Table 29: London Outages 2013-14

Thames Valley WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Addington	Comms Issues	107	1.54
Brixton	Treatment Process Issues	365	3.47
Nonsuch	Borehole issues - turbidity	365	1.77
Epsom / Railway BH	Borehole issues - turbidity	365	2.00
		Total	8.78

South East WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Crayford	Failure of baffles within the contact tank.	110	4.10
Crayford	Restricted flow limitations in treatment process	45	0.48
Dartford	Electrical issues	26	0.26
Horton Kirby	WQ Issue	15	0.19
Horton Kirby	Chlorine guard failure	5	0.06
Ladywell Fields	Water Quality issues	30	0.79
Lane End	Site capabilty restricted due to treatment process/borehole issues	365	2.71
Lullingstone	Site Upgrade work	15	0.18
North Orpington	Maintenance	8	0.18
Orpington	Pump issues	33	0.25
Wansunt	HV Switchgear work	122	4.55
West Wickham	Site Upgrade	101	2.27
		Total	16.03

Lee Valley WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
ELReD (East Ham)	Operational control issues	365	6.30
Waltham Abbey	Treatment Process issues	92	2.87
Wanstead	Treatment Process issues	118	1.04
Coppermills CW Pumps	Pump failure	186	16.31
New River Head BH	Sand ingress into BH	365	3.45
		Total	29.97

London Major Water Treatment Works	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Chingford	Process issues	343	
Chingford	Reduced water treament capability	16	
Chingford	Control issues	6	
Coppermills	Algal blooms impact	99	
Coppermills	Reduced water treament capability	113	
Coppermills	Reduced raw water transfer capability	109	
Hornsey	Site being re-furbished	365	11.00
Ashford	Reduced water treament capability	104	
Ashford	Planned work	20	
Hampton	Reduced water treament capability	323	
Hampton	Contact tank work	11	
Hampton	Ozone plant work	7	
Kempton	Reduced water treament capability	346	
Kempton	Planned maintenance	19	
Walton	Reduced water treament capability	365	

Total London Outage for 2013-14	Total	65.79

Table 30: Thames Valley Outages 2013-14

Swindon WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Sheafhouse	Water quality	217	0.96
Swindon Total			0.96

North Oxon WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Farmoor WTW	Maintenance	4.33	0.85
Farmoor WTW	Pump house flooded	0.83	0.16
Swinford WTW	Maintenance	2.04	0.37
North Oxon Total			1.38

South Oxon WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Britwell	Planned refurbishment	365	1.31
Manor Road	Planned refurbishment	94	0.47
Witheridge Hill	Maintenance	10	0.05
South Oxon Total			1.84
SWOX Total (Swindon + NOXON + SOXON)			**4.18**

Kennet Valley WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Speen	WQ Issue	103	1.81
Kennet Valley Total			1.81

Henley WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
No Outages			0.00
Henley Total			0.00

Slough, Wycombe & Aylesbury WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Dancers End	Water quality	365	1.49
Datchet	Maintenance	1	0.05
Radnage	Maintenance	3	0.01
Pann Mill	Planned refurbishment	267	12.29
SWA Total			13.84

Guildford WRZ	Reason for Outage	Total No. Days Outage	Weighted Outage (Ml/d)
Millmead	Maintenance	1	0.01
Sturt Road	Maintenance	1	0.01
Sturt Road	Water quality	139	0.79
Guildford Total			0.81

4. Results

The difference between the “Outage Risk” and the “Actual Outage” that has occurred over the period 2006-07 to 2013-14 across the Company area is shown in Table 31 and Figure 3. Whilst there are changes in Outages year on year the total Actual Outage for the Thames Water area is 86.4 Ml/d, which is a reduction from last year following the resolution of issues at some sites in the London WRZ. An update of the Outage Risk assessment is also presented, which shows a decrease in Outage Risk primarily as a result of the reduction in outages during 2013-14.

