## Appendix 10: Improvements to the Model of Underlying Demand

Each year, demand dips reasonably predictably on and around bank holidays and during the summer months. We understand that demand drops during these periods partially because a reduction in commercial consumption and partially because domestic customers go on holiday. These changes to underlying levels of demand matter both to the annual averages and the peak-week figures as the reduction during summer school holidays can coincide with peaks in weather dependent demand. Over the years we have refined our modelling of demand during these periods. Initially we modelled the reduction in base demand using a constant reduction during fixed periods (for example, a 100 Ml/d reduction in London base demand during the summer school holidays). Some years ago we moved to modelling the reduction based on publicly available statistics on the number of flights as a surrogate for people leaving the area. The impact of the flight-based model on the percentage of people away can be seen in the slow droop during the summer months in the green "tracker baseline trend" in Figure 14.

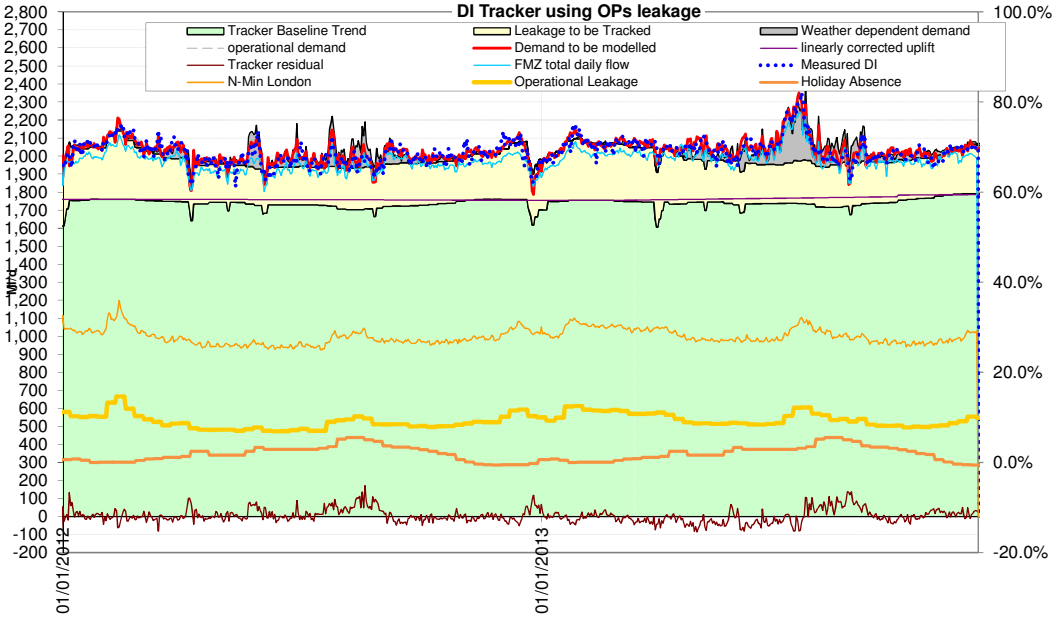



Figure 14: Tracking base demand using flight statistics

The flights statistics explained a portion of the reduction in the summer months, however it did not explain all the variability in August, nor did it account for reduction during some bank holidays. This year we investigated and finally adopted an alternative indicator mined from our unmeasured domestic water usage (DWUS) panel. The indicator monitors the percentage of the DWUS panel that are away from their homes on any given day (details are given later in this section). This indicator visibly improved the ability of the models to track both summer holidays and special days over the Christmas period. A plot equivalent to Figure 14 but using the DWUS % away function rather than the flights statistic is shown in Figure 15. Note how the green "Tracker Baseline trend" is a smoother function dropping both during school holidays and in-and-around bank-holidays.

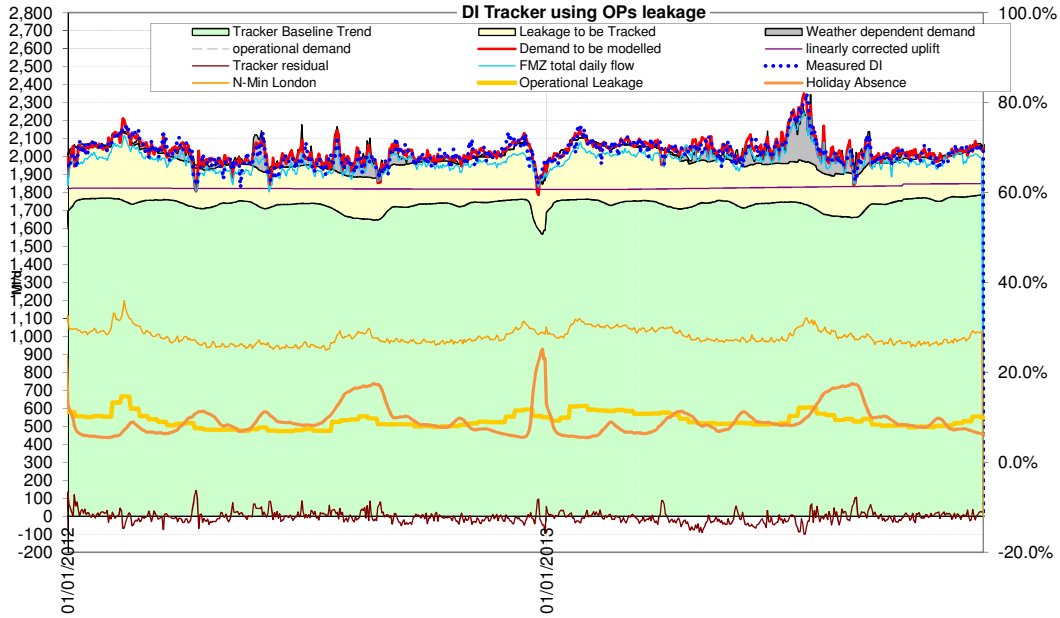



Figure 15: Tracking base demand using a percent empty stat derived from our DWUS panel telemetry

The DWUS %away statistic was mined from the validated DWUS data we use for our reported PCC (i.e. data from occupied sites with valid logger data and no evidence of wastage or leakage). The detail of the calculation for each day is broadly as follows:

For each property-type, using the DWUS daily consumption data:

- **Count of valid sites** = Count the number of sites with valid data
- **Count of unoccupied sites** = Count the number of sites with valid data where the daily demand suggested the site may be (temporarily) unoccupied using a threshold of 5 litres per person per day.
- Calculate the percent away:
  - (count of unoccupied sites) / (count of valid sites)
- Calculate the DWUS % away factor: For each region (London / Thames Valley) use the regional mix of property counts to arrive at an overall estimate of the number of occupied, but empty properties on each day of the year.

