD forecasts by WRZ



B3.8 Averaging across model outputs

As discussed above, the annual and quarterly data models are prone to different errors given the available data.

Quarterly data gives more observations to fit models and a better basis for relating changes in demand to changes in economic conditions – annual data tends to average these out - so that the quarterly data models establish stronger links to economic drivers than do the annual models – which tend to rely more on trends elements.

On the other hand, quarterly data is subject to larger estimation errors (on water demand side due to billing systems, on economic side due to need to infill from annual output estimates at the sub-national levels – and is also more volatile. This raises a greater risk that the econometric models may incorrectly assign changes in demand to changes in economic conditions, potentially over-estimating the importance of economic factors in driving water demand.

Thus annual models are prone to under-estimate economic effects; while quarterly models may tend to over-estimate them. Averaging across forecasts from the annual and quarterly date models therefore provides a simple way to mitigate both potential errors, and therefore to produce smoother and more reliable forecasts which nevertheless exploit all available information. The resulting forecasts, based on simple un-weighted averages of annual and quarterly data model outputs, are presented in Figure B3.16 and table B3.8.

Figure B3.16: Averaged long-run NHWD forecasts

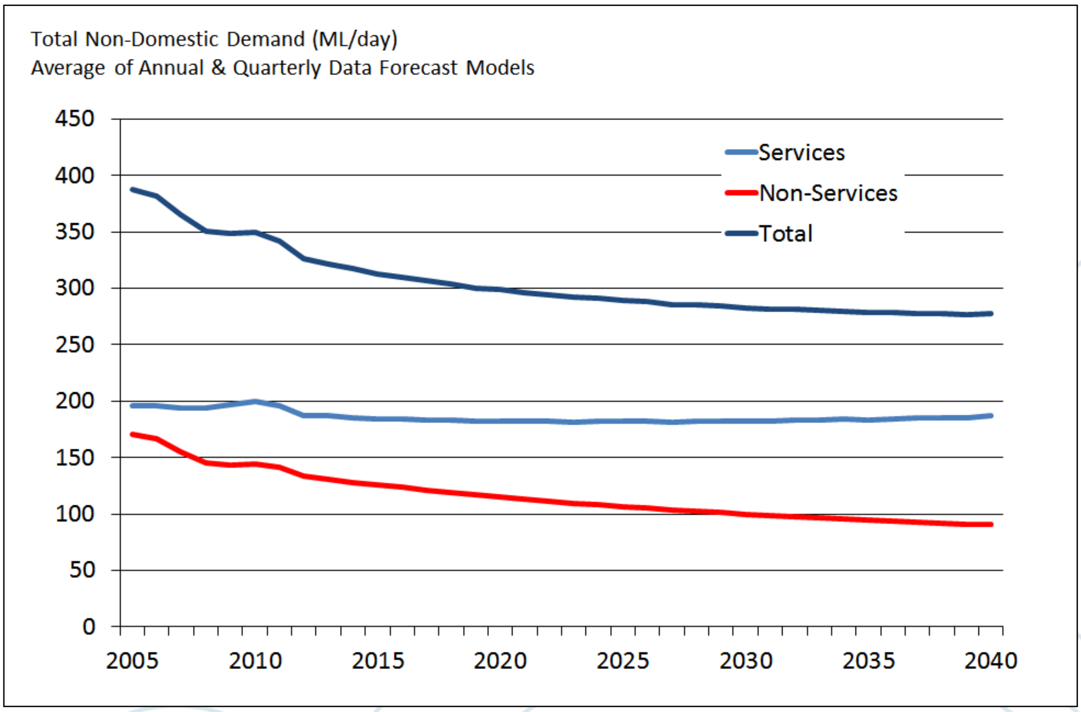


Table B3.8: Averaged long-run NHWD forecasts by WRZ

Daily Consumption by WRZone (Ml/day)	2010	2020	2030	2040
Bishops Castle	0.5	0.5	0.4	0.4
Forest and Stroud	10.4	9.1	8.8	8.7
Kinsall	1.1	1.0	0.9	0.9
Llandinam and Llanwrin	3.2	2.7	2.5	2.4
Mardy	0.7	0.6	0.7	0.7
Newark	2.8	2.4	2.1	2.0
North Staffs	21.0	18.3	17.2	16.9
Nottinghamshire	42.9	38.4	36.9	36.4
Rutland	2.1	1.8	1.7	1.6
Ruyton	1.5	1.3	1.2	1.2
Shelton	22.2	19.3	18.1	17.6
Stafford	5.0	4.3	4.0	3.9
Strategic Grid	217.6	189.6	179.2	175.6
Whitchurch and Wem	2.4	2.1	1.9	1.8
Wolverhampton	8.0	7.2	7.1	7.3
ALL	341.7	298.8	282.9	277.2

Source: Severn Trent Water; Experian

B4 Baseline leakage

This section describes how we have determined the baseline forecast for leakage. Our baseline distribution input scenario assumes that, as a minimum, our 2014/15 leakage target is maintained with no deterioration to 2039/40. It is important to note that simply maintaining this level of leakage over time will require significant investment to offset the underlying leakage breakout rate (LBR) in leakage which results from mains deterioration over time.

The baseline leakage scenario is consistent with the requirements of the Environment Agency's Water Resources Planning Guideline that it should be based on a continuation of our AMP5 policies.

Determining base year leakage

Our base year for forecasting leakage is 2015/16 as required by the dWRMP guidance. We forecast leakage for each resource from a base year position. The base year position for each resource zone is derived by proportioning the end of AMP5 company total leakage figure by the resource zone proportion of the 2011/12 annual average DMA leakage. The company DMA leakage for the end of AMP5, and therefore the start leakage for AMP6 is 377 ML/d to which we add trunk mains leakage and MLE adjustments. Table B4.1 below shows the AMP6 start leakage in 2015 for each WRZ.

Table B4.1: AMP6 start leakage for each WRZ

Appendix B: What is the likely demand for water?

	DMA Leakage 2011-12 (Mld)	Estimated DMA Leakage (Mld)	Trunkm Main Leakage (Mld)	MLE (Mld)	Total Start AMP6 Leakage
Bishops Castle	0.76	0.75	0.05	-0.21	0.59
Forest and Stroud	12.42	12.03	3.2	0.18	15.41
Kinsall	1.37	1.14	0.05	0.01	1.2
Llandinam and Llanwrin	4.26	4.19	0.35	0.31	4.85
Mardy	0.76	0.8	0.02	0.15	0.97
Newark	1.88	1.81	0.04	0.06	1.91
North Staffs	23.35	23.08	4.1	2.98	30.16
Nottinghamshire	40.82	38.99	7.22	2.42	48.63
Rutland	1.75	1.86	0.08	0.01	1.95
Ruyton	1.67	1.77	0.13	-0.11	1.79
Shelton	26.48	26.95	2.47	-1.88	27.54
Stafford	4.33	4.13	1.08	0.68	5.89
Strategic grid	253.32	241.01	31.59	18.71	291.31
Whitchurch and Wem	2.69	2.48	0.59	0.04	3.11
Wolverhampton	12.9	11.26	2.63	0.81	14.7
Company	388.76	372.25	53.59	24.16	450.0

AMP 5 leakage targets and current policies on leakage detection & control

Table B4.2 shows the AMP5 leakage targets for our region and the target profile to arrive at the forecast 2015 leakage level. At WRMP09, we committed to a 43 Ml/d reduction in leakage between 2010/11 and 2014/15, a reduction of 10% during AMP5. The targets, derived as part of the WRMP09, represent the Sustainable Economic Level of Leakage (SELL) to maintain the long term (25 year) supply/demand balance.

Table B4.2: WRMP09 AMP5 and long term leakage forecast

	AMP4	AMP5				
	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Severn Trent region leakage (Ml/d)	496	483	474	468	456	450

Our plan to deliver these AMP5 savings via an Active Leakage Detection policy and new pressure management investment are set out below. Table B4.3 shows the savings we have achieved to date in AMP5.

Table B4.3: Summary of AMP5 leakage savings

Leakage Control Mechanism	Effect	Contribution to AMP5 reduction to 2012/13
Active leakage control	• Baseline level designed to keep pace with increasing breakout in leakage • Additional level to reduce leakage	21Mld

Pressure management	• reduces the volume of water leaking resulting in an immediate saving • reduces future leakage by offsetting LBR	21Mld
Mains Renewal	• Targeted renewal of frequently bursting and high leakage mains offsets the contribution LBR	nil
DMA Maintenance	• Maintains ALC effectiveness	nil
Customer metering	• By installing meters externally we maximise the opportunity to identify and repair supply pipe leaks	<1Ml/day

Details of our AMP5 plan

Active Leakage Control

Our current policy for leakage control is predominantly one of "Find and Fix" through reactive and proactive campaigns. There are three streams of work each with a specific focus:

- Stream 1 Reactive Maintenance – eruptive bursts and unplanned integrity issues e.g. meter failures
- Stream 2 Proactive detection of leaks to offset and reduce levels of DMA leakage. Modelling of network deterioration determines the levels of ALC resource required
- Stream 3 Proactive improvement of DMA operability through enhanced desk top assessment and improved consumption measurement

Pressure management

Our current policy for pressure management is to reduce overall network pressure through the installation of new valves, the replacement of failing and under-performing valves with modern equivalent and installation of more advanced control systems to optimise existing pressure managed areas;

- PRV maintenance and replacement - approximately 70% of properties are subject to pressure management. We currently actively manage around 3,500 PRVs of which 152 are flow-modulated. We proactively maintain all key PRVs through an annual programme of inspection and minor servicing and a rolling five year programme of major servicing.
- We plan to install 450 new pressure management systems (new valves and advanced controllers) in AMP5 to deliver a leakage saving of 28Ml/day
- Enhanced, more frequent maintenance of poorest condition pressure reducing valves (PRVs). Following asset condition surveys we are promoting poor condition PRVs for fast track maintenance, and renewal if necessary.

Mains renewal

Our mains renewal programme replaces 0.6% of water mains per annum and is balanced to maintain leakage and serviceability over the long term.

We have measured leakage levels pre and post mains renewal in the past and found that the immediate impact on actual leakage levels was negligible. We are repeating this analysis between March and May 2013.

DMA Maintenance

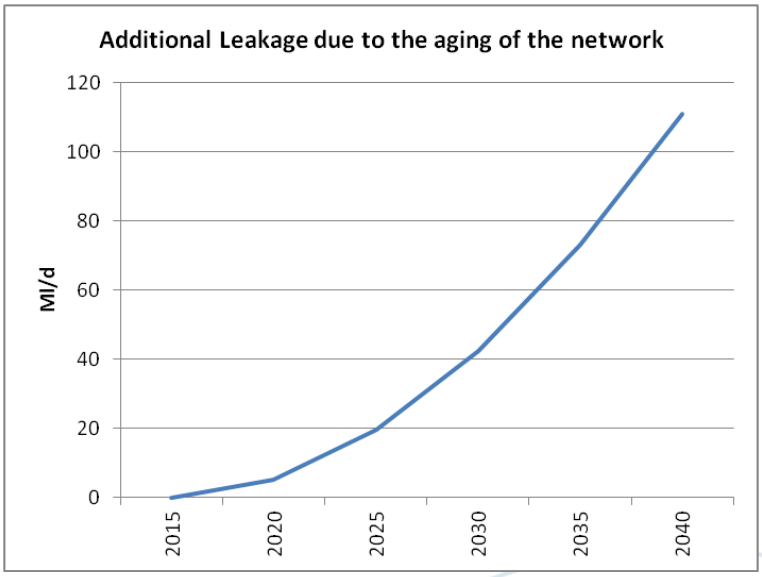
Alongside active leakage detection and pressure management activity, we are increasing levels of necessary to maintain our DMA infrastructure. These will include:

- Increased replacement of DMA meters as poor condition, older assets fail (particularly electromagnetic meters). We are seeing increasing numbers of failing electromagnetic meters that were often buried based on previous best practices. These are being replaced in AMP5 for a preferred choice Helix 5000 mechanical meter in a chamber on a by-pass.
- Installation of sub DMA meters to improve the detection response time. Existing waste meters in STW are often legacy assets which are not maintained or managed for leak detection purposes. New probe technologies are allowing cheaper installations to be carried out and assist in reducing detection times
- DMA Maintenance – we have to maintain the data integrity of 3500 DMAs. This includes replacement of Cello data logger for daily data retrieval, valve maintenance and reconfiguring DMAs as the network grows.
- Leakage Equipment – We need to invest in new acoustic and correlating technologies to improve the effectiveness and efficiency of leak detection staff. We offer an in-house training facility to both direct and contract staff in new and old technology and equipment.

Baseline leakage forecast

Leakage will increase over time due to the aging of the network. This is known as leakage breakout rate (LBR), and we can estimate this by measuring the rate of increase of the night-flow between repairs in all our DMAs. The charts below shows the cumulative impact over twenty five years if we keep Active Leakage Control at the current level.

Figure B4.1: Forecast leakage deterioration due to network deterioration



Appendix B: What is the likely demand for water?

Figure B4.2: Scale of leakage reduction needed to hold at end AMP5 levels

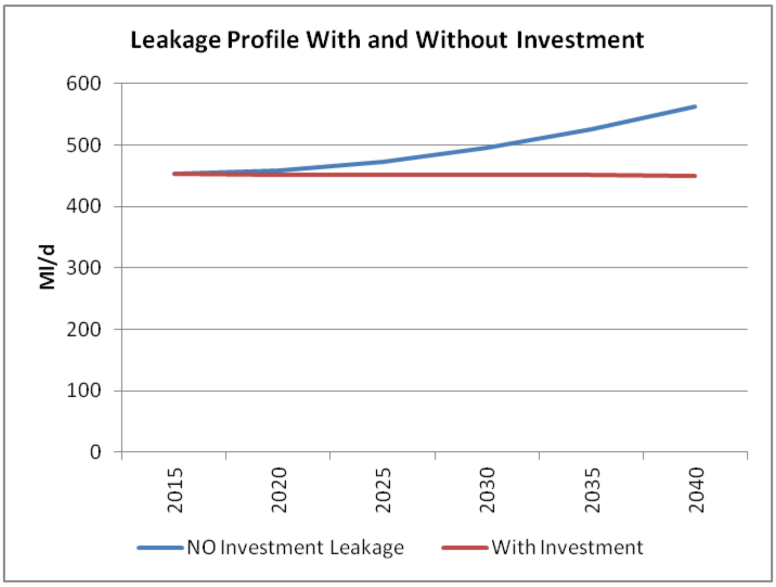
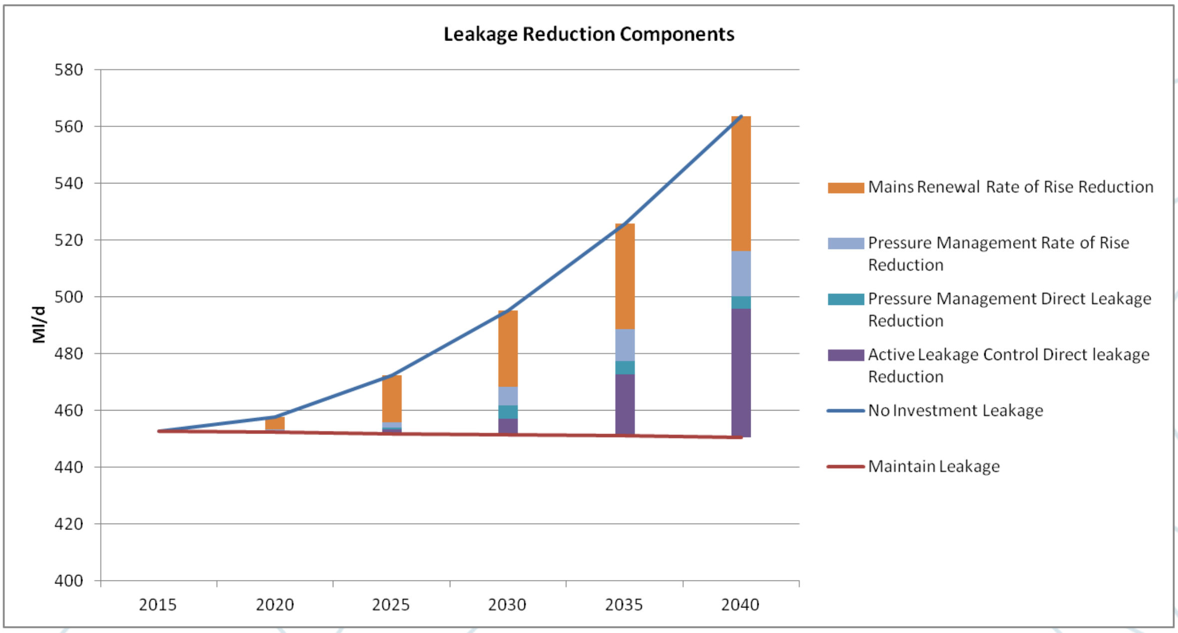


Figure B4.3: Projected leakage activities needed to maintain at end AMP5 levels.