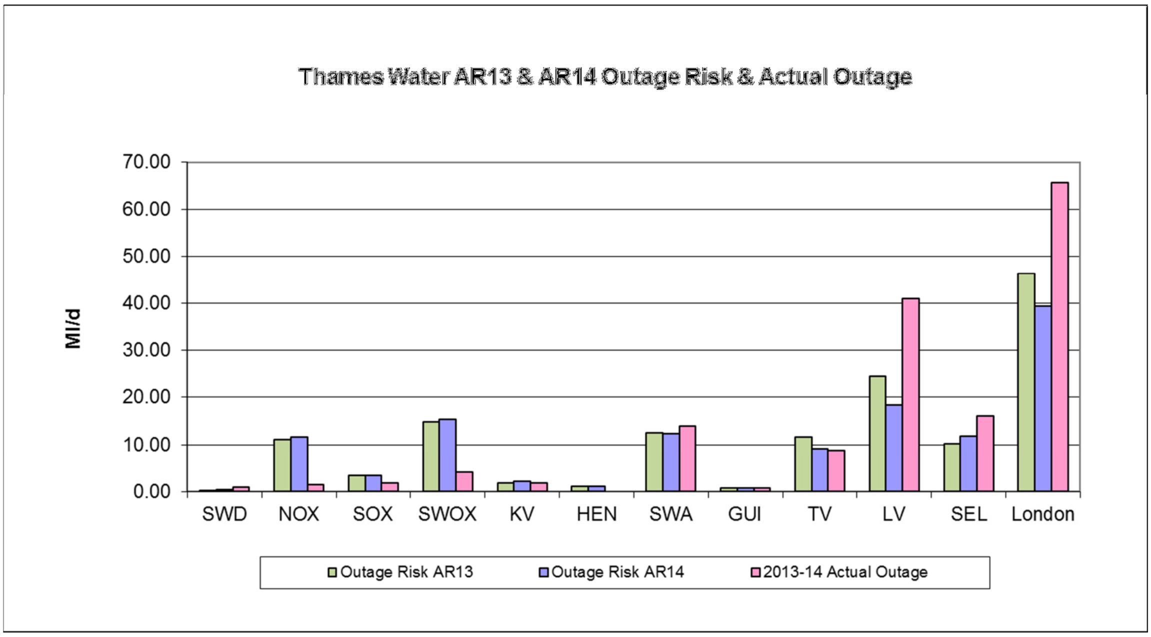
Table 31: Outage Assessment for inclusion in AR14

Outage Assessments for Inclusion in AR14 (Ml/d) -- Outage Risk @ 5%

Resource Zone	SWD	NOX	SOX	SWOX	KV	HEN	SWA	GUI	TV	LV	SEL	London	Total
Outage Risk dWRMP08	0.99	9.19	0.43	10.61	1.60	1.07	3.00	0.38	1.13	3.34	7.07	11.53	28.22
Outage Risk WRMP09/JR08	0.91	9.06	0.66	10.62	1.68	1.05	3.06	0.38	1.06	5.73	7.97	14.76	31.57
Outage Risk Update 2009	0.49	9.12	3.72	13.33	2.18	1.06	9.53	0.64	2.45	6.98	8.53	17.97	44.70
Outage Risk JR10	0.25	9.46	3.43	13.14	1.79	1.06	9.71	0.65	4.70	11.43	8.34	24.47	50.82
Outage Risk JR11	0.23	11.55	3.51	15.28	1.78	1.06	10.84	0.62	9.23	16.92	8.42	34.57	64.15
Outage Risk AR12	0.18	11.36	3.50	15.04	1.77	1.08	11.97	0.78	10.00	17.42	8.61	36.04	66.67
Outage Risk AR13	0.30	11.15	3.44	14.88	1.85	1.05	12.53	0.81	11.63	24.43	10.21	46.27	77.39
2006-7 Actual Outage	0.08	0.00	0.50	0.58	0.00	0.00	0.11	0.03	55.77	0.00	4.21	60.0	60.7
2007-8 Actual Outage	0.93	1.03	2.31	4.27	4.50	0.00	0.00	0.00	3.45	11.00	4.21	18.7	27.4
2008-9 Actual Outage	0.93	0.34	10.65	11.92	4.55	0.61	10.65	1.13	13.90	9.70	31.20	54.8	83.7
2009-10 Actual Outage	0.15	3.62	1.09	4.86	0.02	0.00	5.52	0.00	32.98	21.95	3.89	58.8	69.2
2010-11 Actual Outage	0.00	9.93	1.66	11.59	0.00	0.00	10.97	0.00	59.25	46.43	7.62	113.3	135.9
2011-12 Actual Outage	0.02	1.31	1.41	2.73	0.00	0.01	9.95	1.06	19.53	63.41	7.41	90.4	104.1
2012-13 Actual Outage	1.73	0.30	1.80	3.83	0.02	0.00	18.30	2.08	30.47	66.02	23.79	120.3	144.5
2013-14 Actual Outage	0.96	1.38	1.84	4.18	1.81	0.00	13.84	0.81	8.78	40.97	16.03	65.8	86.4
Outage Risk AR14	0.34	11.60	3.41	15.34	2.14	1.04	12.27	0.77	9.06	18.39	11.87	39.32	70.88

Note: the table above and the chart below include WRZ's and their sub-areas.

Figure 3: AR13 & AR14 Outage Risk & Actual Outage



5. Discussion

An assessment of the Outage for 2013-14 has been made and an update of the Outage Risk (at 5%) has been re-assessed. The Actual Outage may well be larger than Outage Risk but depends on the nature and the number of events that have occurred in the year as well as the duration, together also with any mitigation that may have taken place to resolve issues.