The percent away was then used to modulate the base level of demand and the scale of the weather sensitive demand. The model residuals were inspected and the new method adopted to replace the flight-based factor. The new DWUS percent away factor has helped us to arrive at an objective and well founded way to better explain the droop in summer demand and how demand reduces during special days and bank-holidays.

## Appendix 11: Per Capita Consumption Methodology

### Population

**Table 33: Population figures ('000s)**

| Population ('000s) | | | | |
|---|---|---|---|---|
| WRZ | 2012/13 | 2013/14 | | |
| | AR13 | AR14 | fWRMP09 | rdWRMP14 |
| Guildford | 151.89 | 153.29 | 146.07 | 152.50 |
| Henley | 49.53 | 48.52 | 47.82 | 49.90 |
| Kennet Valley | 392.56 | 396.44 | 383.98 | 396.98 |
| London | 7051.98 | 7133.60 | 6751.87 | 7110.49 |
| SWA | 511.78 | 516.67 | 485.26 | 516.56 |
| SWOX | 1004.42 | 1013.48 | 996.42 | 1018.16 |

### Whole water supply area

Our total population estimate for water supply is 99,834 (1.09%) higher than in AR13.

Our methods are essentially unchanged, but the following should be noted.

- The 2012 ONS mid-year estimates data were used as base figures (with an estimate of the change between mid-2012 to 2013-14 from Experian trend based projection).
- We have updated our "Popsys" system for deriving estimates for our areas from the ONS estimates. It now uses the corporate ESRI GIS, and so uses the latest boundary and address data. The principles of the calculation are unchanged.
- Estimates of hidden and transient population, short-term residents from overseas, and people with working second addresses have been obtained from Edge Analytics.

**Water Resource Zones**

At Resource Zone level, we estimate that there has been some population growth in all zones except Henley. The reduction in Henley is due to the re-zoning of two District Meter Areas from the Sheeplands supply zone into the Earley Booster supply zone in the Kennet Valley WRZ.

**Measured and Unmeasured Non-Household Population**

The non-household measured population is derived from the sum of two components:

- Population in communal establishments (obtained from 2001 census data)
- Metered subsidiary population – derived from regulatory finance accounts listing properties with domestic size pipes supplying them

Population in communal establishments has remained the same. Metered subsidiary population has increased from 334,911 to 339,130 following updates to the numbers of residential metered subsidiary properties.

The non-household unmeasured population remains at zero.

**Measured and Unmeasured Household Population**

Total household population is derived by subtracting the total non-household population from the total population.

The population split between measured and unmeasured households uses data obtained from occupancy questionnaires which were sent to 49,028 households during JR10, both unmeasured and measured, of which 11,482 were returned with valid data. All responses could be classified by property type, metering type, ethnicity and region so we were able to gross-up responses according to the effective sampling rates of each category. We could then compare the resulting profile of occupancy classes with profiles obtained from the Census for regions roughly corresponding to our London and Thames Valley regions and thus quantify the response bias of each occupancy class.

Using these to adjust the proportions of each occupancy class, for each of the categories above, we obtained estimates of the population for unmeasured and measured households for JR10.

For the update of the population splits this year we have simply used the movement in properties, with reductions in unmeasured properties as customers opt for a meter, and increases in measured properties associated with the optants and also newly built properties. For this update of population split it is assumed that the occupancy of the additional measured properties is the same as the occupancy of the existing measured properties. The residual movement in population is assumed to be in the unmeasured population base.

**Property Numbers**

Company level property numbers by type (measured/unmeasured, household/non-household, voids household/void non-household) are derived from Customer Information System (CIS). They include adjustments to the unmeasured and measured household and non-household figures for missing properties. They also take account of properties that have moved from a measured tariff due to optant metering as well as the addition of new properties to the count on measured households.

The numbers of properties within each WRZ are then calculated using the Table 7 dataset and cross-matching this with the property numbers from Netbase. Netbase takes property information from CIS and geo-references it, firstly to District Meter Areas (DMAs), then Flow Monitoring Zones (FMZs) and finally to WRZs. This allows Annual Return Table 7 property numbers to be split by applying Netbase WRZ distribution percentages.

**Table 34: Property figures ('000s)**

| Properties ('000s) | | | | |
|---|---|---|---|---|
| WRZ | 2012/13 | 2013/14 | | |
| | AR13 | AR14 | fWRMP09 | dWRMP14 |
| Guildford | 63.09 | 63.40 | 63.48 | 63.68 |
| Henley | 21.25 | 20.94 | 20.98 | 21.44 |
| Kennet Valley | 159.80 | 161.20 | 160.16 | 161.71 |
| London | 2802.54 | 2822.41 | 2829.32 | 2804.51 |
| SWA | 205.52 | 207.22 | 206.24 | 207.31 |
| SWOX | 414.64 | 412.31 | 431.12 | 421.36 |

**Occupancies**

Occupancies for each property type are calculated by dividing population by properties.

**Measured Household Billed Measured Volume**

Metered household properties are extracted from CIS for the Annual Return with household properties defined as those with a chargeable pipe size of 12 mm or less that are not parent properties (i.e. do not have subsidiary properties). Accruals are then calculated for each bill to give the volume of water used in the period 2013/14 and total volumes are reconciled against financial values. The bills for these properties are then matched against the Household/Non Household lists to get the volumes split by Household and Non Household.

The accruals process used this year is the same as the methodology employed last year, i.e. with the accrual volume calculated at each account level and split between household and non-household to give the appropriate accrual to each.