For the baseline distribution input forecast we assume future leakage is maintained at 2015 levels. The WiSDM model is constrained to not let baseline leakage in any Water Resource Zone rise. The starting position is the expected 2014/15 year end position.

The Strategic Grid Water Resource Zone in the model is split East, West, South and Central to allow greater granularity for the decision levels in the model. Leakage for the Strategic Grid as a whole is constrained to not let leakage rise at Water Resource Zone level, but it is allowed to either deteriorate or improve in the Sub Grid areas as long as the overall net leakage meets the constraints.

Investment to maintain baseline level of leakage is contained in our PR14 Business Plan.

Determining the Sustainable Economic Level of Leakage

The *Review of the calculation of Sustainable Economic Level of Leakage and its integration with water resource management planning report* has been considered in forecasting leakage. We have fully adopted the least cost planning for SELL estimation so that leakage targets are an output to the WRMP, over a 25 year planning horizon at the resource zone level. Incorporated in the least cost approach are:

- Bulk water transfers – feasible options for achieving target headroom through inter-zonal or inter-company transfer have been considered as the ability to import/ export water between zones impacts on SELL targets
- Environmental and social valuation – we have fully adopted the guidance documents for the inclusion of externalities
- Marginal Cost of Water – private costs are calculated and used in combination with the environmental and social valuations stated above
- New Water Sources – in establishing the least cost SELL associated by means of ALC, pressure management and mains renewal, the cost/ benefit options of new water sources are modelled. This is in combination with our policy of not allowing leakage to rise in any Resource Zone as a model parameter
- Background Leakage – the background leakage has been set using the 50th percentile of the Minimum Achieved Leakage, which we consider reasonable given the practical experience of the cost of driving leakage down in AMP5 and the degree of uncertainty in estimating BL. Adoption of lower percentiles for BL risks underestimating the costs of maintaining leakage at lower levels and associated step reductions
- Active Leakage Control (ALC) Cost Curves – ALC cost curves are produced using DMA level performance data and considers the factors affecting ALC within different DMAs (size, material, LBR, background leakage)
- Pressure Management – feasible options on pressure management are available in the model, which are taken up due to their favourable cost and resultant lowering of leakage
- Customer metering – options are modelled on the associated saving of metered customers with changes in the supply demand balance and the effect on SELL.

In addition to the adoption of the least cost planning for SELL, mains renewals are selected around whole-life costs of pipe cohort, based on deterioration relationships in regards to age, size and material, along with current burst performance. This has meant a move away from wholesale renewal of DMAs to a more targeted approach of mains renewal that is not limited by DMA boundaries. The policy of mains renewal also involves the renewal of communication pipes.

We have tested our methods against the recommendations from the best practice report on SELL; *Environment Agency, Ofwat, Defra Review of the calculation of sustainable economic level of* *leakage and its integration with water resource management planning (Contract 26777)* published in October 2012.

We comply with the recommendations in most areas as shown in the table below.

SMC EA SELL October 2012 Recommendations	Progress Against Recommendation
8.1.2 Approaches to setting leakage targets	
We recommend that in future reviews all companies with a deficit within the planning horizon develop the SELL using a least cost plan. We recommend that companies without a deficit should also consider undertaking a least cost plan.	**Compliant** – SELL is derived for all WRZs regardless of their supply demand status. The calculation takes into account leakage detection, pressure management, water efficiency, compulsory metering, mains renewal, the marginal cost of water, carbon & amenity costs as well as the supply demand need and supply side options.
We have two principal recommendations: • It is important not to double count environmental benefits: this can most easily be avoided by undertaking a least cost planning analysis of the supply-demand balance. From our experience, companies using a marginal cost of water approach are more likely to double-count environmental benefits within different intervention options.	**Compliant** – We use a single model to concurrently derive both our BP and our WRMP. The model considers all benefits and costs (including environmental and amenity), at the same time to ensure the benefits only counted once.
When developing intervention options it is important that the size of the demand saving must be appropriate so the option is suitable for selection. (Since for example, a large leakage reduction may be uneconomic or smaller options may need to be grouped together to ensure their demand impact is sufficiently large to be selected).	**Compliant** – ALC and pressure management levels are represented in our least cost model as a series of levels. The levels tested to ensure they are at the appropriate level of granularity.

SMC EA SELL October 2012 Recommendations	Progress Against Recommendation
8.1.5 Inclusion of externalities in the current and future reviews of the SELL	
Leakage Carbon: companies should continue to use the existing estimates of carbon, based on electricity consumption. There appears little merit in more detailed analysis (i.e. including chemicals and other impacts), as this component has very little impact on the SELL.	**Compliant** – The calculation of SELL takes into account carbon costs. The costs are derived for both the reduction activities and also water production.
Leakage Management Externalities: companies should develop estimates that use appropriate company specific assumptions where they are available, supplemented with the typical values presented in Appendix A.	**Compliant** – our estimates are based on STW specific data using RPS consultants
Leakage Management Carbon: companies should develop estimates that use appropriate company specific assumptions where they are available, supplemented with the typical values presented in Appendix A.	**Compliant** – our estimates are based on STW specific data using RPS consultants
8.2.1 Background leakage	

Appendix B: What is the likely demand for water?

SMC EA SELL October 2012 Recommendations	Progress Against Recommendation
We make the following recommendations: • As background leakage is a major element of SELL, we suggest that there is a need for the companies to reassess the previous methodology which accepted a fixed element of policy minimum leakage in the SELL calculation. If policy minimum is used in the SELL calculation instead of an estimate of true background leakage, the result assumes that the current policy is economic, which may or may not be the case. The Steering Group accepted that this is the single most important component of the current estimates of SELL, and that it should be given greater consideration for future plans.	**Further work required** – For our background leakage assumption we use the 50th percentile of Minimum Achieved Leakage (MAL). This is consistent with our WRMP09 approach. We feel that further practical field work is needed in proving the adoption of the Minimum Achievable Levels (MAbL) setting of background leakage. We are considering whether the possible, given the time-scales between draft and final water resource management plan to adopt an approach based on MAbL
Future SELL assessments should consider Minimum Achievable Levels of Leakage (MAbL) rather than, or as well as, historical minimum achieved values.	
8.2.3 Supply pipe leakage	
As part of the determination of SELL it is important for companies to understand and take account of the: • relative costs and benefits of measures designed specifically to reduce supply pipe leakage • impact of customer metering • policy on whether to fit meters internally or at the property boundary • economics of AMR (automated meter reading), and other smart metering.	**Compliant**: • our ALC cost curves include spend to reduce SPL. • Metering impact, based on company specific data is included in least cost plan • Our policy remains to fit meters externally where possible so we can identify SPL • Impacts of AMR not included in the SELL calculation. We have no plans to introduce AMR
Whilst historically the level of customer supply pipe losses had little impact on the SELL estimate due to the processes being followed, this is becoming a more important area for consideration given the different leakage management options available, and the need for alignment between SELL and current or future policies. In order to manage leakage economically, it is important that companies have a robust estimate of the proportion of total leakage allocated to customer supply pipes.	**Compliant** – SPL is included in the modelled Natural rate of rise (NRR) and ALC relationships
We recommend that companies develop separate SELL models for supply pipe leakage, as distinct from leakage on mains and communication pipes, and whether any change of economic policy would result.	**Further work required -** We have insufficient current data available to carryout this analysis. In the past year the company policy of "One Contact" on customer supply pipe find and fix has been adopted which will help robust SELL models specific to supply pipe leakage.
8.2.4 ALC cost curves	
Companies should adopt specific processes to determine the shape of the curve for each zone, rather than rely on averages, defaults and assumptions.	**Compliant** – ALC cost curves for each WRZ are derived on an annual basis
Companies should seek to improve their available data on costs and benefits of all leakage management operations when estimating the SELL	**Compliant** – in 2011 we introduced SAP which will improve the granularity of our better data. We review the data requirements periodically.
8.2.5 Pressure	
The lack of published data on pressure is a limiting factor in understanding the extent to which pressure management has been used to achieve leakage targets. We suggest that pressure data be supplied by the companies in future WRMP's.	**Compliant**. We have measured the benefits of our AMP5 pressure management programme and used this to inform the dWRMP modelling

Appendix B: What is the likely demand for water?

SMC EA SELL October 2012 Recommendations	Progress Against Recommendation
There is a need to review the methodologies for assessing average zonal pressure (AZP), average zone night pressure (AZNP) and hour to day factors (HDF) as part of the WRMP process. We are aware of a wide range of practices for estimating each of them and there should be a requirement for companies to follow best practice guidelines. Further consideration should be given to the variation of hour to day factors between districts and how they vary from day to day. An industry standard methodology is needed, which should take account of the need to change hour to day factors with different forms of pressure management.	**Compliant**: We improved our methodology of AZP, AZNP and HDF as part of our Water Balance Improvement programme to align with best practice. All estimates are now based on field data and will be updated periodically when we alter the pressure management regime.
SELL should be reassessed against the assumptions made in the last round of WRMPs to ensure consistency with what has been achieved through pressure management since ELL was last assessed.	**Compliant** – the results of our AMP5 pressure management programme have informed the cost and benefit of the proposed AMP6 schemes
Future cost benefit studies for pressure management should take a holistic view of the costs and benefits over the planning horizon.	**Compliant** – The pressure management intervention includes CAPEX and OPEX costs as well as social and environmental impacts over a 25 year horizon.
Pressure management policies should be aligned operationally with ALC policies to achieve SELL	**Compliant** – we balance pressure management with ALC. In AMP5 we set up a dedicated team of engineers to ensure consistent delivery of new and replacement schemes
8.2.6 Treatment of repair costs	
We recommend that repair costs should form part of the SELL assessment. The SELL process should assess repair costs associated with making the transition from one steady state to another over the forecast time horizon. Future plans should require companies to explain their assumptions regarding the current and future burst frequency and the associated costs.	**Compliant**. Repair costs are considered in the SELL calculation.
8.2.7 The approach to risk	
More attention should be given to the level of risk which is implied from each company's SELL forecast and we recommend that any assumptions and policies should be documented in the plans.	**Compliant**. We have documented all relevant assumptions and policies.
The confidence limits on SELL are wide due to the inherent uncertainly in some of the parameters used in the calculation. We recommend that the approach to regulating SELL should recognise this uncertainty and a pragmatic assessment may be required.	**Compliant**: we have undertaken an extensive programme of sensitivity and uncertainty work using a third party (Cap Gemini) on variables that have been found to affect the SELL figure has been carried out.
8.2.8 Asset renewal	
Companies need to demonstrate that the approach they choose is optimal. Suboptimal replacement increases the cost for each unit of leakage saved and eliminates other more cost effective schemes when considering leakage options on the least cost plan.	**Compliant** – The SELL calculation optimises all available interventions to find the least cost solution. Sensitivity and uncertainty testing has been carried out on the result to test its strength.

Appendix B: What is the likely demand for water?

SMC EA SELL October 2012 Recommendations	Progress Against Recommendation
We recommend that companies should take a targeted approach to determining those mains which could be renewed economically to reduce background leakage and/or the new burst frequency. This approach should include undertaking sub-metering, step testing and/or pressure testing which could add to the cost per metre of mains replaced (an output measure) but reduce the overall cost per unit of leakage saved (an outcome measure).	**Compliant** – The optimisation process selects the mains most beneficial to leakage through NRR (so that high NRR materials are selected preferentially) at the same time as balancing other service drivers; interruptions, mains bursts per km and discolouration. We have sufficient confidence in the model to use it as the starting point to generate mains renewal schemes. Once these schemes are in feasibility, appropriate techniques are used to confirm the localised extent of the required renewal.
8.2.9 The impact of customer metering Increased coverage of household metering should impact on SELL in a number of ways and should be taken into account in the SELL assessment.	**Compliant**
8.2.10 Assessing the true value of water For the SELL calculation it is important to determine the benefit of reducing leakage; both in the short-term and the longer term.	**Compliant** – the AMP6 leakage reduction profile is taken from a long term 25 year optimisation. This long term view includes the supply demand challenge, with leakage being assessed against other supply demand options.
8.2.12 The general approach to SELL The short run ELL (SR-ELL) depends on the level of investment in leakage management measures such as district metering, new technology, pressure management and asset renewal. The current SELL process tends to consider these investment options only in zones which are resource constrained whereas companies should explore them fully for all zones.	**Compliant** – SELL is calculated for all zones.
We recommend that companies should consider strategic options for reducing leakage and report on the net costs of operating at different levels of leakage. This top down approach could be combined with the current bottom up estimate of SELL to provide an iterative routine which arrives at the SELL by considering various key drivers.	**Compliant** - We have increased our leakage reduction target between draft and final plans through a top down approach and consultation with our customer challenge group..
8.3 Regulating Leakage As standard practice within the industry, studies which report the economic level of leakage should present a range of leakage values either side of a central estimate along with associated costs in order that the materiality of operating at levels within the range can be reviewed by senior management, stakeholders and, where appropriate and specifically requested, by regulators. Costs should distinguish between one-off transition costs required to achieve the options under consideration and recurring costs required to maintain them.	**Compliant**; We have included an an upper and lower bound with associated rewards and penalties in our Final Business plan. .
8.4 Water resource management plans ..We have found a lack of integration by some companies between the SELL setting process and the WRMPs. Future WRMP's should include a greater degree of optioneering within leakage management alternatives (pressure management, asset renewal, and ALC), irrespective of the water resource and planning and water efficiency options.	**Compliant** – the WRMP and the BP are one of the same (as they were at PR09). Leakage is considered equally along side other demand and supply side options.
Companies need to see SELL, and to derive it, as an integral part of water resources planning. That is, SELL as an output from a WRMP, not an input. Failure to clearly demonstrate this approach would result in the regulators failing to support the WRMPs and the estimate of SELL.	**Compliant** – SELL is an output of an optimisation process not an input

Appendix B: What is the likely demand for water?

<table>
<tr><th>SMC EA SELL October 2012 Recommendations</th><th>Progress Against Recommendation</th></tr>
<tr><td>We consider it is vital that, when preparing a WRMP, companies undertake a least cost planning analysis that includes a range of leakage management options. Although we do not consider it essential that a company uses its short run economic level of leakage (or current level of leakage if this is lower) in the baseline we feel this is a useful approach.</td><td>Compliant – The BP and WRMP are the same. All leakage management options are considered along side other demand and supply side options.
We use the current / planned levels of as the baseline</td></tr>
<tr><td>Even where there is no deficit within the planning horizon, companies should still consider the benefit of further reductions in leakage. This should review the cost and benefit of a range of possible leakage management options. Whilst a marginal cost of water approach is sufficient for the analysis (if there is no deficit), companies should always consider using a least cost plan to examine the wider impacts (such as mothballing existing resource/treatment schemes) or demand management options.</td><td>Compliant – all WRZs are assed and SELL derived. The calculation takes into account the leakage detection, pressure management, marginal cost of water, carbon & amenity costs and benefits. As well as the supply demand need.</td></tr>
<tr><td>The Average Incremental Social Cost can be used to exclude any options from further consideration if the cost/benefit ratio is too high. However, care must be taken in selecting the increments over which the AISC is evaluated. We recommend that the increment for any one option should be related to the current level of leakage at water resource zone level as follows:
<table>
<tr><th>Current Leakage Level (Ml/d)</th><th>Maximum incremental step (%)</th><th>Step size (Ml/d)</th></tr>
<tr><td>Up to 5</td><td>5</td><td>0 to 0.25</td></tr>
<tr><td>5 to 20</td><td>2</td><td>0.1 to 0.4</td></tr>
<tr><td>Over 20</td><td>1</td><td>Over 0.2</td></tr>
</table>
</td><td>Compliant - We do not use AISC to exclude any demand management options before the whole life cost assessment.</td></tr>
<tr><td>When there is a deficit within the planning horizon companies should apply the following steps when updating their SELL as part of the water resource planning process:

Calculate short-run SELL using marginal cost of water approach which includes environmental and social impacts.
Use the lower of the SR-ELL or current level of leakage within baseline demand forecast.
Identify the costs and benefits of leakage management options.
Undertake a full least cost plan to compare leakage management options with other supply and demand options, to identify the optimal solution to balance supply and demand.
</td><td>Compliant – However our process starts with step 2 as we use a least cost planning tool that considers all leakage management options concurrently and optimises a least cost solution taking into account all costs, the marginal cost of water and social and environmental impact.</td></tr>
</table>

SELL calculation

SELL remains an output from our whole life cost Water Infrastructure Supply Demand Model (WiSDM). The SELL result comes from balancing investment on Active Leakage Detection, Pressure management and Mains renewal, as well as marginal cost of water (MCOW) for production. The long range economic level of leakage takes in to the balance the cost of ALC against the cost of building and operating a new resource. The WiSDM model is described in section D5 of this final WRMP where we explain how the preferred investment plan has been generated.