The level of risk also depends on the length of record available over which to assess the risk, currently we have thirteen years of record from 2001. Outage Risk is calculated from the product of the magnitude of the outage; the frequency of occurrence from the probability density function (pdf); and the duration from its pdf. The period of time that an Actual Outage has occurred in any year is also taken into consideration, as the source may still be available for much of the year.

This year the decrease in Actual Outage in London since AR13 is due to Thames Water taking measures to resolve long term outages, this includes outages at:

- Battersea, Honor Oak and Streatham in Thames Valley, SW London;
- Southfleet in SE London;
- Stratford Box and ELRED (partial success) in the Lee Valley.

The measures taken to mitigate outages means also that Outage Risk has been reduced at these sites, although with ELRED there remains a reduced output that is being investigated. Outage Risk has also been reduced by the reduction in Deployable Output because the Merton source is now out of supply therefore outages cannot occur.

The Actual Outage for 2013-14 however remains larger than the outage risk as the scale of the Outage Risk is also dependent on which month the Actual Outage occurs as an outage could occur in a non-critical month that would have no impact on the level of Outage Risk. Thus when the impact of an ever increasing length of record is also included Outage Risk has been reduced for AR14.

6. Summary of Outage Impacts

WR Zone	Comment on Actual Outage	Comment on Change to Outage Risk
SWOX	Outage is of the same order of magnitude as last year with a marginal increase due to refurbishment and maintenance.	Outage Risk is also of the same order of magnitude as AR13 although showing a small increase related to the timing of outages in the year.
Kennet Valley	Only one outage at Speen reported in this zone	Outage Risk has increased as a result of the Speen outage.
Henley	No issues within the year.	Outage Risk remains at the expected level.
Slough, Wycombe & Aylesbury	Engineering work and water quality investigations have again influenced Actual Outage this year.	The issues have resulted in a marginal decrease in the Outage Risk.
Guildford	Water quality issues at Sturt Road are again the main outage over the year, however overall outage has reduced.	Outage Risk remains at the expected level however has reduced marginally since AR13.
London	Actual Outage has reduced due to several issues having been resolved at various sources.	The decreased level of Actual Outage has resulted in a decrease in Outage Risk.

Appendix 5: Inset Appointments

Insets in Thames Water's Region						
Year	**Inset Provider**	**Site**	**No of properties**	**Services**	**Max Demand (m^3/year)**	**Status**
2009	SSE Water	Kennet Island Phase 5&6 (see phase 7&8)	269	Water and waste	see phase 7&8	Appointed
	SSE Water	Hale Village	1200	Water and waste	206,992	Appointed
2010	SSE Water	Bromley Common, Kent	617	Water and waste	58,458	Appointed
	IWN	The Bridge, Dartford	894	Water and waste	134,000	Appointed
	SSE Water	Park Views, Epsom*	300	Waste only	n/a	Appointed
	IWN	Berryfields (Phase 1), Aylesbury	3600	Water and waste	657,000	Appointed
	IWN	Kings Cross, London	2500	Water and waste	1,300,000	Appointed
	SSE Water	Kingsmere, Bicester	1585	Water only	29,200	Appointed
2011	SSE Water	Great Western Park, Didcot	3300	Water and waste	421,000	Appointed
	SSE Water	New South Quarter, Croydon	370	Water and waste	40,400	Appointed
	SSE Water	Barking Riverside	655	Waste Only	n/a	Appointed
	SSE Water	Kennet Island Phase 7&8	615	Water and Waste	110,000	Appointed
2012	SSE Water	Marine Wharf	532	Water and Waste	65,000	Appointed
	SSE Water	Riverlight	752	Water and Waste	82,000	Appointed
2013	IWN	Berryfields (Phase 2)	see Berryfields Phase 1	Water and Waste	see Berryfields Phase 1	Appointed
	SSE Water	Heart of Greenwich	645	Water and Waste	71,000	Appointed
	Albion	Rissington Camp Phase 1	368	water only	112000	Appointed
	SSE Water	Embassy Gardens	639	Water and Waste	73,000	Appointed
	IWN	Greenwich Millennium Village	1746	Water and Waste	249000	Appointed
	Albion	Rissington Phase 2 (see phase 1)	340	Water Only	see Rissington Phase 1	Appointed

Appendix 6: Sustainability Reductions

AMP3 Sustainability Reductions

All the actions relating to AMP3 (non-statutory) Restoration of Sustainable Abstraction Programme (RSAP) have now been completed, as reported in the AR13 Environment Agency Annual Report.

AMP4 Sustainability Reductions, Investigations and Options Appraisal

All AMP4 sustainability reductions have been completed and all investigations associated with the RSAP were carried out jointly with the EA and are now complete, and the options appraisals arising as requirements in AMP4 have been completed. Details of these have been reported in previous returns.

AMP5 Sustainability Reductions

Sustainability Reductions or mitigation solutions to address low flow issues are required for two cases in AMP5. These are for Speen groundwater source and for Thatcham Reedbeds Special Area of Conservation (SAC). These schemes were funded under the FD.