Although the progressive metering programme started installing meters during 2013/14 the two-year lead time to billing means that usage from the first non-opted customers will only be seen in the 2015/16 reporting year.

As with property numbers, total TWUL billed measured volumes are split between WRZ using data obtained from Netbase which geo-references the billing data from CIS.

**Measured Household PCC**

The measured household PCC is calculated by subtracting supply pipe leakage for externally metered properties and then dividing through by the measured household populations.

**Unmeasured Household PCC**

The unmeasured household PCC for each resource zone is derived from the Domestic Water Use Study (DWUS) which examines the water use in volunteer households which have a meter fitted for monitoring purposes but which continue to pay for their water on the unmeasured tariff. This study follows the best practice criteria defined in the UKWIR/EA report (Demand Forecasting Methodology).

DWUS results are weighted by property type, occupancy, ethnicity and region to determine an overall value for unmeasured household consumption. The sample is not designed to be specifically representative of the company unmeasured households but to include a sufficient number of households within each category to allow their results to be used to produce robust estimates at region and company level.

The average number of DWUS properties contributing valid data to estimates of PCC per month in AR14 was 1612, compared with 1320 in AR13. This increase is largely associated with the work undergone to maintain the technology. This year we have had huge issues with technology in all areas, however we have undertaken far more maintenance work than normal in an effort to maintain panel size.

We have seen a reduction in the number of volunteer households due to those opting to pay their bill as a measured customer or moving. It also reflects those properties that are within the areas targeted for progressive metering. These properties will have received promotional material regarding the metering programme and advice on reducing water use. These properties are therefore no longer considered representative as their behaviour is more likely to represent a measured customer.

**Meter Location for the Volunteer Properties**

Meters are installed externally as we consider that this is less intrusive and less likely to influence water use behaviour.

**Assessing Property Type**

We determine property types of all households supplied by Thames using Ordnance Survey Master Map (OSMM) data. The OSMM data represents each property as a polygon on a map, and each can be classed as detached, semi-detached or terraced based on the number of adjacent polygons. End-terrace houses are distinguished from semi-detached houses by looking at the type of the adjacent property. Ordnance Survey Address Layer 2 (OSAL2) data associates x, y co-ordinates with every postal address so these can be classified based on the total number of postal address points its property/polygon contains to identify flats (1 = non-flat, 2-5 = FSB

(flat in small block of flats), 5+ = FLB (flat in large block of flats)). Combining the two classifications we classify properties as one of five different types: detached, semi-detached, terraced, FSB or FLB. In London terraced houses are also split into large and small depending on the area of the dwelling.

This methodology has been used to find the property types of DWUS households and the property type distribution of all unmeasured households in each WRZ.

**Assessing Occupancy of DWUS**

To ensure that the monitor reflects the latest occupancy information, a questionnaire is mailed to all monitor panel members once a year to request updates on their details. Reminders are sent out to try to obtain as many responses as possible and provide incentives to respondents in the form of a rebate on their water bills and prize draws. New occupants within the existing DWUS properties are invited to join the study panel, both as part of the annual update and as part of routine tracking of occupancy changes over the year.

**Assessing Occupancy of the Unmeasured Population**

Occupancy of the unmeasured population is derived from a major survey undertaken at the start of 2010. Occupancy questionnaires were sent to 49,028 households, both unmeasured and measured, and 11,482 were returned with valid data. All responses could be classified by property type, metering type, ethnicity and region. It was therefore possible to aggregate responses according to the effective sampling rates of each category. The resulting profile of occupancy classes could then be compared with profiles obtained from the 2011 Census for regions, roughly corresponding to the London and Thames Valley regions, and thus quantify the response bias of each occupancy class.

The response bias was used to adjust the proportions of each occupancy class, for each of the categories above, and subsequently obtain estimates of the population in each and thus their average occupancies. These were then used in the DWUSpcc model, which makes minor adjustments to exactly reflect the populations of each Resource Zone, including clandestines.

This year further work has been undertaken to look at periods of absence and age, along with water efficiency, using the annual questionnaire. The first study was to determine if there was a link with periods of absence and the age of occupants. The second study used the question on water efficiency in the home to understand if the panel or sub groups showed any tendencies towards water efficiency device use. In both cases no evidence of bias has been found within the panel, however, the work on absences has been used within our demand modelling.

**Assessing Impact of Ethnicity**

Thames Water has a large and varied Supply Area that contains London Boroughs with some of the most densely populated and ethnically-diverse communities in the UK. As DWUS is under-representative of those of Asian origin, this means that DWUS average PCC under-estimates PCC of the unmeasured population. We therefore correct for recruitment bias by estimating and applying different usages for household members on the basis of the households' estimated ethnicity.

As before, we then apply the following rigorously estimated adjustments to Asian household usage:

a) Because of the "cultural dilution" effect – DWUS Asians in areas of lower Asian density uses less water than average Asians, and DWUS has a bias to the former – we make an addition of 2.8 litres/person/day to Asian households.

b) Because the Asian households in DWUS contain a higher proportion of adults than the average for Asian households in our region, and adults use more water than children, the households' average personal usage is slightly higher than if they had the average proportion. We have made corresponding adjustments to Asian PCC: -1.36 litres/person/day in London and -5.05 in Thames Valley.

**Data Validation**

Data validation is carried out to ensure that the quality of the data is robust prior to its inclusion within our analysis software (DWUSView). Once logger data have been downloaded, they are validated using software that we have developed.

If any data value fails any of the following checks, it is automatically flagged and excluded from subsequent analysis:

- Time check. This verifies that the data recording frequency is every 15 minutes and that there is no overlap with data previously held for each household. It also checks that there is no data after the current date.
- Repetitive Value check. 96 consecutive identical non-zero readings (i.e. one day).
- Empty property checks. 2,688 consecutive zero readings (i.e. 28 days).
- Leakage check. 480 consecutive readings (i.e. five days) greater than 0.0011 litres/sec (i.e. 4 litres per hour).
- Negative Data check.
- Instantaneous High Flow check. Single flow values greater than 0.5 litre/sec.
- Meter reading check. This compares the water use recorded by the logger with the volume given by the meter at the time of manual download. Data are flagged if there is greater than 5% discrepancy.