ALC Cost Function

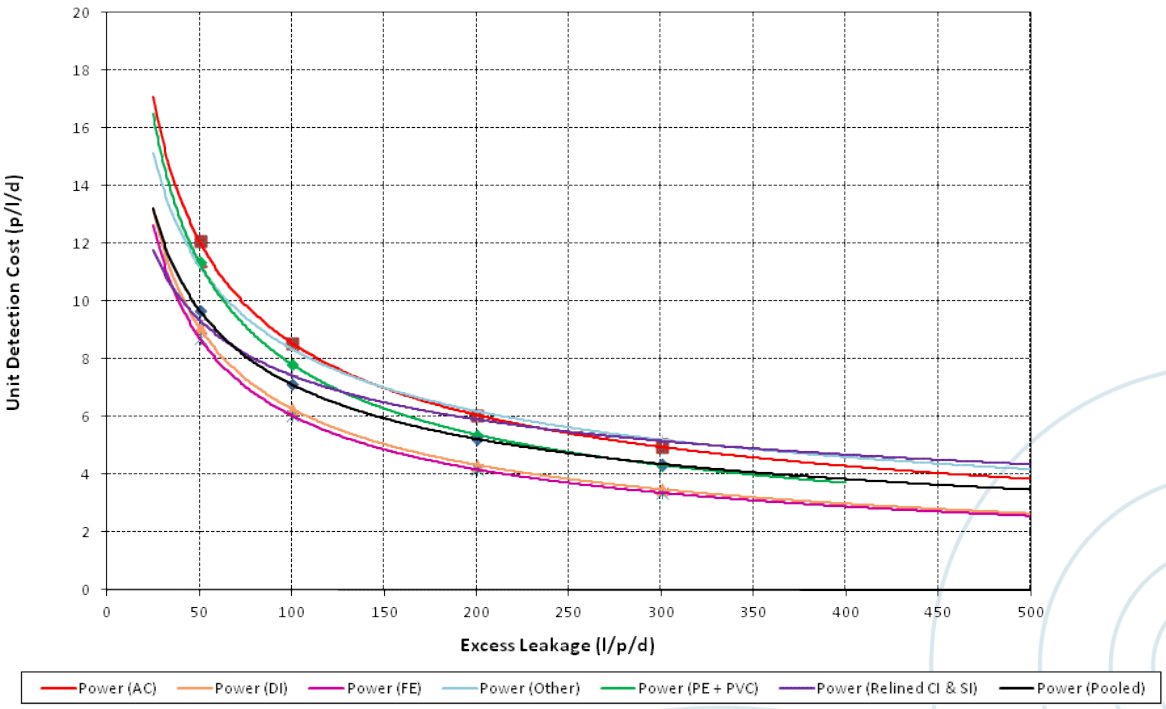
The ALC cost function relationship is expressed as follows:

UDC, URC = a.(L – BL)b

where UDC is unit detection cost; URC unit repair cost, L is the level of leakage appropriate to UDC or URC and BL is the background level of leakage. The coefficients ‘a’ and ‘b’ are established for each of the detection and detected repair functions on a material basis. The resource zone area coefficients were weighted based on the percentage of cohort material types in each zone.

Detection costs are taken from man-hours and fixed man-hour rates. Man-hour rates were £34.67 for 2011-12. Detected repair costs for each DMA were calculated on the average unit costs for each type of job recorded. Background Leakage is derived from the 50th percentile of the minimum achieved leakage values at DMA level. The ALC scenario is based on 5 years set of data.

Figure B4.4: Marginal detection cost curves for STW cohorts based on 50th percentile MAL and 5 year average data



Mains renewal and pressure management is related through the total cost curves by changes in the natural rate of rise in leakage detected (NRRd) through ALC.

The total cost (TC) per property of detection plus repair of detected leaks per property is given by :

TC = c.[(L1 + NRRd – BL)d – (L2 – BL)d]

L1 is leakage in year one; L2 is leakage in year two in litres/property/day and where “c” is a coefficient (c=a/d) and “d” an exponent (d = b + 1).

Constraints are around assumptions on BL minimum achieved leakage in DMAs and the appropriate level of percentile to apply to the data. Consequently the DMA logged data needs to contain as few gaps as possible. Gaps can be filled in, but the more gaps there are the greater the uncertainty. Logger data is also crucial for the derivation of NRRd, as well as the derivation of leakage from one year to the next.

The approach adopted takes in to consideration externalities of leakage management and leakage related externalities to the environment.

Impact of new options on SELL

The following options impact the level of leakage selected in the WiSDM model:

Active Leakage Control

This option achieves an absolute reduction in the level of leakage for a particular Water Resource Zone. Levels of Active Leakage Control are configured for the model to choose from. The levels graduate between the starting position and base line for a particular Water Resource Zone with a maximum number of 20 levels for any one Water Resource Zone.

Pressure Management

This option achieves an absolute reduction in the level of leakage for a particular Water Resource Zone, and a reduction in the breakout of leakage. Up to 3 levels of pressure management options are configured for each Water Resource Zone. The levels of saving have been derived ‘bottom up’ through pressure management studies.

Mains Renewal

The asset base in the WiSDM model is split into cohorts of like material, diameter, size, soil, location and age. The leakage breakout rate calculation in the model is calculated using the age and material components of the asset base. The dynamic between the asset base and the breakout rate allows the model to calculate the rate of rise benefit of main renewal and focuses the renewal on the worst performing cohorts.

Metering

The metering option can only be picked in Water Resource Zones that, at some point in the next 25 years, go into supply demand deficit. If the metering option is chosen there is a one off leakage reduction through the installation of boundary box meters.

How Customer views influence setting or amending SELL

We have taken into account stakeholder views from a range of sources, but principally from our workshop on 12 June 2012 and written responses to *Making the right choices*. Around 32 individuals representing 28 separate organisations attended our water workshop.

The views of customers have been taken from a range of sources including: our willingness to pay research; our historic catalogue of research (spanning 20 years); the views of CCWater and relevant research carried out by CCWater and Ofwat.

Appendix B: What is the likely demand for water?

The following summarise the key insights we have drawn from this information.

Our approach to supply demand should represent a shift to a best value solution (rather than least cost) which balances environmental impact and affordability

Guidance from Government and the Environment Agency, and the views of our stakeholders, suggest that we should select the 'best value' option to balance supply and demand rather than the options which have the lowest financial cost. A 'best value' approach would include seeking solutions that would deliver longer term environmental benefits. This should also take into account customer views on what is acceptable and affordable.

To manage future supply and demand and reduce the pressure on the environment from the water we abstract from rivers and other water sources, we need to be smarter in using the supplies we have, develop new ways of capturing, storing and sharing water, and reduce the amount of water we waste. We also need to take action where too much water is being abstracted from catchments and damaging water ecosystems, and reform our approach to abstraction to reduce the risk that these problems become worse in the future.
DEFRA, strategic policy statement to Ofwat (draft for consultation)

"A preferred solution will have to be decided on the basis of it being the best value for water company customers and the environment. The final preferred solution may not necessarily be the least cost option"
DEFRA / WAG / Ofwat / EA Water resources planning guidelines

"We would like to see options selected which give the best value (not necessarily the lowest cost). Options should be selected which also cause the least environmental impact"
EA MTRC written response

"We consider that all decisions should be driven by customer's views on what they think is acceptable and affordable"
CCWater MTRC written response

There is a political and regulatory expectation that we will reduce demand.

Guidance from Government expects companies to deliver demand reductions over the long term, and in the next five years where demand is high or water resources are over-used.

"Where companies are in designated water stressed areas, or where they have demand that is significantly above the national average, we expect companies to produce a plan that will deliver overall demand reductions in the first five years. Looking further ahead we will expect all WRMPs to demonstrate that the demand trend is significantly downward"
DEFRA White Paper, Water for Life, December 2011

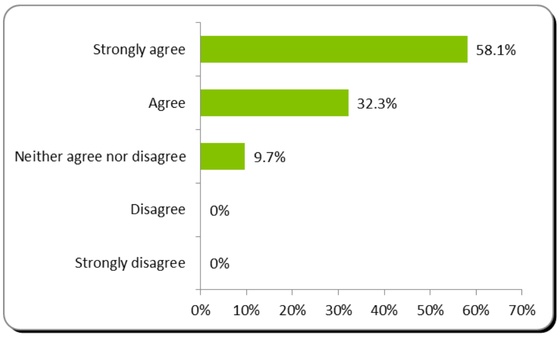
Stakeholders emphasise demand management options, although there is no consensus on which. On the supply side stakeholders believe we need to make the best of what we have got. However there is some qualitative evidence of customer support for new supply options.

Appendix B: What is the likely demand for water?

Stakeholders at our water workshop supported demand reduction options over new source development. This was further reflected in written responses to *Making the right choices*.

Water workshop, June 2012

To what extent do you agree with this statement: "STW should prioritise demand reduction options over new source development"



"A mixed package of options, emphasis on reducing demand through education"
Worcester County Council MTRC written response

"We support an approach which makes best use of the water resource you currently have access to before the development of new supplies"
EA MTRC written response

"Priority must be given to managing / ensuring the efficiency of the existing water supply before new options are considered"
Central Lincolnshire Joint planning unit MTRC written response

"STW should seek to secure the supply of water whilst reducing the environmental impact…In order to achieve this, priority should be given to improving water efficiency, reducing leaks, and accelerating the role out of water meters. STW should also seek to invest in expansion of the grid…these measures should take priority over investment in new assets and sources of supply"
Derbyshire CC MTRC written response

"English Heritage considers that the more efficient use of existing supplies be prioritised, as for example through reducing leakage, the introduction of demand management measures and wider catchment management measures. The increase in supply through the exploitation of new sources and or greater extraction could potentially impact the historic environment"
English Heritage MTRC written response

Stakeholders also recognised the potential future impact of climate change on the supply demand problem and agreed it was our responsibility to encourage customers to be more carbon efficient in their water usage.

"Reducing leakage and increasing water efficiency will become increasingly important and should be given equal priority. The predicted impacts of climate will inevitably lead to a change of services offered by ST, including more regular hosepipe bans"
Cotswold conservation board MTRC written response

Appendix B: What is the likely demand for water?

> *"It is clear from the Met Office rainfall deficit maps that part of the STW region will be impacted by future water shortages…Whilst it is recognised that reducing leakages or moving water around the region can help to address concerns over the water supply, it is considered that STW should address supply issues as part of a holistic approach"*
> **Worcestershire country council MTRC written response**

Comments in our quarterly tracker research show some customers express an interest in more reservoirs being built. The logic underpinning this is that they feel they are paying their bills and "doing their bit", but water companies should spend money to ensure we have more supplies. Research carried out by CCWater in 2012 also shows some people believe companies should build more reservoirs to avoid hose pipe bans in the future.

In our Q3 2012 customer satisfaction survey most customers see meeting the supply/demand balance as a joint responsibility between them and the water companies. There is a slight emphasis for some towards this being more a water company responsibility:

- 11% responsibility lies more with customers
- 23% more with companies
- 67% combination of the two.

There is a political and regulatory expectation that we will reduce leakage.

> *We want to see the downward trend for leakage to continue. If a water company is unable to reduce leakage further during the planning period it must clearly justify its position.*
> **DEFRA / WAG / Ofwat / EA Water resources planning guideline**

> *Leakage needs to be maintained at the point where the environmental, economic and social cost of water saved by reducing leakage is lower than, or equal to the cost of getting water from other sources. As ELL us developed it is likely that companies will undertake more wholesale mains replacement than simply patching up small sections of mains. In the longer term this is likely to be a more effective and efficient method of cutting losses from the network.*
> **CCWater Policy Position, November 2010**

Visible leakage is a key area of customer dissatisfaction, and tackling it is key to getting customers to reduce demand. We also need to respond to leakage better, including when it is reported to us. Tacking leakage is a customer priority equal to safe water.

For stakeholders the 2nd most important thing they want to hear about from us is how we are tackling leakage. However 98% of them consider this to be a priority - the same extent to which they consider delivering safe drinking water. Research carried out by CCWater in 2012 showed that customers identified both lack of rain and leaks from pipes as equally important causes of drought.

Our own customer tracker research shows that customers rate our leakage performance as the number one area of dissatisfaction, and top area for improvement and have done so consistently for years. 53% of customers think we should do more in this area, compared to 26% who think we are doing the right amount.

Appendix B: What is the likely demand for water?

Almost all our qualitative research underpins this, suggesting that customers find being charged for something that they see us as wasting is fundamentally unfair, especially when they are being asked to conserve water or are subject to a hose pipe ban.

"Leakage continues to be a key issue for customers and can be a barrier to them doing more to save water. We, therefore, believe that customers would support the company's current work to reduce leakage"
CCWater MTRC written response

"Our experience shows that when our residents report a leak to STW there is no consistency in the response they receive, sometimes the sewers will be checked and there is no follow up to check the mains"
Birmingham City Council MTRC written response

"We endorse continuing to reduce leaks from the network and to increase the number of customers with metered water"
CPRE (Gloucester) board MTRC written response

"My impression is that there isn't a shortage of water, it is just in the wrong place and there is an issue with leakage"
Council officer, Water workshop

Some of the comments at our water workshop were:

"A council officer said that STW doesn't do enough to publicise what it does to prevent leaks, and that perhaps local information on leakage prevention could be provided to customers"

"A council officer expressed the view that there should be a focus on leaks on highways as these can cause accidents. S/he said 'in the past I have discussed leaks on highways with STW who have initially denied the leaks were their responsibility, but I have then been proved right'"

"An environmental group representative said that a cost-effective approach needs to be taken by looking at whether it costs more to repair a leak than let it continue"

"A council officer said people wouldn't mind paying more to ensure major and important leaks are repaired"

"A conservation group representative agreed with the earlier cost-effectiveness point. 'I don't want to see water wasted, but cost has to be taken into account, it has to be a realistic and practical approach'."

Customers expect large leaks to be dealt with quickly. More noticeable or visible leaks are the priority.

On the question of expectations for response times, our Q3 2012 customer satisfaction tracker found that:

- Noticeable large leaks are expected to be dealt with within 1 day by most customers.
- Similarly, large leaks that are less noticeable are expected to be dealt with in around 2 days.
- For small leaks, differences between expectations of visible versus non-visible is less pronounced. Typically the expectation here is 3-4 days.

On the question of priorities, as with response expectations, there was a slight preference for visible leakage. However, most customers regard these of equal priority, if not response speed:

- 9% say non-visible leaks are a priority
- 13% say visible leaks are a priority; and
- 77% say treat both the same.

Activity		Forecast savings Mld	Current practise
Pressure Management	New/optimised PRV and controllers	5	AMP5 saving to date 21Mld
Quicker Repair Times	All leaks fixed within 24hrs (where safe to do so)	4	30% reported leaks fixed within 24hrs
Trunk mains and service reservoirs	Increased efforts to demonstrate savings	2	Desktop assessment only. TMs walked in 2011
DMA Maintenance	Programme of additional DMA restructuring and sub-metering	2	Minimal investment in proactive restructuring and sub-metering in AMP5
Consumption initiatives	Increased programme to identify and measure unaccounted for demand	2	Programme to end of AMP will account for 4Mld of reported leakage.
Active leakage control	Find and Fix effort	11	11Mld leakage reduction plus leakage breakout offset
	Total	26 (6%)	

B5 Baseline demand projections

Chapter B1 to B4 explain how we build the components of our baseline projections of demand for water and total distribution input for the next 25 years. Chapter B5 summarises baseline projections used in our final WRMP.