Speen

This scheme is nearing completion. The solution of the pipeline from Theale to Crookham Common to bring water in from the Reading area to support Newbury has been completed. The revised operating protocol for implementation when the Speen licence is reduced is undergoing commissioning to confirm that it works to the satisfaction of water Operations. The pipeline installation was completed by March 2014 and the scheme commissioning and handover to Operations is due to be completed and in place by March 2015 and is on track.

Thatcham Reedbeds

The Thatcham Reedbeds scheme is to deliver a mitigation solution to protect the Thatcham Reedbeds Special Area of Conservation (SAC) which is designated under the European Habitats Directive.

The originally identified solution of mitigation through drilling of boreholes to allow for augmentation of the reedbeds underwent options appraisal and it was identified that the option had high risk of contamination due to landfill contamination in the area. All potential options were reviewed and the option selected for implementation was development of an abstraction from the River Kennet. The preferred option has been agreed with the Environment Agency and Natural England and is being progressed by the Thames Water Capital Delivery team.

The scheme has progressed to detailed design phase and negotiations have been held with the local stakeholders to establish access for installation and to agree ownership and operation when the scheme is completed. Commencement of scheme installation has been delayed due to the site being extensively flooded following the exceptional rainfall of the winter of 2013/14 and is now scheduled for July–September 2014 with completion by the end of October 2014.

Axford and Ogbourne

A licence reduction is also required at our Axford source in SWOX in order to mitigate potential adverse environmental impact on the River Kennet SSSI. This option was not funded in the FD. The scheme will also require closure of the Ogbourne source following an investigation and options appraisal into the Ogbourne abstraction. The scheme was due to be funded through the payment of compensation through the Environment Agency's abstraction charging scheme. However, the mechanism for funding of licence reductions for sustainability reasons has recently changed so that in future schemes will be funded through the price review process. This was affirmed when the Water Act 2013 gained Royal Assent in May 2014. This change to the means of funding the schemes has meant that the scheme did not commence as expected in 2013. However Thames Water has included the project in its Business Plan and is expecting funding to be approved by Ofwat. Thames Water has completed network modelling and outline design work and developed a provisional programme and best estimate of cost. Thames Water has also now committed to detailed design and site investigations to enable scheme construction to commence in summer 2015 with completion scheduled for the end of 2016.

Investigations
AMP5 Investigations

A number of investigations have been undertaken in the AMP5 period, these are shown in Table 1.

The investigations are for Lower Thames abstraction (Lower Thames and Thames Tideway), Mousehill and Rodborough (Royal Brook), Waddon (Waddon Ponds), Pann Mill (River Wye) and Manor Road Wantage (Letcombe Brook).

The investigation work was completed by March 2013 with indicative results for potential sustainability reductions available by August 2012 to feed in to the draft WRMP14. The final reporting for all the investigations was completed by 2013/14 or earlier. The investigations into Lower Thames abstraction, Waddon (Waddon Ponds), Pann Mill (River Wye) and Manor Road Wantage (Letcombe Brook) led to the requirement for options appraisals to be undertaken.

AMP5 Options Appraisals

In addition a number of options appraisals were required in the AMP5 period following investigations in AMP4 or AMP3. These are at Ogbourne (River Og), Farmoor (Oxford Watercourses), Orpington and North Orpington (River Cray), New Gauge on the River Lee (Amwell Magna Loop), Childrey Warren (Letcombe Brook). The Environment Agency requires completion of these options appraisals but they have not been funded.

Thames Water is undertaking these options appraisals and they were either completed in March 2013 or later in 2013. The only exception is at Childrey Warren because of the need for prior investigation in AMP5 as outlined above and this options appraisal will be completed in 2014.

The Environment Agency has also requested that Thames Water complete options appraisals for Pann Mill and Waddon following completion of the AMP5 investigations. The Pann Mill options appraisal will be completed in 2014. The Waddon options appraisal will be deferred to AMP6 following identification by the EA of further work required to jointly investigate the impact of Thames Water's Waddon abstraction in conjunction with Sutton and East Surrey's investigation into the impact of their abstractions in the area.

Drought Permit Baseline Monitoring

Thames Water has undertaken a programme of monitoring of ecology and hydrology to provide baseline information to support its Drought Permit Environmental Reports. These reports are an underpinning source of information for Thames Water's Drought Plan and provide the essential information to understand the impact of the Drought Permit options that feature as supply-side options in our Plan. The 2013 monitoring programme was completed and reported by the end of 2013/14 and further monitoring will be undertaken during 2014.