Properties with stopped meters and with suspected underground supply pipe leakage are excluded from the analysis. Properties where occupants are temporarily absent or where there are plumbing losses (for a period of less than five days), apparent or otherwise, are not excluded. Householders can be away for up to four weeks before we consider the property is considered to be empty.

**Identifying Wastage in Unmeasured PCC**

Wastage is defined as loss of water that occurs after the internal stop valve that is not 'normal' usage. It can include leaking cisterns, overflowing ball-cock valves, continuous dripping taps, etc. Therefore this loss of water should not be included in the overall estimate of leakage, but rather, it should be incorporated as a legitimate component of per capita consumption (PCC) and domestic night use estimates.

Water use in unmeasured households is estimated by surveying a selection of properties which are charged on an unmeasured basis, but where consumption is

metered – the DWUS panel. Members of the DWUS panel are volunteers and are aware that they are being monitored.

In 2006 we completed a study of almost 2000 unmeasured detached, semi-detached and terraced properties and concluded that a volume of 35 litres/property/day (11.9 litres/head/day) should be added to PCC for these property types to properly account for wastage. This change was introduced in JR06.

A separate investigation into wastage in flats in 2007 resulted in four estimates of wastage by flat type (purpose built or 'other') and region (London/Thames Valley). These wastage estimates were incorporated into estimates of PCC in JR09.

## Appendix 12: Water Efficiency activities undertaken in 2013/14

### Summary of AR14 performance:

## Water Efficiency

| | | | | 2013-14 | CG |
|---|---|---|---|---|---|
| **Household and non household cistern displacement devices** | | | | | |
| 1 | Number of cistern displacement devices distributed | nr | 0 | 33,204 | |
| 2 | Number of cistern displacement devices installed | nr | 0 | 27,136 | |
| 3 | Total savings assumed | Ml/d | 2 | 0.58 | |
| **Retrofit devices** | | | | | |
| 4 | Number WC devices assumed installed | nr | 0 | 35 | |
| 5 | Number tap devices assumed installed | nr | 0 | 43,137 | |
| 6 | Number shower devices assumed installed | nr | 0 | 59,457 | |
| 7 | Total savings assumed | Ml/d | 2 | 2.37 | |
| **Outdoors** | | | | | |
| 8 | Number of water butts distributed to households and non households | nr | 0 | 627 | |
| 9 | Number of trigger guns / crystal packs distributed | nr | 0 | 21,954 | |
| 10 | Total savings assumed | Ml/d | 2 | 0.05 | |
| **Additional activity** | | | | | |
| 11 | Total savings assumed | Ml/d | 0 | 0.00 | |
| **Behavioural change** | | | | | |
| 12 | Total savings assumed from behavioural change (information/education activity) | Ml/d | 0 | 0.62 | |
| **Non-household activity** | | | | | |
| 13 | Total savings assumed | Ml/d | 2 | 0.57 | |
| **Totals** | | | | | |
| 14 | Total savings assumed | Ml/d | 2 | | 4.19 |
| 15 | Total cost of initiatives | £000 | 2 | 914.36 | |
| 16 | Total savings assumed carried forward from previous year(s) | Ml/d | 2 | 3.03 | |
| **Sustainable economic level of water efficiency** | | | | | |
| 17 | Savings claimed in the report year to meet selwe targets | Ml/d | 2 | 1.00 | |
| 18 | Total cost of initiatives | £ | 0 | 540,400 | |

| Line | Description | 2013/14 |
|---|---|---|
| 1 | Number of cistern displacement devices distributed | **33,204** |
| 2 | Number of cistern displacement devices installed | **27,136** |
| 3 | Total savings assumed | **0.58 Ml/d** |

A total of **33,204** CDDs have been distributed in 2013/14.

- **32,292** CDDs were distributed via partnership projects and direct customer requests and
- **912** CDDs were distributed by Water Regulations inspectors

| Line | Description | 2013/14 |
|---|---|---|
| 4 | Number of WC devices assumed installed | **35** |
| 5 | Number tap devices assumed installed | **43,137** |
| 6 | Number shower devices assumed installed | **59,457** |
| 7 | Total savings assumed | **2.37** |

A total of **35** WC devices have been assumed installed in 2013/14 all were installed via partnership projects. These devices were EcoBetas and provided an assumed saving of **0.0016 Ml/d**

A total of **43,137** tap devices have been distributed via partnership projects and direct customer requests. These tap devices provided an assumed saving of **1.13 Ml/d**.

A total of **59,457** shower devices have been distributed via partnership projects and direct customer requests. These were a mix of water-saving showerheads, flow restrictor devices, shower timers and provided an assumed saving of **1.24 Ml/d**.

| Line | Description | 2013/14 |
|---|---|---|
| 8 | Number of water butts distributed to households and non-households | **627** |
| 9 | Number of trigger guns/ crystal packs distributed | **21,954** |
| 10 | Total savings assumed | **0.04 Ml/d** |

A total of **627** water butts were sold and distributed to Thames Water customers in 2013/14 resulting in a saving of **0.002 Ml/d.**

A total of **21,878** hose trigger guns and **76** crystal packs were distributed by partnership projects and direct customer requests, providing combined assumed water savings of **0.04 Ml/d**.

## Line 11: Additional activity

***There are no activities to report in this section.***

## Line 12: Behavioural change

**23,112** customers were engaged by behaviour change activities resulting in **0.62 Ml/d** savings. A wide variety of behaviour change activities were delivered resulting in savings as follows:

- **0.44 Ml/d** from website activity including use of the water efficiency calculator
- **0.001 Ml/d** from responses to leaflets
- **0.17 Ml/d** from downloads of school resources on the TES website

## Line 13: Other non-household activity

A total of **851** water efficiency audits have been delivered by the Water Regulations team, with reportable savings of **0.57 Ml/d**. Water efficiency audits and advice have been integrated in Water Regulations Inspections at high risk premises where there is considered to be a high risk of contamination from backflow or high water usage. The audits consist of identifying water savings that could be achieved through:

- implementing enforceable changes
- recommending additional changes
- identifying any leaks which can be confirmed as plumbing losses
- providing behaviour change guidance to the customer
- delivering CDDs to the properties.