B5.1 Water Resource Zone baseline demand projections

The general trends in the baseline demand projections across all WRZs are:

- Measured PCC to broadly remain flat over the forecasting period
- Unmeasured PCC to modestly decline over the forecasting period
- Measured water delivered to rise as new household property consumption and FrOpts customer consumption is added to this category
- Unmeasured water delivered to decline as customers opt to have a meter installed
- Leakage to remain flat to 2040 at the end of AMP5 level in each WRZ (this is what is required in a baseline forecast)

The following series of charts show the baseline PCC forecast, baseline dry year distribution input forecast and components of the demand forecast.

Appendix B: What is the likely demand for water?

Bishops Castle zone

Figure B5.1: Bishops Castle baseline dry year PCC

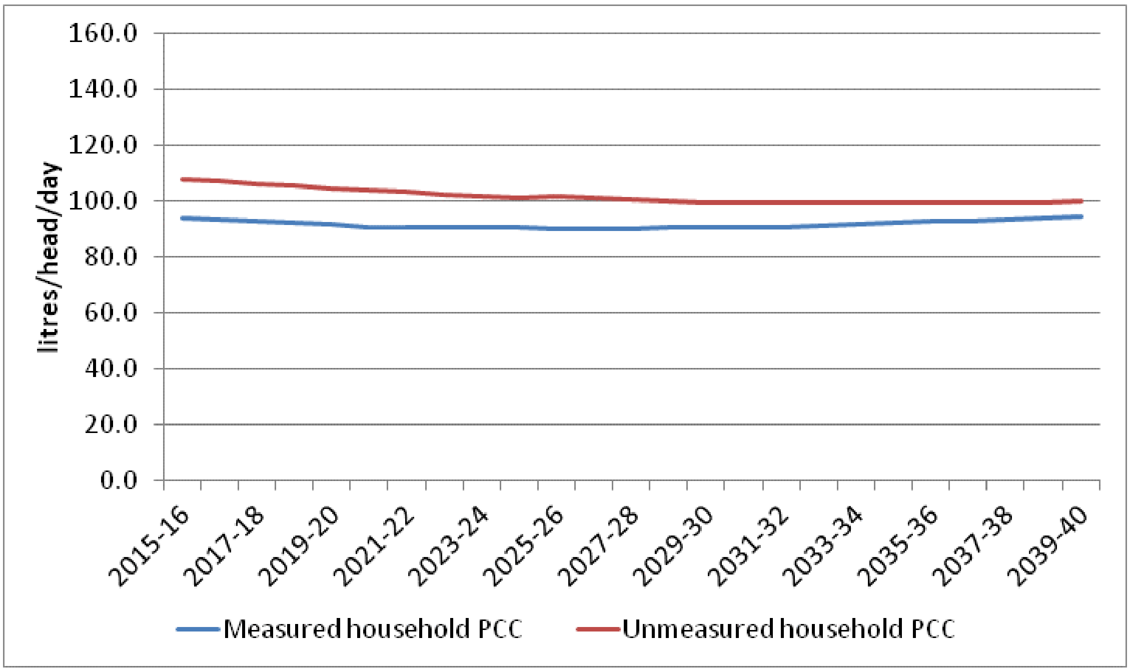
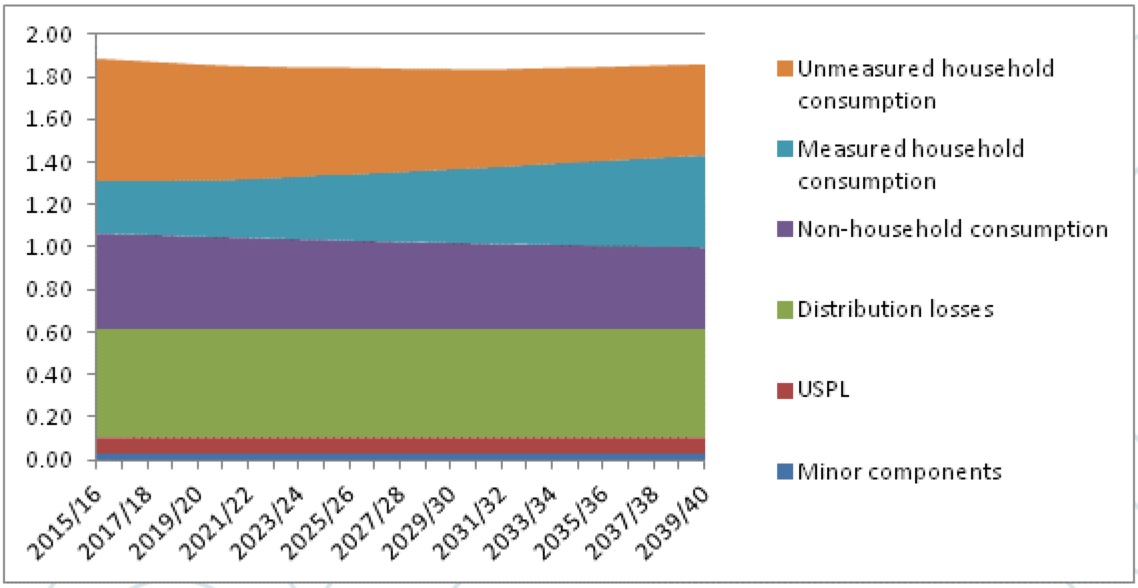


Figure B5.2: Bishops Castle baseline dry year DI



Forest & Stroud zone

Figure B5.3: Forest & Stroud baseline dry year PCC

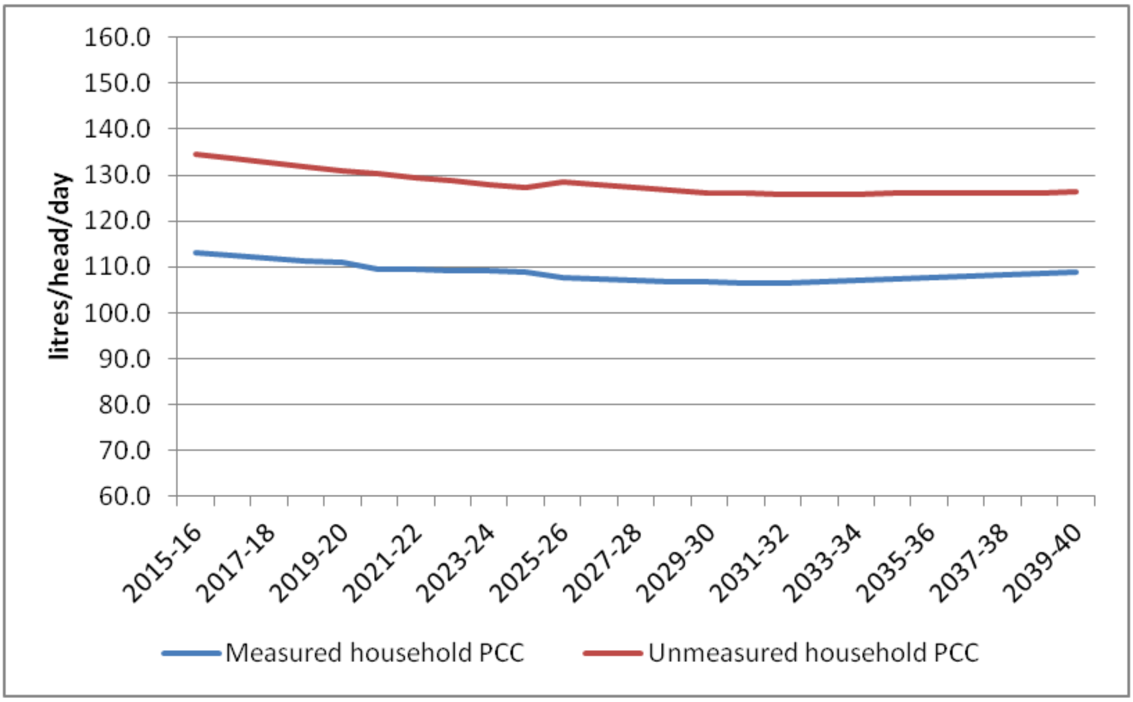
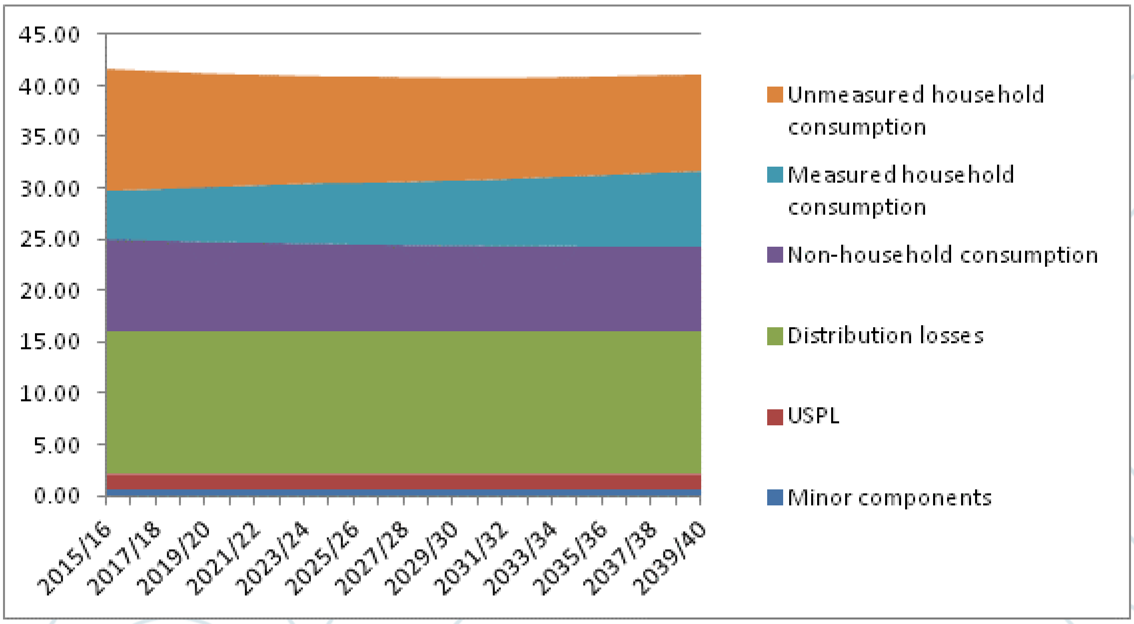


Figure B5.4: Forest & Stroud baseline dry year DI



Kinsall zone

Figure B5.5: Kinsall baseline dry year PCC

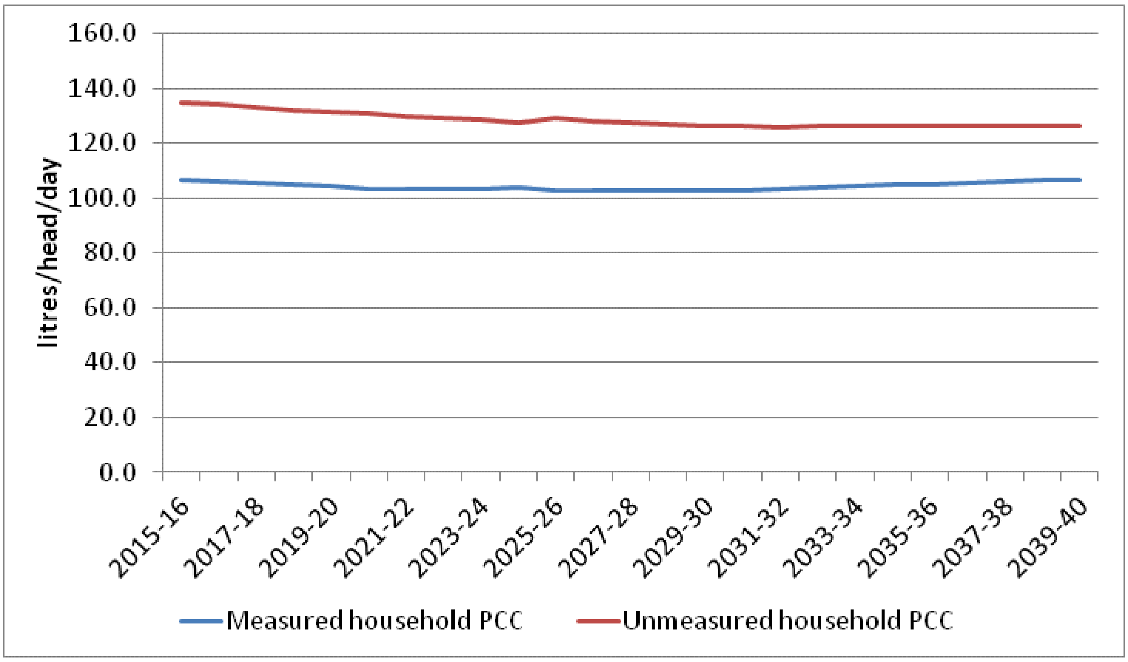
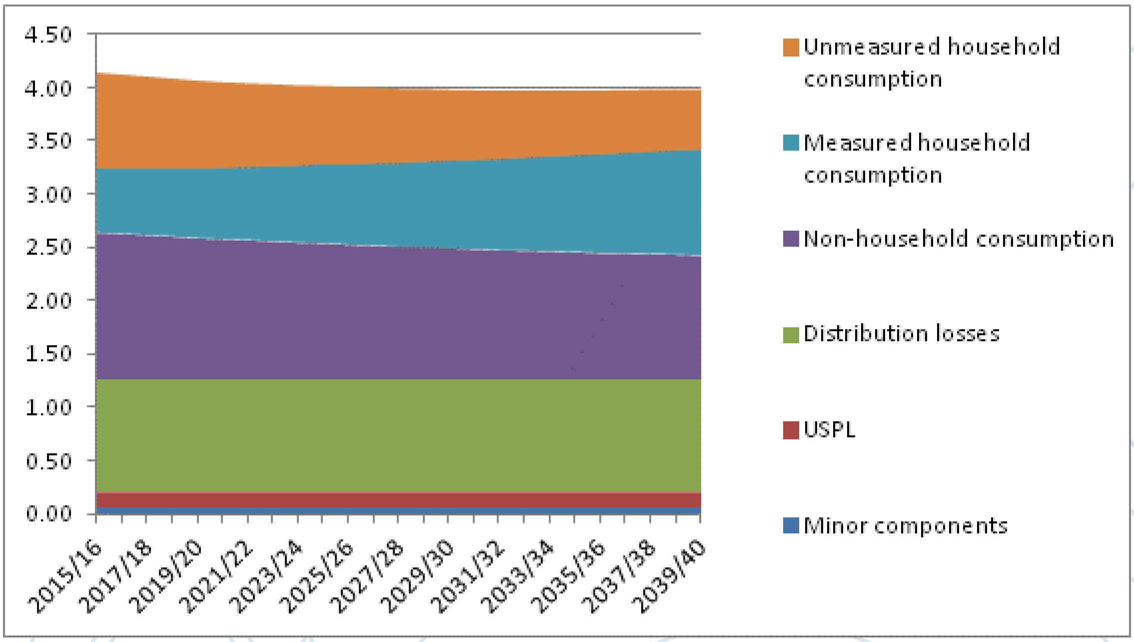