Table 32: RSAP Investigations in AMP5

Investigation Name	**River or Water Body**	**Completion Date**	**WRZ**	**EA Region**
Lower Thames	River Thames and Thames Tideway	31/03/2013 **Complete**	London	Thames
Waddon	Waddon Ponds	31/03/2013 **Complete**	London	Thames
Mousehill & Rodborough	Royal Brook	31/03/2013 **Complete**	Guildford	Thames
Pann Mill	River Wye	31/03/2013 **Complete**	Slough/ Wycombe/ Aylesbury	Thames
Manor Road, Wantage	Letcombe Brook	31/03/2013 **Complete**	SWOX	Thames
Options Appraisal	**River or Water Body**	**Completion Date**	**WRZ**	**EA Region**
Ogbourne	River Og	31/03/2013 **Complete**	SWOX	Thames
Farmoor	Oxford Watercourses	30/10/2013 **Complete**	SWOX	Thames
Orpington & North Orpington	River Cray	31/07/2013 **Complete**	London	Southern
River Lee at New Gauge	Amwell Magna Loop	30/09/2013 **Complete**	London	Thames
Childrey Warren	Letcombe Brook	31/03/2015 **Ongoing**	SWOX	Thames
Pann Mill	River Wye	31/03/2015 **Ongoing**	Slough/ Wycombe/ Aylesbury	Thames
Waddon	Waddon Ponds	31/03/2015 **Deferred to AMP6**	London	Thames

Appendix 7: Estimation of Dry Year Demand

As in previous years, Dry Year demand (both AA and CP) has been derived using analysis of the impact on demand of a range of weather scenarios using long-term validated weather data from the Met Office. Models of how demand varies as a function of weather have been developed and calibrated using a number of years of weather and demand data. The models explain the weather dependent variability of both usage and leakage. The models have been levelled to match measured distribution input (DI) from 01/04/2013 to 31/03/2014 and used to estimate the amount of demand attributable to the prevailing weather conditions in 2013/14.

Overall, the performance of the models in 2013/14 has been very good (as evidenced in Appendix 8). There are two aspects of the dry-year calculations that are worth of note this year:

- Correction of spurious weather data received for London during the peak-week in July 2013. These are detailed in Appendix 9.
- Improvements to the way that variations in underlying demand (due to holiday absence) are modelled. These are detailed in Appendix 10.

Figure 4 shows the London annual average (AA) demand risk curve levelled to the DI observed in 2013/14. The curve shows the relative position of the overall demand as modelled based on weather data from the last 66 years. London DI for 2013/14 has been just above the normal year, and below the dry, being ranked 35th of the 66 available years in terms of average demand. Normal and dry year demands are highlighted in green and yellow respectively.

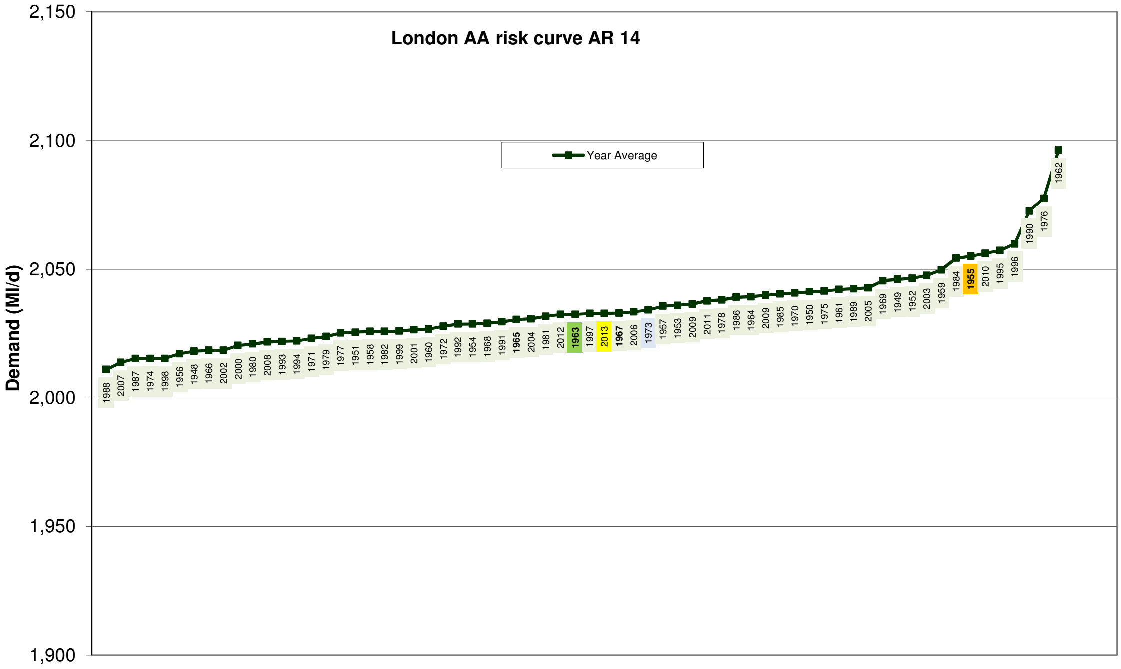


Figure 4: London annual average risk curve

Figure 5 below shows how 2013/14 (labelled 2013) ranked in terms of leakage and usage. The ranking of 2013 in terms of usage and leakage can be seen to be quite different (48th and 17th of 66 respectively). This reflects the relatively dry summer and mild winter conditions. On balance, the increase in usage during the summer had a marginally greater impact on the Annual Average DI than the supressed winter leakage, resulting in the overall AA position for DI shown in Figure 4.