Identified changes to save water are confirmed as being completed through a subsequent inspection or via an approved plumber visit. Within block F, we have only included savings from the enforceable and recommended changes, CDDs and behaviour change savings have been reported in blocks A and E respectively.

Due to loss of data on a network database, a proportion of the Water Regulations

savings have been assumed. The assumption is based on the number of inspections and proved savings from the period prior to the data loss. A full methodology for this approach has been provided in the following *Methodology* section, and included in the methodology statements in the reference section of this return.

## Line 14, 15, 16: Totals

Total savings of **4.19 Ml/d** were achieved in 2013/14 at a cost of **£0.91m**. A full breakdown of costs, and associated cost allocations, has been provided in the reference section.

Note that the total cost of delivering the baseline water efficiency programme includes an allocation of costs from water regulations inspectors as well as some design work from our external affairs department. The cost does underrepresent the cost of providing water saving devices to our customers since some of this stock cost was expensed against a different cost centre and not seen in 2013/14 costs. For comparable evaluation with our AMP6 plans see the section below titled AMP6 business plan data table equivalent.

## Line 17 & 18: Sustainable economic level of water activity

**1.0 Ml/d** savings were delivered towards the SELWE target for 2013/14 at a cost of **£0.54m**.

Note that the total cost of delivering the SELWE water efficiency programme includes an allocation of costs for design work from our external affairs department. The cost does underrepresent the cost of providing water saving devices to our customers since some of this stock cost was expensed against a different cost centre and not seen in 2013/14 costs. For comparable evaluation with our AMP6 plans see the section below titled AMP6 business plan data table equivalent.

The savings were achieved by specific projects:

- **Save Water Swindon-** Thames Water has continued to deliver the Save Water Swindon project as the primary delivery agent, working in partnership with Swindon Borough Council and contracted suppliers. It is a large scale water efficiency retrofit and behavioural campaign which aims to:

    - provide a replicable case study for large scale water efficiency
    - achieve measurable demand savings
    - support residents to gain an understanding of the link between their water use and the local natural environment, energy use, and potential financial savings.

The project continues to provide useful insights into customer attitudes towards their water use and the effectiveness of different methods of engagement.

- **Fixed network Trial**
  The fixed network trial water efficiency project targeted 4 out of the 5 areas being tested with Automatic Meter Readers (AMR) with various marketing and water efficiency messaging. This included testing direct mailings to over 4000 households and a media campaign, offering free water saving products and

installs for households. This project will help us develop future messaging plus build evidence on measured water savings.

- **London Water for Schools project**
  We continued our involvement in this project by utilising existing AMR meter sites to identify and prioritise leak detection work. We carried out leakage/wastage investigations at 13 sites, and are using the AMR data to confirm the savings achieved. This process also provided useful insight into water management issues in schools, which will prove valuable for future work in this sector.

## Appendix 13: Process Losses Calculation

Total process losses equate to the difference between the amount of water abstracted (minus raw water exports and raw water reservoir storage changes) and the amount of water into supply. Process losses are split between Raw Water Losses and Operational Use (Line 4) and Treated Water Losses and Operational Use (Line 9) by splitting the calculated losses based on percentage splits derived through a comprehensive study of process losses at water treatment works.

Three components that are included within the volume defined as "Total Process Losses" have specific categories to which they are allocated, namely:

- Returns to River – included in Treated Water Losses and Operational Use
- Non-Public Supplies – included in Treated Water Losses and Operational Use where they related to water supplied to sewerage treatment works
- Non-Public Supplies – included in Raw Water Losses and Operational Use in the case of the supply to Crossness Nature Reserve.

Therefore, in calculating the volume of water that is split across the two categories of process losses, these three components are excluded from the calculation of Process Losses (k) and then subsequently allocated to the correct category after the splits have been applied to Process Losses (k).

Process losses (k) are calculated as the difference between Public Raw Water into Treatment and Treated Water into Supply after taking into account adjustments for flow meter errors.

Public Raw Water into Treatment is calculated from Raw Water Abstracted after removing abstraction that supplies non-public sources, returns to river and changes in raw water reservoir levels. Raw Water Exported (Line 5) is also removed and Raw Water Imported (Line 2) is added.

As last year the effect of net rainfall/evaporation from raw water storage reservoirs has been included in the calculation. If rainfall is less than the estimated evaporation from the reservoir, then the net amount of water into treatment is reduced. If rainfall is greater than evaporation then the opposite is true. The net effect has increased for the reporting year as a result of higher levels of rainfall than average and stands at 18.77 Ml/d in London and 1.03 Ml/d in SWOX (-ve representing more evaporation than rainfall).

**ANNUAL AVERAGE**

| All figures in Ml/d | Guildford | Henley | Kennet Valley | London | SWA | SWOX | Total |
|---|---|---|---|---|---|---|---|
| **Raw Water Abstracted (Line $1_{AR}$)** | 51.78 | 12.07 | 110.03 | 2257.29 | 138.45 | 274.12 | 2843.75 |
| Non-Public Supply | 0.00 | 0.00 | 0.00 | -5.69 | -0.58 | 0.00 | -6.27 |
| Returns to River | 0.00 | 0.00 | -0.10 | -133.89 | 0.00 | 0.00 | -133.99 |
| Storage Reservoir Change | 0.00 | 0.00 | 0.00 | 9.82 | 0.00 | -7.30 | 2.52 |
| **Raw Water Exported (Line $5_{AR}$)** | 0.00 | 0.00 | 0.00 | 81.07 | 0.00 | 0.00 | 81.07 |
| **Raw Water Imported (Line $2_{AR}$)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Net Rainfall/Evaporation | 0.00 | 0.00 | 0.00 | 18.77 | 0.00 | 1.03 | 19.79 |
| **Public Raw Water into Treatment** | **51.78** | **12.07** | **109.92** | **2065.22** | **137.88** | **267.85** | **2644.72** |
| **Treated Water into Supply** | 51.06 | 12.19 | 101.46 | 2039.21 | 136.71 | 267.67 | 2608.31 |
| Flowmeter Error | -0.01 | 0.00 | -0.11 | 3.79 | -0.08 | 0.02 | 3.61 |
| | | | | | | | |
| **Process Losses (k)** | **0.73** | **-0.12** | **8.57** | **22.23** | **1.25** | **0.15** | **32.80** |
| **% of Total Raw Water into Treatment** | 1.4% | -1.0% | 7.8% | 1.0% | 0.9% | 0.1% | 1.2% |