Figure B5.6: Kinsall baseline dry year DI



Llandinam & Llanwrin zone

Fig B5.7: Llandinam and Llanwrin baseline dry year PCC

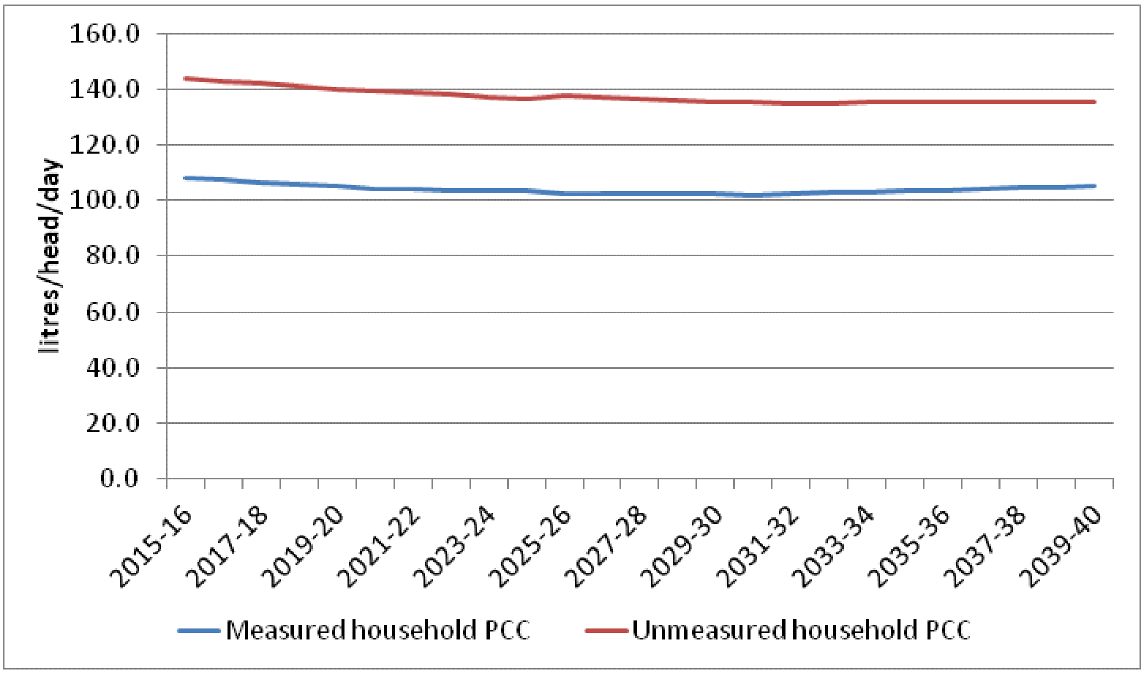
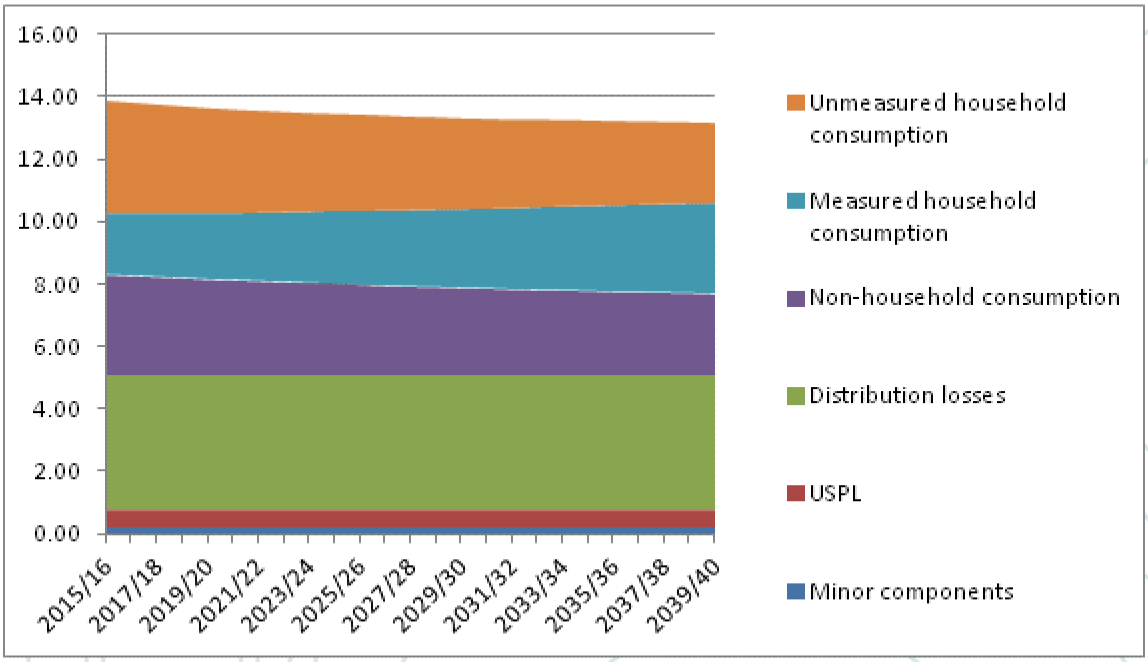


Fig B5.8: LLandinam and Llanwrin baseline dry year DI



Mardy zone

Fig B5.9: Mardy baseline dry year PCC

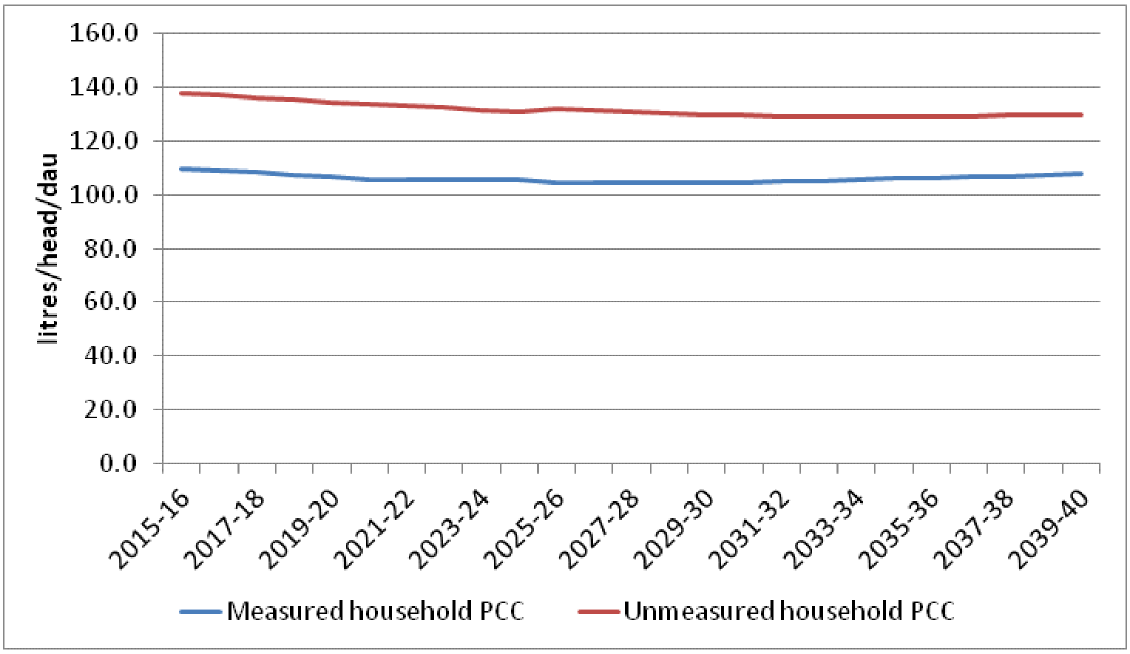
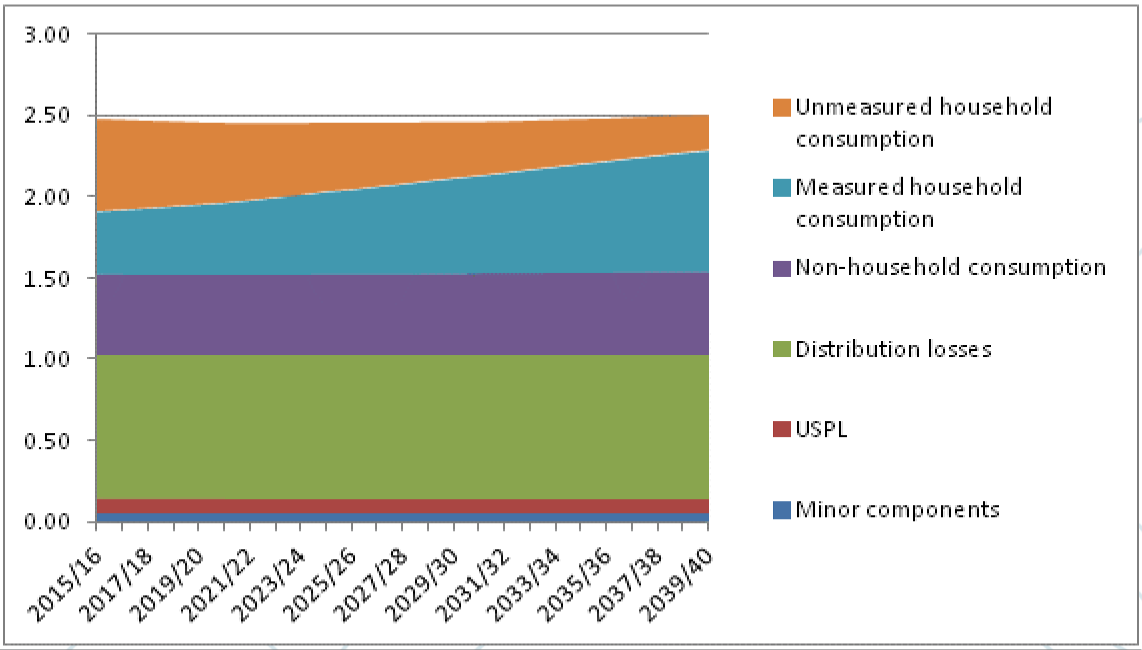


Fig B5.10: Mardy baseline dry year DI



Appendix B: What is the likely demand for water?

Newark zone

Fig B5.11: Newark baseline dry year PCC

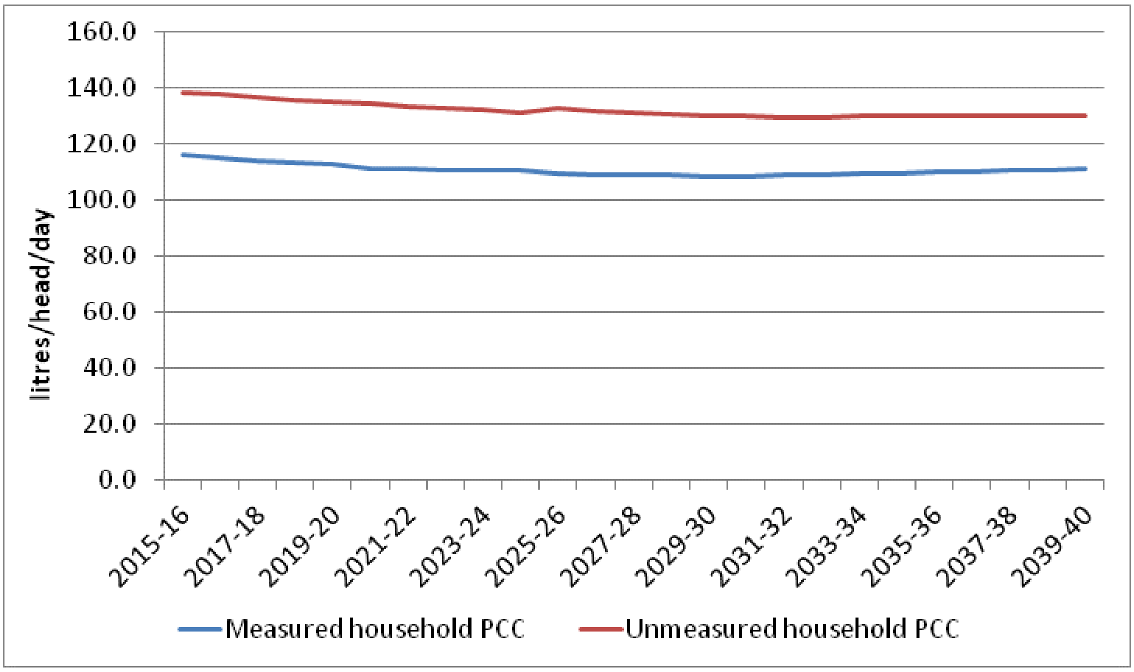
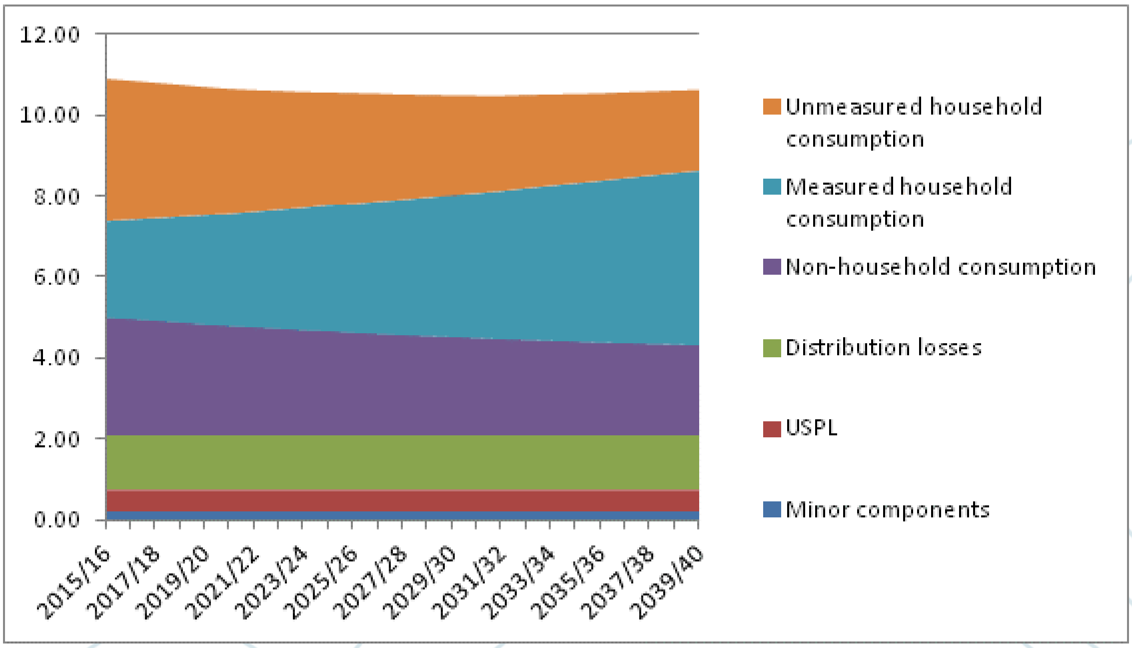