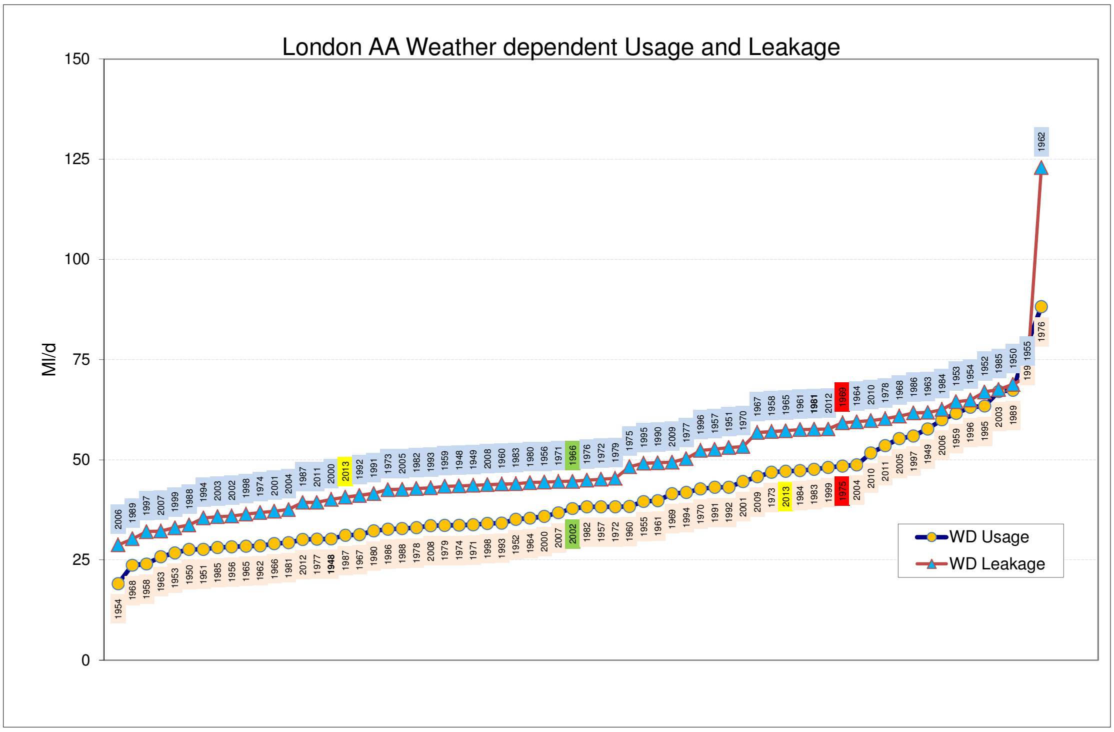


Figure 5: London annual average risk curve split into Leakage and Usage

The equivalent AA risk curve for the Thames Valley (including the Critical Period), is shown in Figure 6. Thames Valley's modelled AA for 2013/14 is ranked 31st of the 46 available years. The peak week occurred in July and was above both the 1 in 10 and in the 1 in 2 year coming in 44th of the 46 available years. This plot shows a similar pattern to that from London however, the influence of leakage on DI is less pronounced in the TV hence the AA is more dependent on the relative severity of the weather in the summer months.