Total raw water losses (raw water losses plus raw water operational use) are assumed to be 10% of the process losses for Thames Valley. In London, total raw water losses are assumed to be 15% of the process losses due to a more extensive raw water movement system including intake tunnels, reservoirs and significant transmission pipe work. Total treatment works losses (treatment works losses plus treatment works operational use) are assumed to be 85% and 90% of the process losses for London and Thames Valley respectively.

| Lines | Description | 2012/13 | 2013/14 | Variance |
|---|---|---|---|---|
| 4 and 9 | Total Process Losses | Ml/d | Ml/d | Ml/d |
| WRZ 1 | Guildford | 1.36 | 0.73 | -0.63 |
| WRZ 2 | Henley | -0.06 | -0.12 | -0.07 |
| WRZ 3 | Kennet Valley | 7.23 | 8.68 | 1.44 |
| WRZ 4 | London | 148.29 | 161.81 | 13.52 |
| WRZ 5 | Slough/Wycombe/Aylesbury | 1.25 | 1.82 | 0.57 |
| WRZ 6 | SWOX | 5.49 | 0.15 | -5.34 |
| Total | Total | 163.57 | 173.06 | 9.50 |
| | | | | |

As Process Losses are calculated by subtracting one large volume from another large volume, both of which have standard metering uncertainties, the resulting value will have a large uncertainty. These uncertainties need to be considered when reviewing the reported losses. Based on the mass balance studies in North East, West and South London (99.8% of London by volume of Public Raw Water into Treatment), the metering uncertainty associated with the process losses for London of 173.1 Ml/d is approximately ± 78 Ml/d (45.1%). A similar mass balance study of the large WTWs in Thames Valley (99.9% of Thames Valley by volume of Public Raw Water into Treatment) results in a metering uncertainty of ± 14 Ml/d (124%). These uncertainties need to be considered when reviewing the reported losses.

**Critical Period Process Losses**

Critical Period process losses are calculated in a similar way as annual average process losses except that the Public Raw Water into Treatment during the summer peak demand week and Treated Water into Supply during the summer peak demand week are used instead of the annual average values. For the London WRZ, values remain as per the Annual Average.

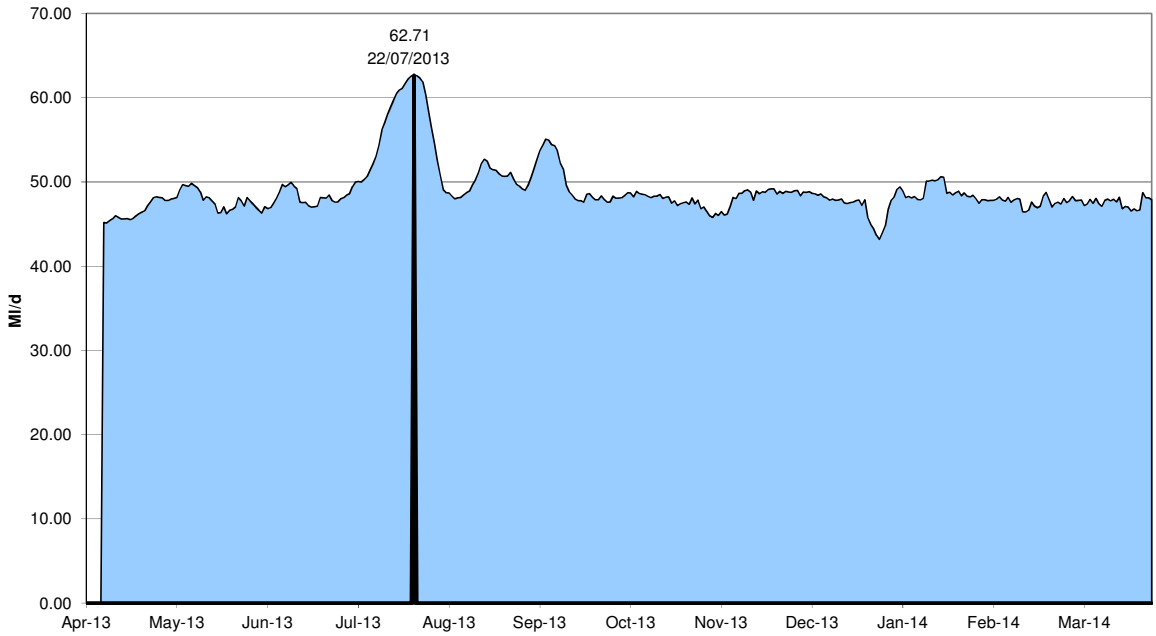
| CRITICAL PERIOD | | | | | | | |
|---|---|---|---|---|---|---|---|
| All figures in Ml/d | Guildford | Henley | Kennet Valley | London | SWA | SWOX | Total |
| **Raw Water Abstracted (Line $1_{AR}$)** | 63.68 | 17.04 | 133.90 | 2257.29 | 171.94 | 347.37 | 2991.23 |
| Non-Public Supply | 0.00 | 0.00 | 0.00 | -5.69 | -0.60 | 0.00 | -6.29 |
| Returns to River | 0.00 | 0.00 | -0.17 | -133.89 | 0.00 | 0.00 | -134.05 |
| Storage Reservoir Change | 0.00 | 0.00 | 0.00 | 9.82 | 0.00 | -11.43 | -1.61 |
| **Raw Water Exported (Line $5_{AR}$)** | 0.00 | 0.00 | 0.00 | 81.07 | 0.00 | 0.00 | 81.07 |
| **Raw Water Imported (Line $2_{AR}$)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Net Rainfall/Evaporation | 0.00 | 0.00 | 0.00 | 18.77 | 0.00 | 1.03 | 19.79 |
| **Raw Water into Treatment** | **63.68** | **17.04** | **133.74** | **2065.22** | **171.34** | **336.97** | **2787.99** |
| **Treated Water into Supply (Ml/d)** | 65.40 | 17.99 | 124.15 | 2039.21 | 171.85 | 331.85 | 2750.44 |
| Flowmeter Error (Ml/d) | 0.00 | 0.00 | 0.00 | 3.79 | 0.00 | 0.00 | 3.79 |
| | | | | | | | |
| **Process Losses (Ml/d) (k)** | **-1.71** | **-0.95** | **9.59** | **22.23** | **-0.50** | **5.12** | **33.77** |
| **% of Total Raw Water into Treatment** | -2.7% | -5.6% | 7.2% | 1.0% | -0.3% | 1.5% | 1.2% |