Fig B5.12: Newark baseline dry year DI



North Staffordshire zone

Fig B5.13: North Staffordshire baseline dry year PCC

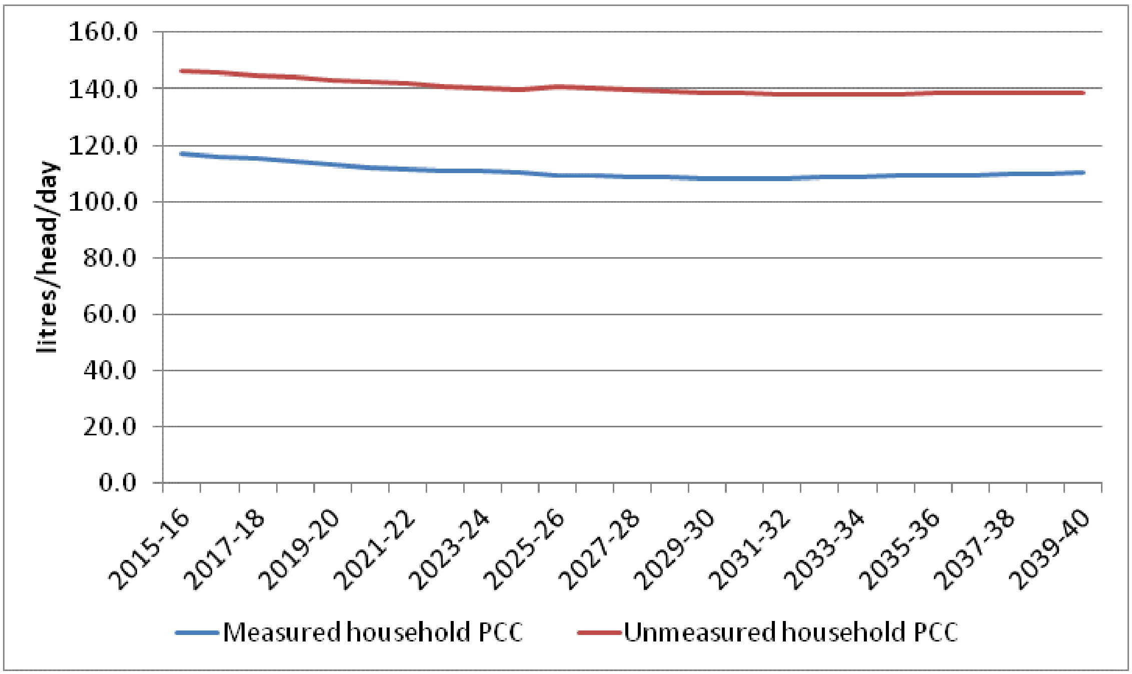
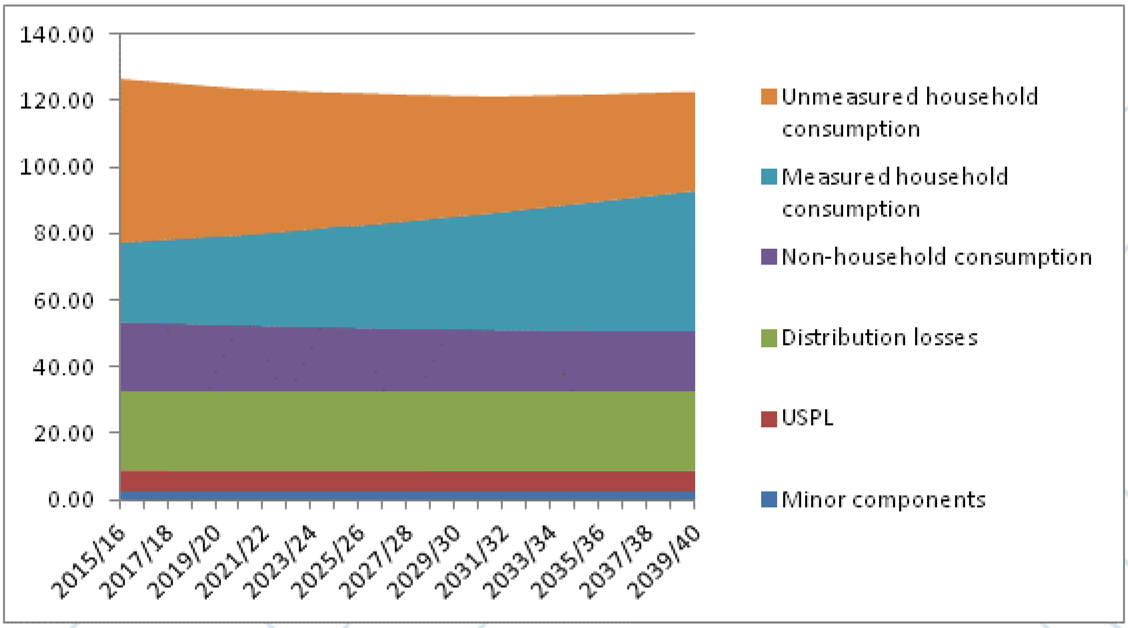


Fig B5.14: North Staffordshire baseline dry year DI



Nottinghamhsire zone

Fig B5.15: Nottingham baseline dry year PCC

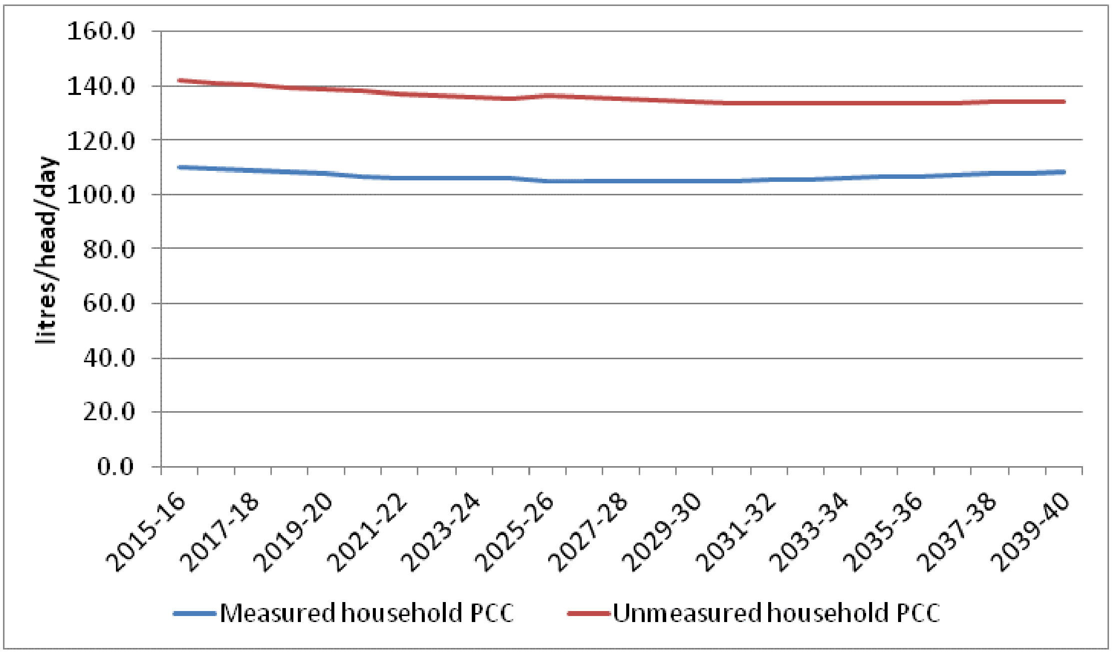
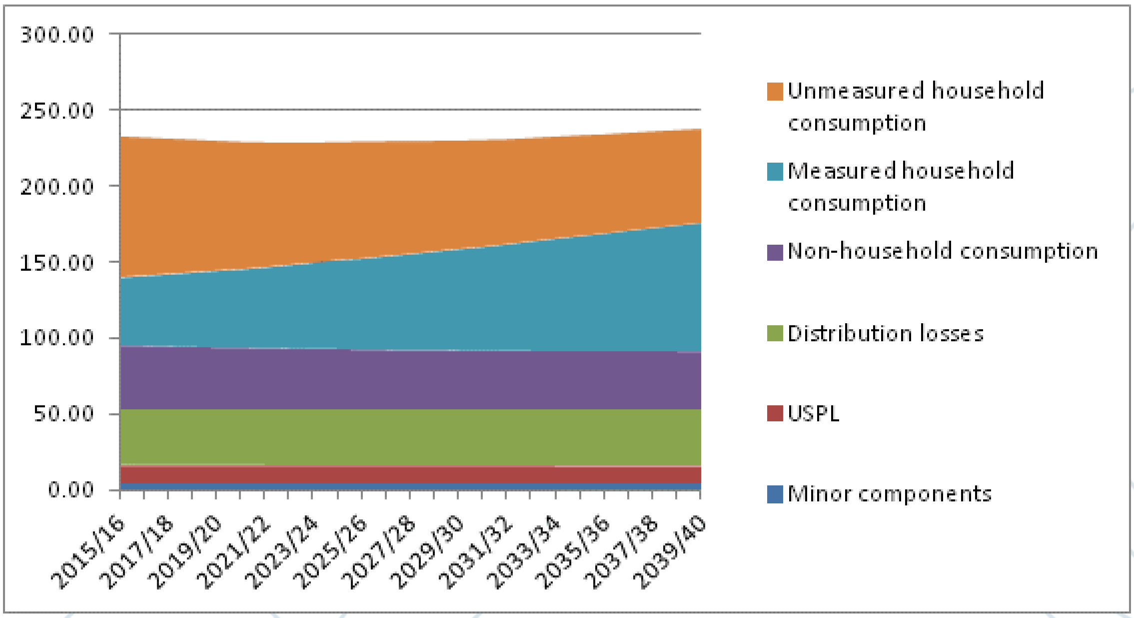


Fig B5.16: Nottingham baseline dry year DI



Rutland zone

Fig B5.19: Rutland baseline dry year PCC

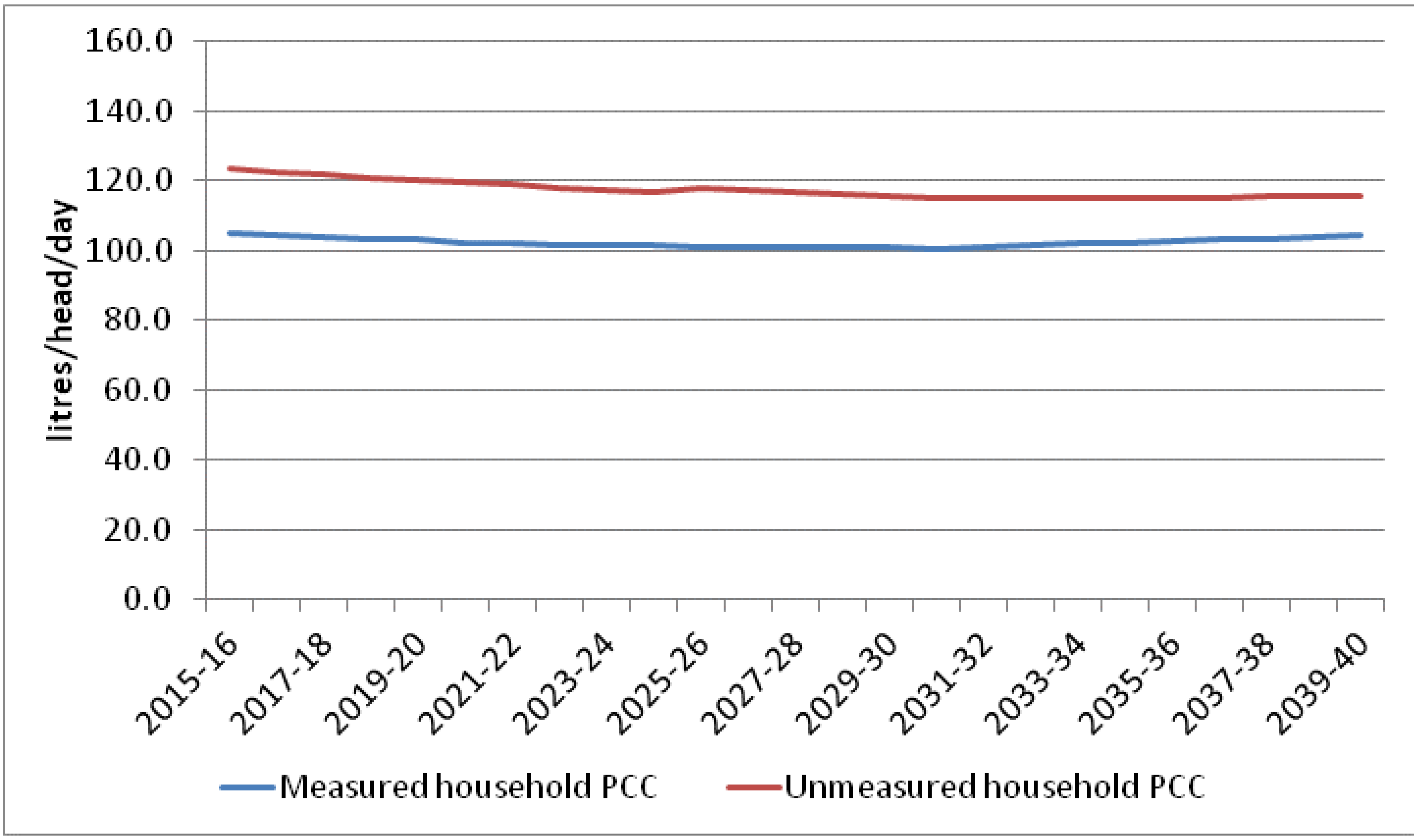
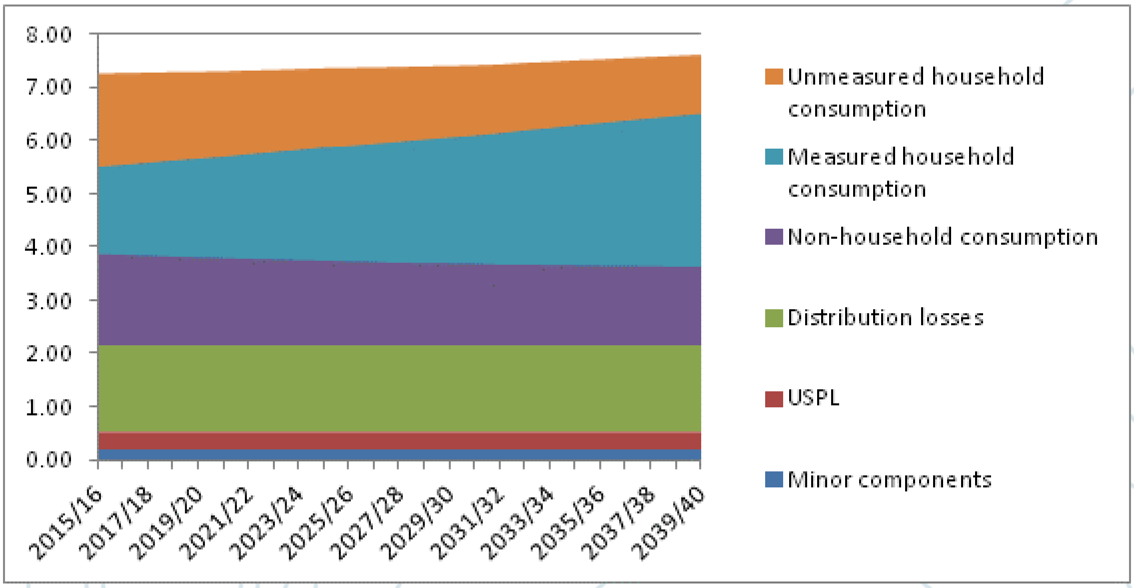