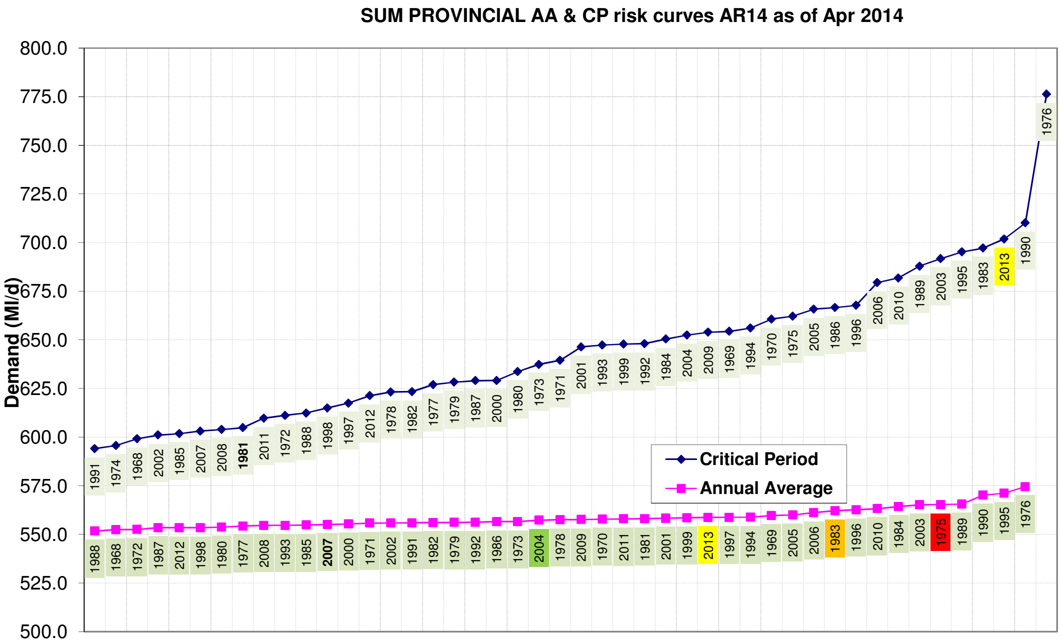


Figure 6: Thames Valley demand risk curve for Annual Average and Critical Period

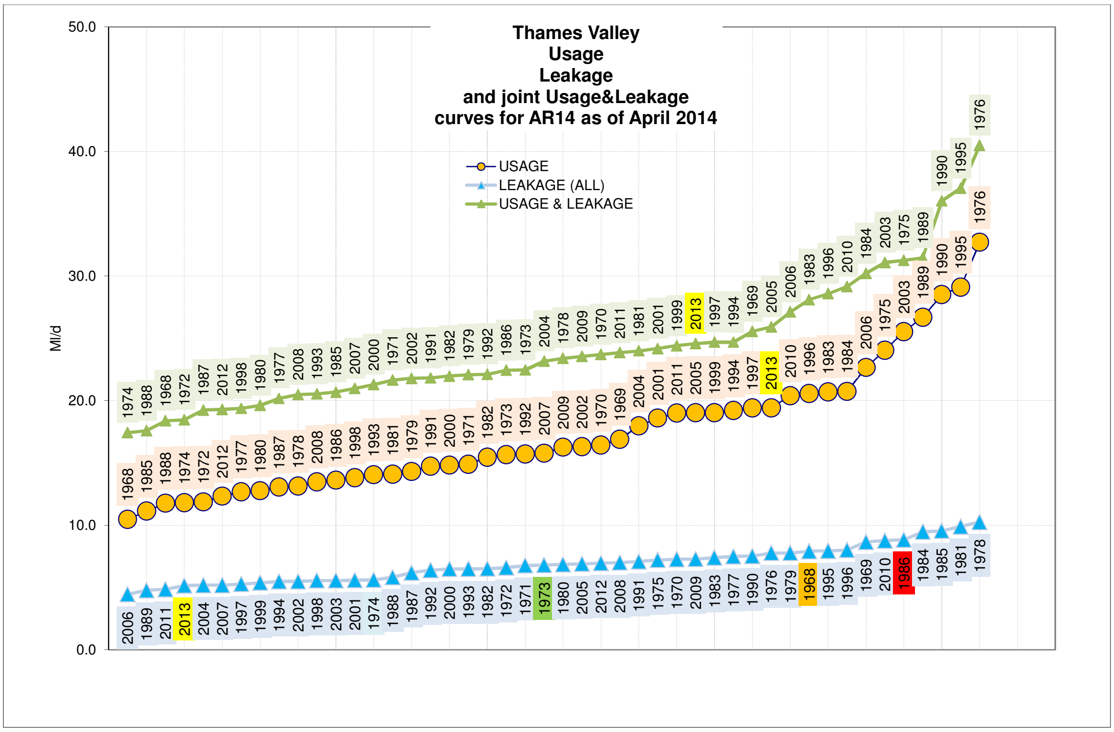


Figure 7: Thames Valley Annual Average usage and leakage risk curves

Appendix 8: Validation of "Dry Year" Uplift Method for Dry Year Demand Estimates

We have continued to track and monitor the performance of the weather sensitive model. Figure 8 and Figure 9 show comparisons of modelled and observed demand in London and the Thames Valley respectively.