Critical Period total raw water losses are assumed to be 10% of the process losses for Thames Valley. Critical Period total treatment works losses are assumed to be 90% of the process losses for Thames Valley.

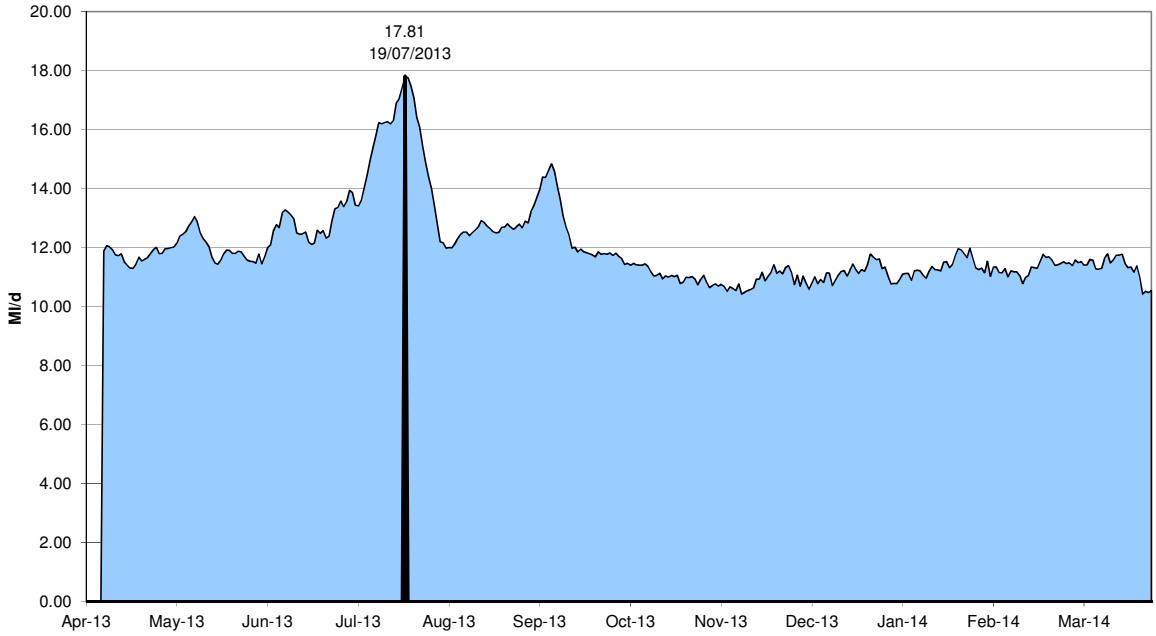
| Lines | Description | 2012/13 | 2013/14 | Variance |
|---|---|---|---|---|
| 4 & 9 | Total Process Losses (Critical Period) | Ml/d | Ml/d | Ml/d |
| WRZ 1 | Guildford | 1.26 | -1.71 | -2.98 |
| WRZ 2 | Henley | -1.43 | -0.95 | 0.49 |
| WRZ 3 | Kennet Valley | 9.18 | 9.76 | 0.58 |
| WRZ 4 | London | 148.29 | 161.81 | 13.52 |
| WRZ 5 | Slough/Wycombe/Aylesbury | -1.52 | 0.09 | 1.62 |
| WRZ 6 | SWOX | -11.10 | 5.12 | 16.22 |
| Total | Total | 144.68 | 174.12 | 29.44 |

## Appendix 14: Daily Demand Profiles

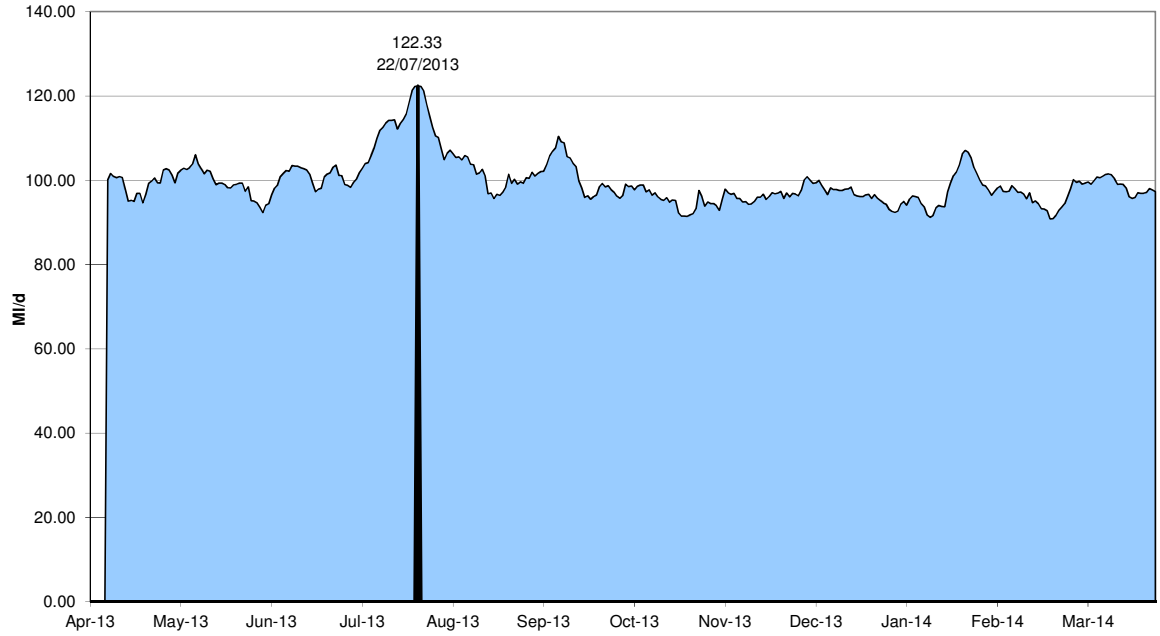
**Guildford Rolling 7 Day Demand 2013/14**