Fig B5.20: Rutland baseline dry year DI



Ruyton zone

Fig B5.17: Ruyton baseline dry year PCC

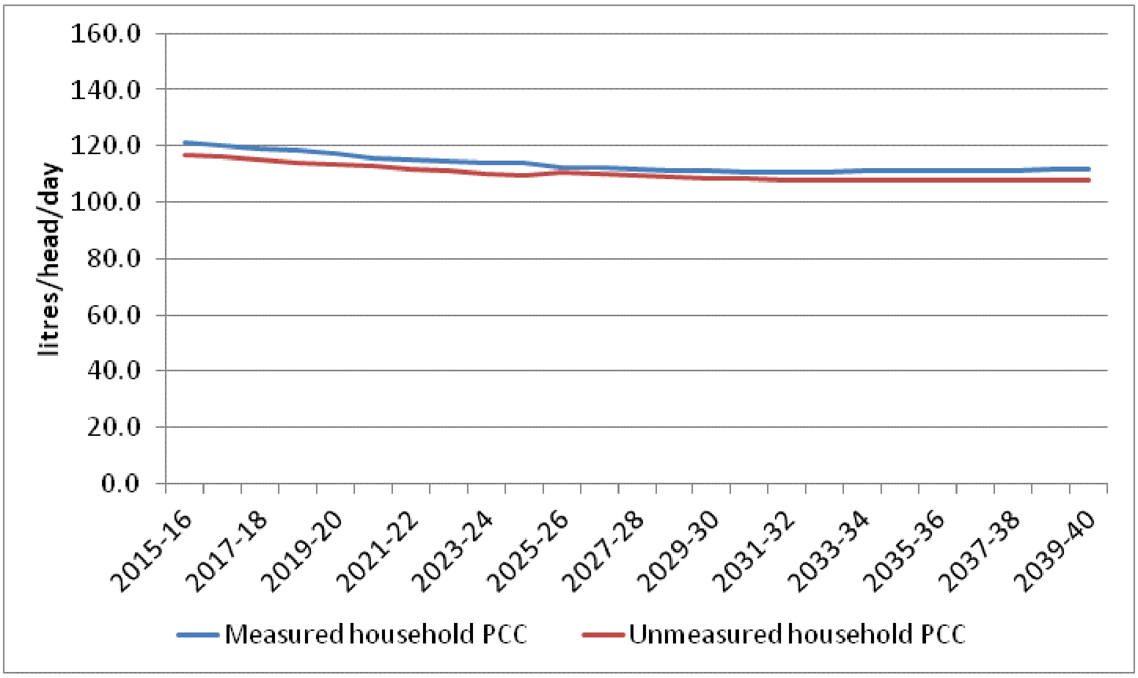
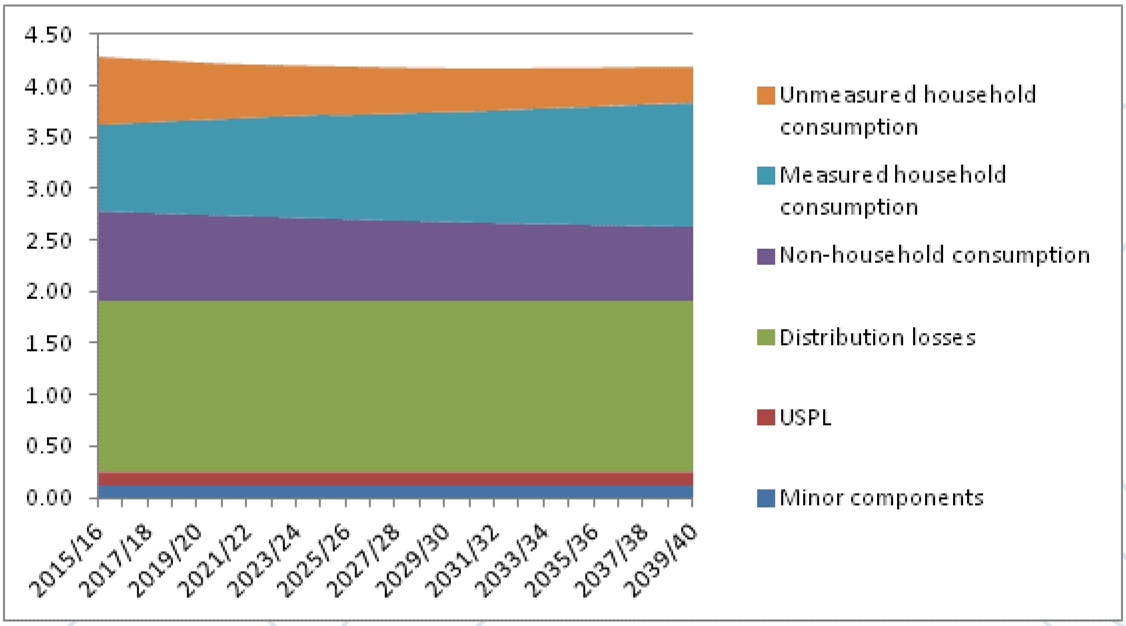


Fig B5.18: Ruyton baseline dry year DI



Appendix B: What is the likely demand for water?

Shelton zone

Fig B5.21: Shelton baseline dry year PCC

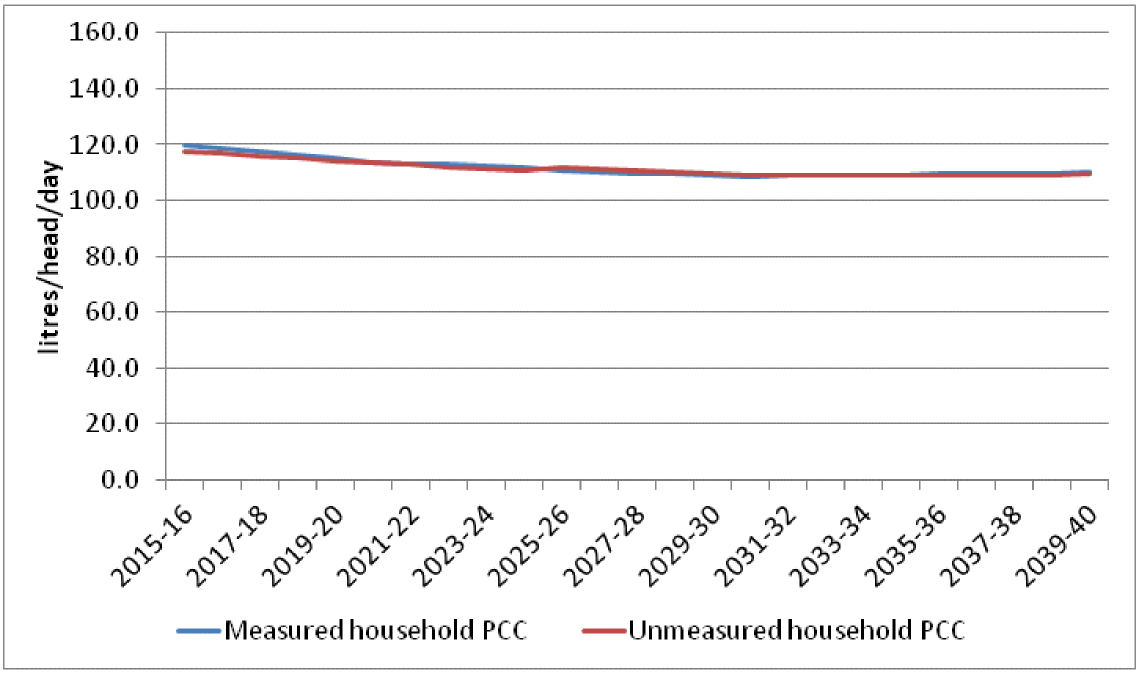
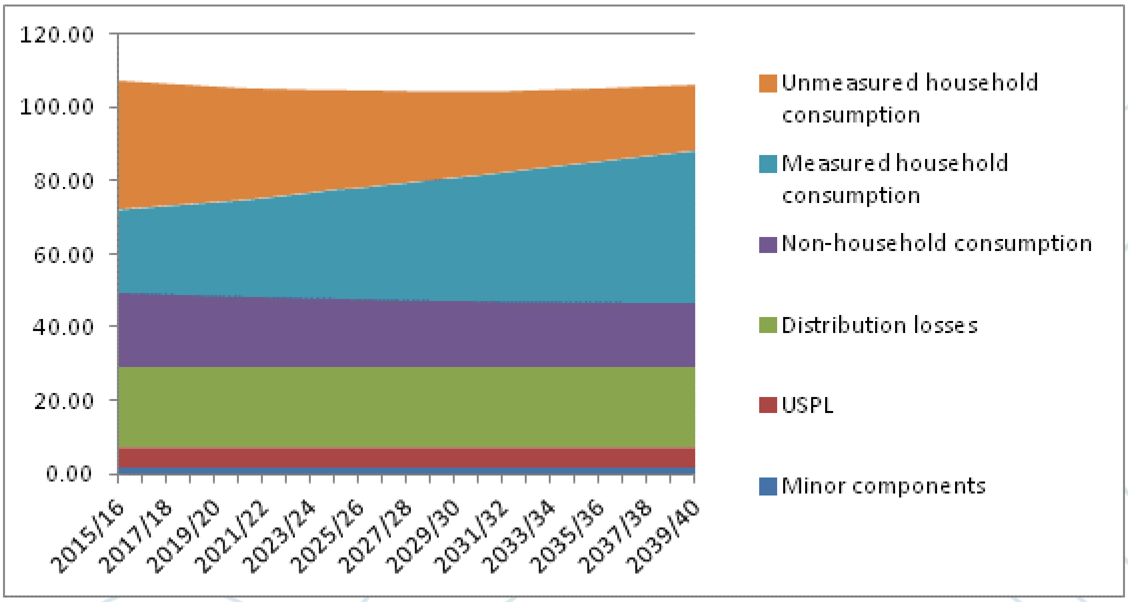


Fig B5.22: Shelton baseline dry year DI



Stafford zone

Fig B5.23: Stafford baseline dry year PCC

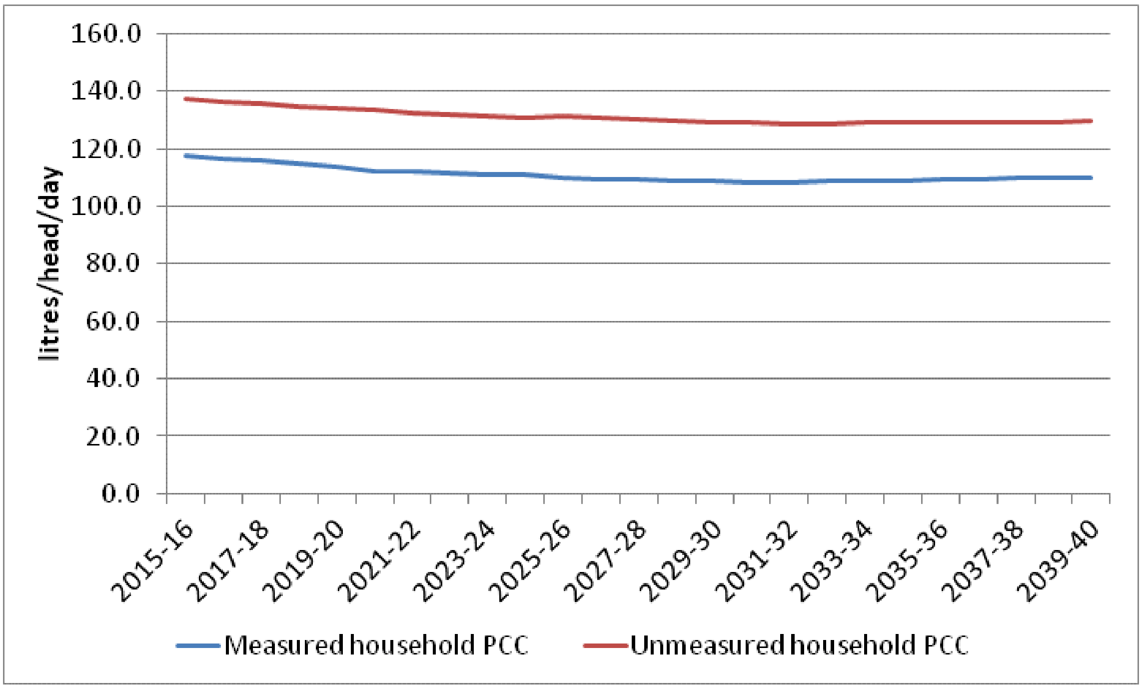
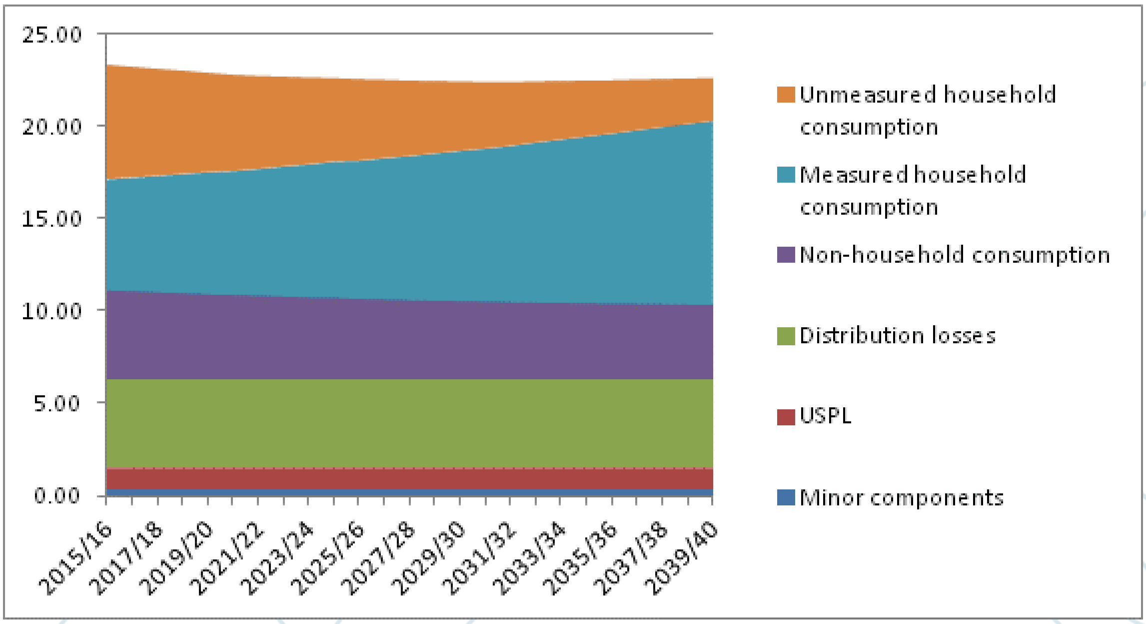


Fig B5.24: Stafford baseline dry year DI



Strategic Grid zone

Fig B5.25: Strategic Grid baseline dry year PCC

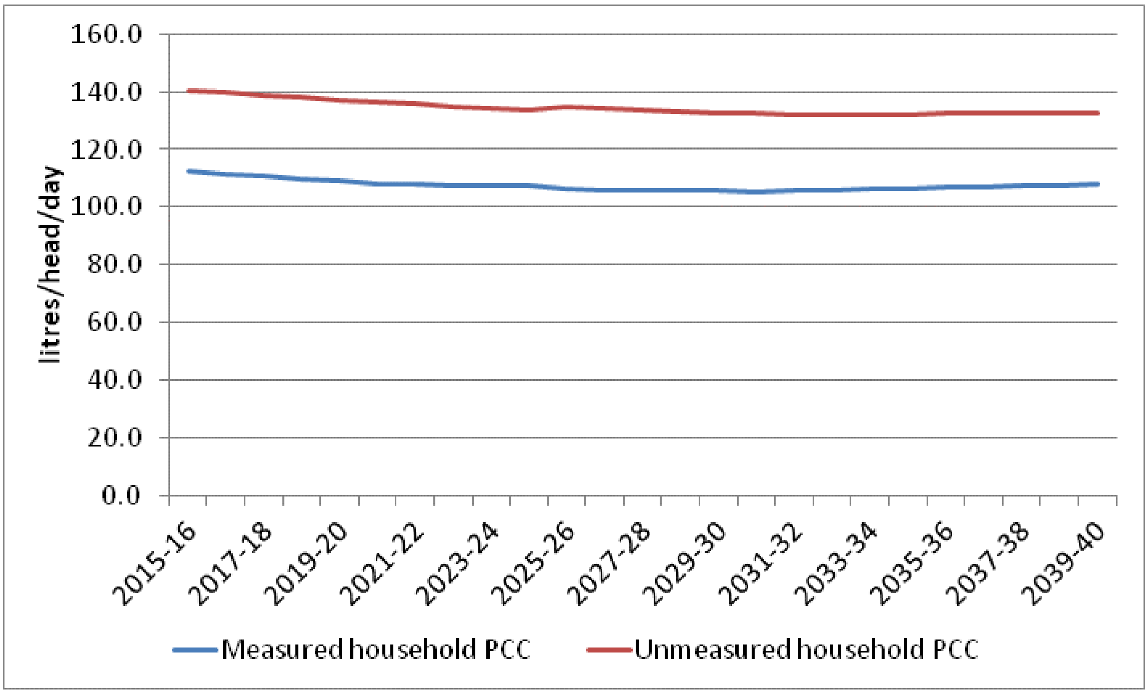
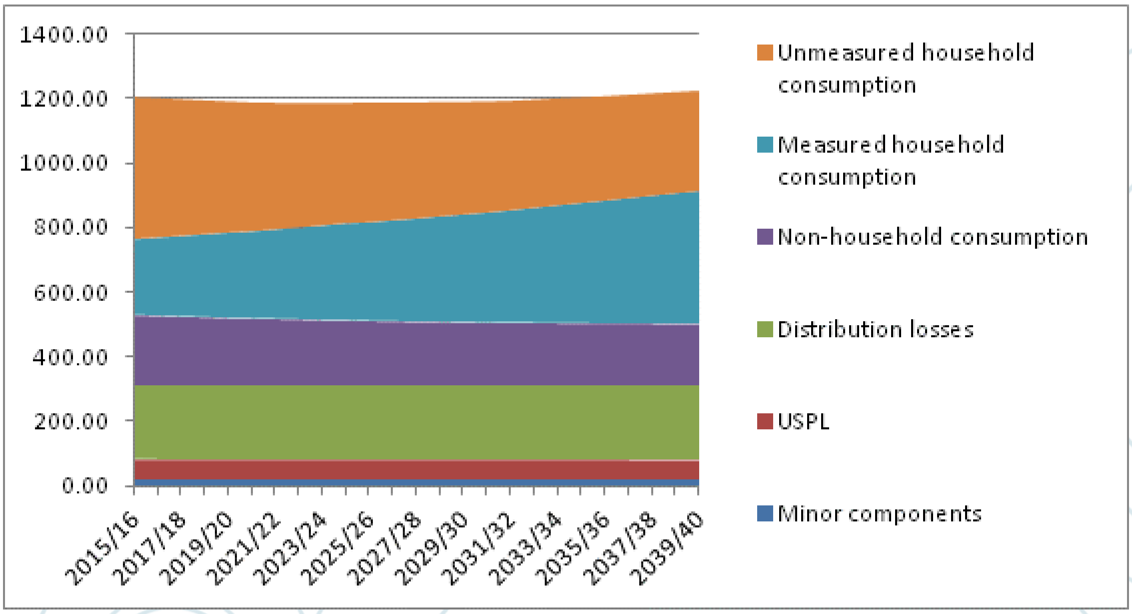


Fig B5.26: Strategic Grid baseline dry year DI



Appendix B: What is the likely demand for water?

Whitchurch & Wem zone

Fig B5.27: Whitchurch & Wem baseline dry year PCC

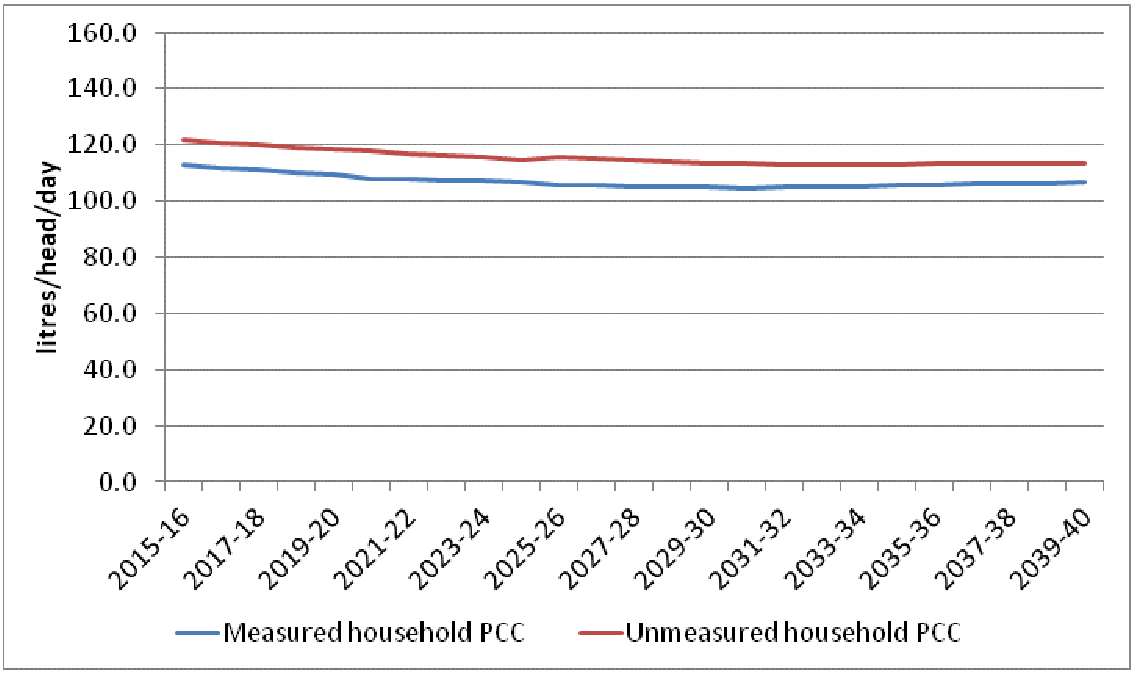
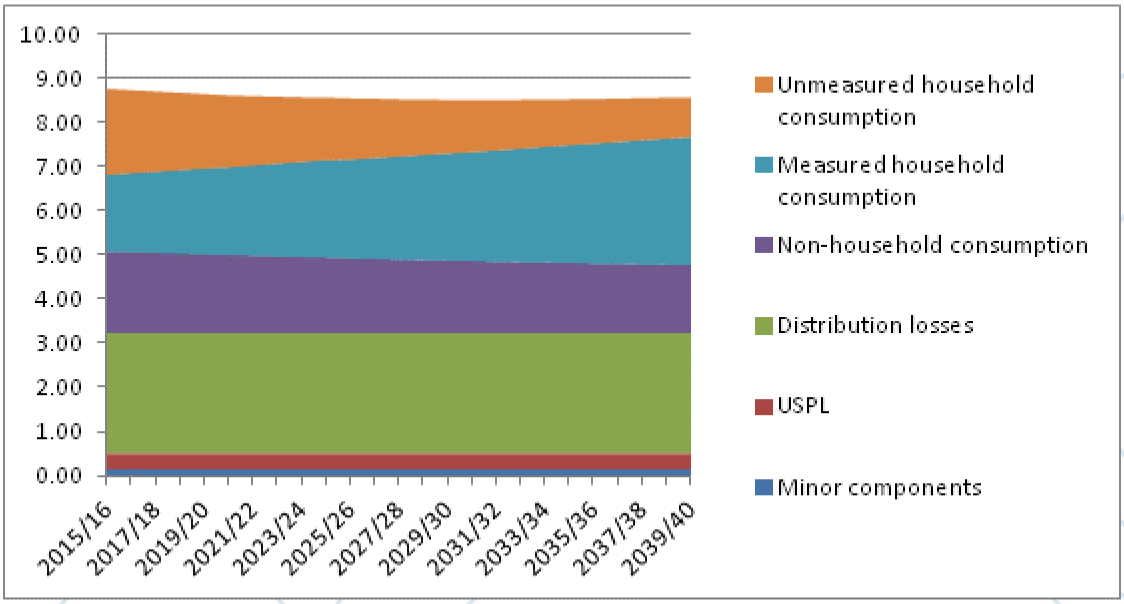


Fig B5.28: Whitchurch & Wem baseline dry year DI



Wolverhampton zone

Fig B5.29: Wolverhampton baseline dry year PCC

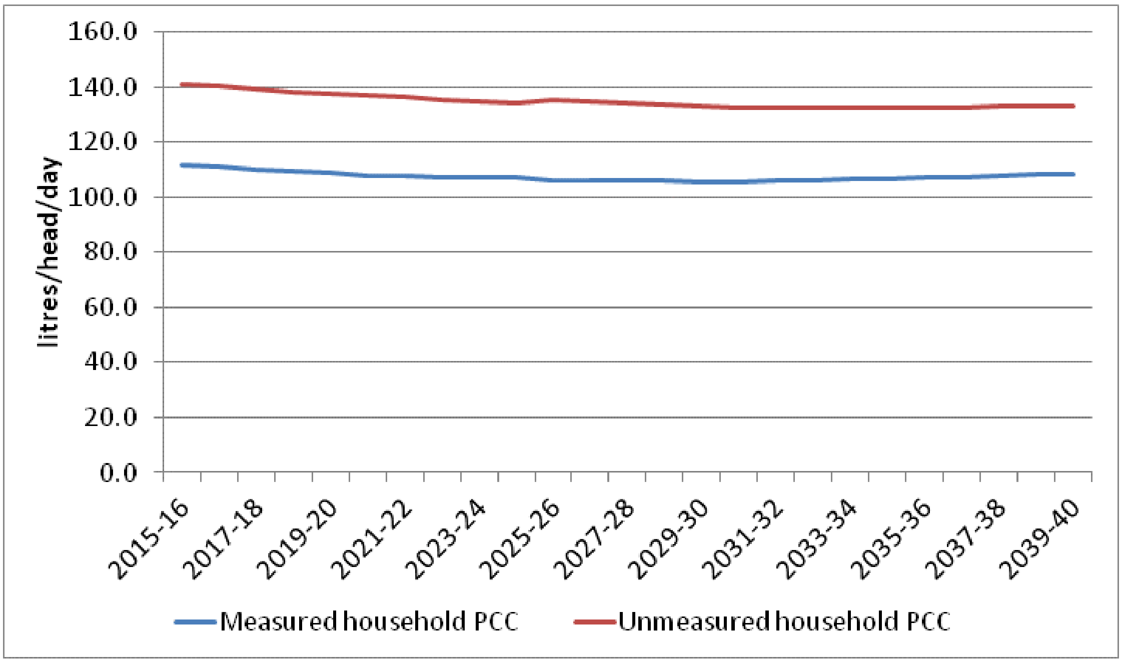
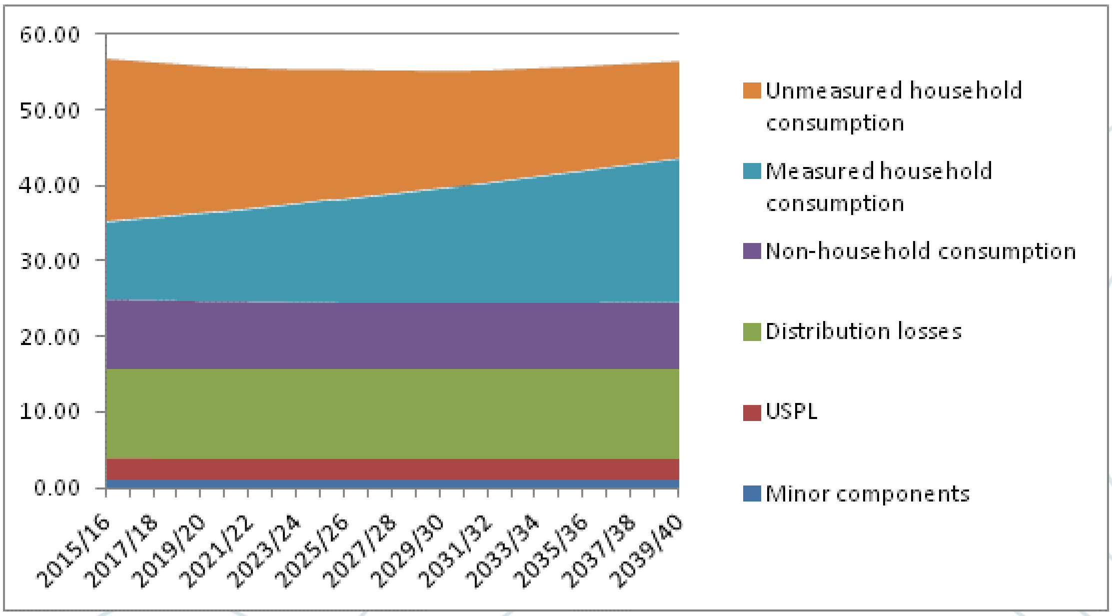


Fig B5.30: Wolverhampton baseline dry year DI



B5.2 Baseline water efficiency activities

Our baseline demand projections incorporate the ongoing benefits of our baseline water efficiency activities. During AMP 5, the water efficiency work we have done with our customers has achieved the target savings of around 3.27Ml/d per year. The baseline demand forecasts we have used include a commitment to increase these savings to 3.64Ml/d. We give details below of how we plan to achieve these savings.

In AMP 5, our water efficiency programme was developed to meet our statutory water efficiency duty and Ofwat water efficiency targets. For AMP 6, we have considered three options to meet as a minimum our on-going statutory water efficiency duty:

- To deliver the same level of activity as in AMP 5.
- To deliver a level of activity in line with the expectations of our customers - informed by our stakeholder and customer engagement programmes - and those of Government and regulators.
- To adhere more narrowly with the wording of our statutory water efficiency duty to promote the efficient use of water by our customers and limit our activity to providing information and education services to our customers on how to waste less water. All other potential water efficiency options being subject to a best value appraisal as part of the WRMP process.

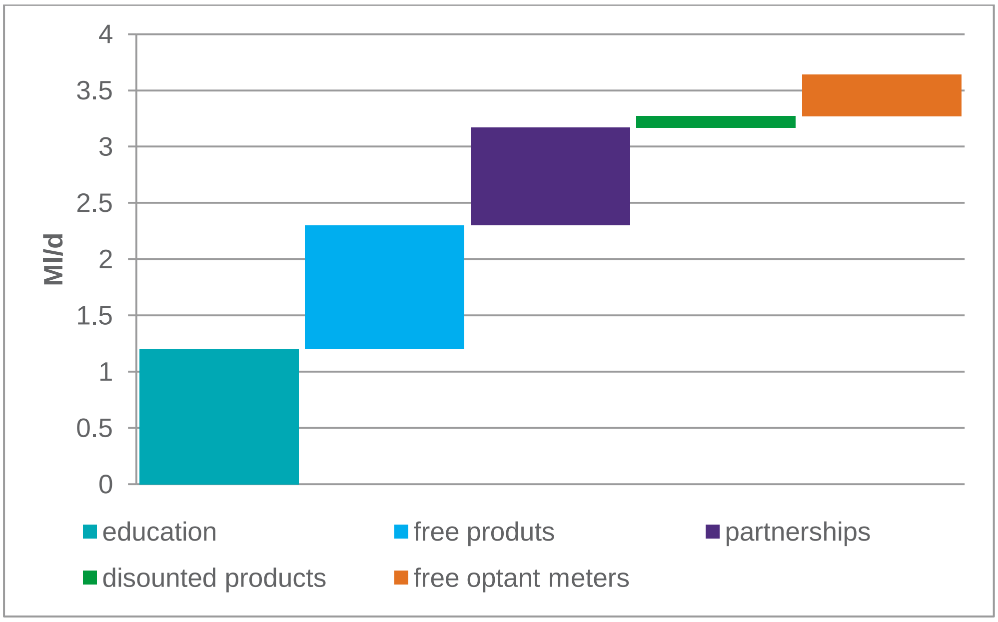
Water efficiency targets will not continue beyond 2015, but it is clear that the expectation of the Government, regulators and our customers is that we will continue to help our customers manage demand by providing access to water efficiency advice and products. In coming to this conclusion, we have taken into account Water for Life, Defra, December 2011 which indicated one of the Government's key priorities is to see a reduction in the demand for water, and WRMP guidance. We have have also taken into account comments by our customers, for example, in our Water Stakeholder Workshop June 2012, and Commercial Customer Consultation, September 2012. At both of these events, the prioritisation of demand management measures over supply side was favoured. Stakeholders asked for more advice, education and communication on water efficiency, with a general expectation of subsidised water saving products particularly water butts.

In line with our understanding of customer, regulator and Government expectations, we will deliver an increase in the level of base activity in AMP 6 compared to that delivered in AMP5. We expect the key metrics to deliver on our statutory duty will be:

- Provide information to consumers on how to save water. This includes maintaining our provision of direct engagement with schools and adult groups via our education team.
- Provide a range of water saving products which are free to customers on request.
- Provide discounted higher value water saving products (e.g. water butts, showerheads)
- Improve and increase our links with third parties to form partnerships – internal and external - to take advantage of scheduled visits to promote water efficiency and to retrofit water efficient devices. (affinity, social housing, Green Deal, Energy Company Obligation etc)
- Provide water efficiency advice and access to free water saving devices as part of our free meter optant programme.

In Figure B5.31 below we provide our current expectations of how we will deliver our baseline activity. However,over time the balance between free products, partner product installation, and education may change in response to the prevailing circumstances and customer expectations.

Figure B5.31: Breakdown of forecast annual activity in AMP6



B5.3 Weighted annual average demand forecast

We have made demand projections for both normal year and dry year conditions. In reality, the demand we are most likely to face on average in the planning horizon will reflect a mix of weather years..For the setting of price limits, Ofwat require a weighted annual average demand forecast reflecting a view of the demand associated with each type of year and the likely frequency of each type of year in the planning horizon.

“Demand” here relates to distribution input that is the total volume of water put into supply, which is the sum of:

- household consumption (metered and unmetered),
- non-household consumption (metered and unmetered),
- total leakage,
- water taken unbilled,
- distribution system operational use and minor components.

In our demand projections, the dry year uplift is applied to household consumption only, and we assume the other components of distribution input do not vary significantly across the range of weather years.

Our approach in deriving our normal year described in section B2.6, is by definition, a weighted average demand since the 50th percentile of ranked PCCs reflects the demand associated with all types of weather year and the likely frequency of each type of year in the historic record 1987 to 2012. We have therefore chosen our normal year forecast as our weighted average demand forecast.