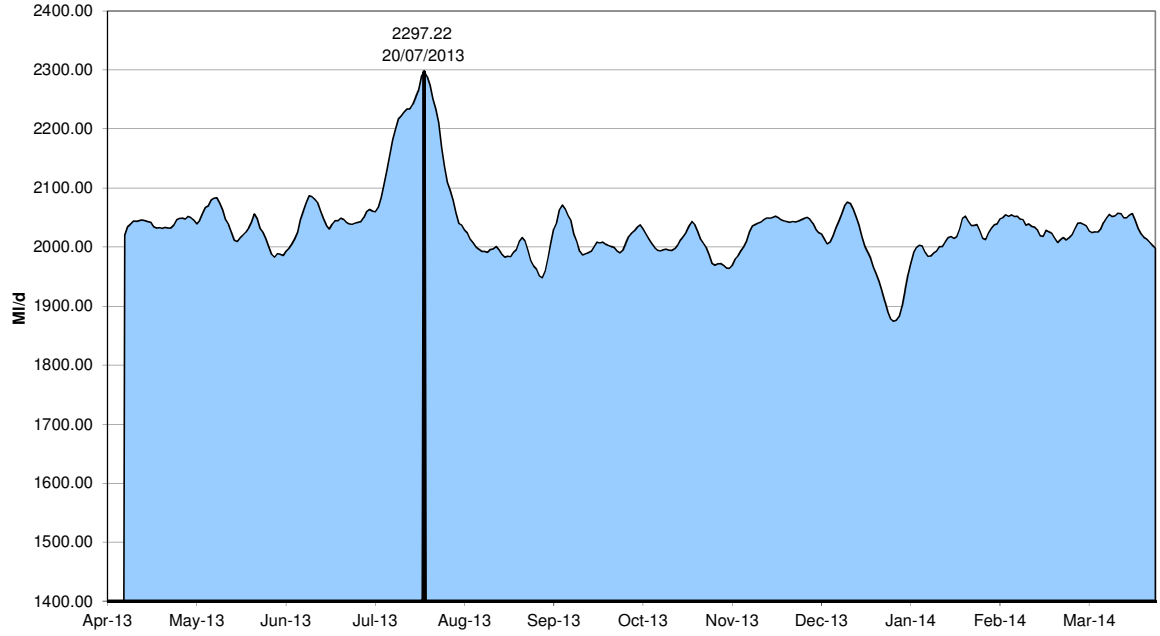

**Henley Rolling 7 Day Demand 2013/14**



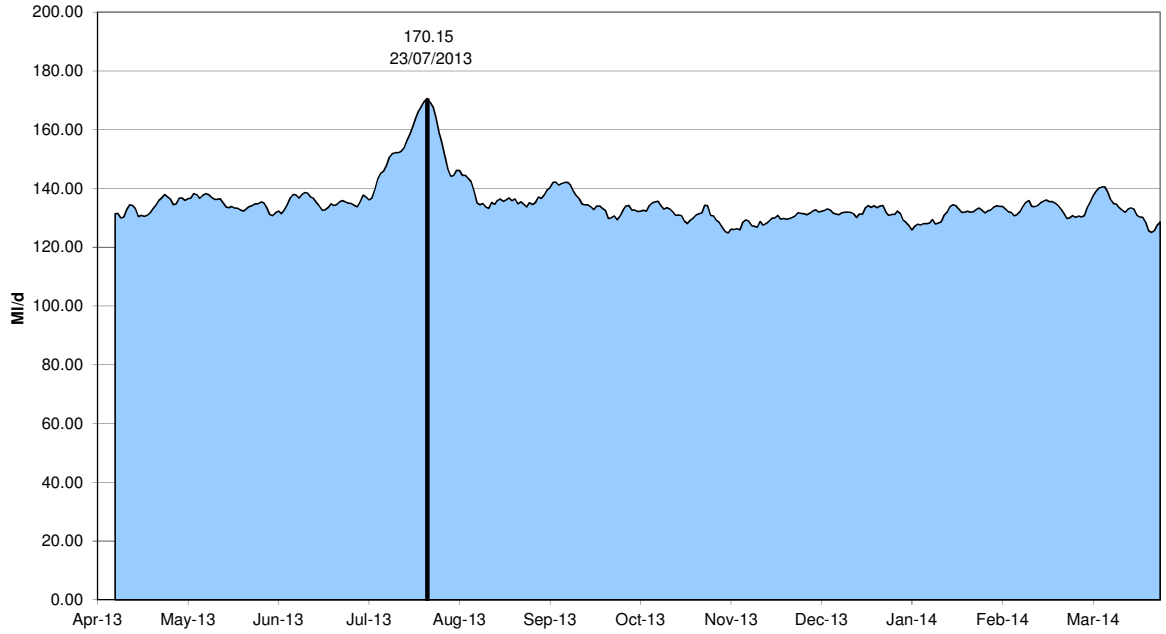
**Kennet Valley Rolling 7 Day Demand 2013/14**




**London Rolling 7 Day Demand 2013/14**



**SWA Rolling 7 Day Demand 2013/14**




**SWOX Rolling 7 Day Demand 2013/14**