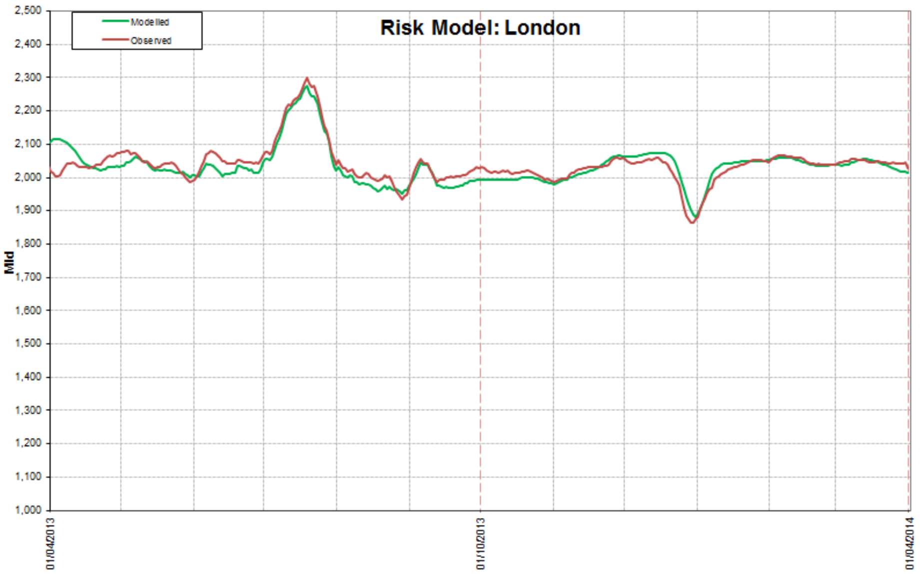


Figure 8 : Plot of modelled and observed DI for London 2013/14

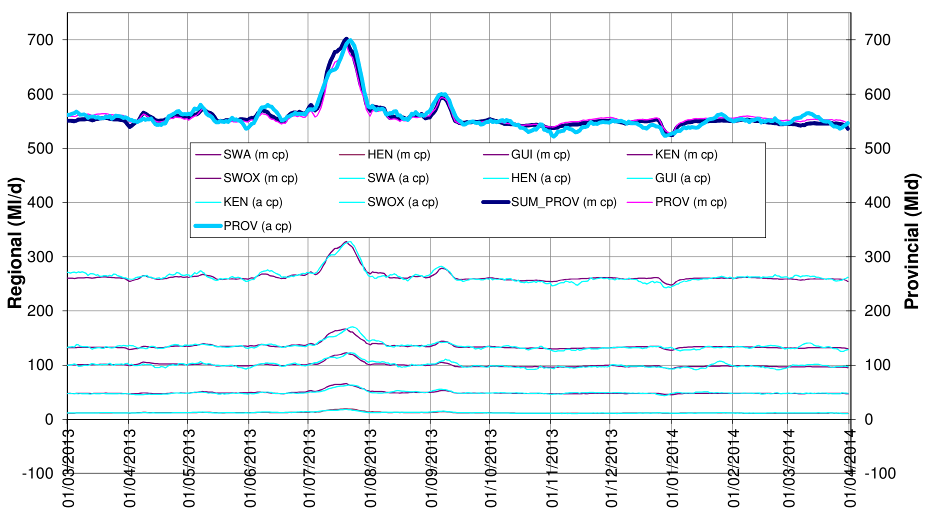


Figure 9: Plot of modelled and observed DI for Provincial regions 2013/14

Year-on-year, we monitor the ability of the model to explain the variability in demand by plotting the gradient of the best-fit line regressed onto the actual from the model (the “m” component of the linear regression of observed demand to modelled demand). The plot for London is shown below in Figure 10: The dip at 2006 shows evidence of observed demand being constrained (rising slow than usual) because of the impact of the hosepipe ban. Restrictions were also in place for part of 2012. Although the summer was very wet 2012 exhibits a similar dip to 2006. Last year we highlighted the difficulties associated with interpreting demand in 2012/13 and presented alternative interpretations (constrained/unconstrained) of the year. This year, given that modelled and observed demand has fallen back in line, we return to the standard dry-year reporting methodology.

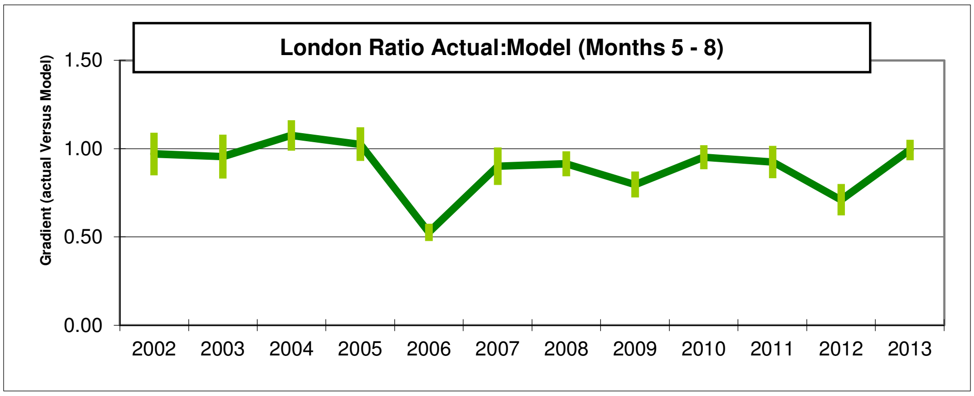


Figure 10: Year-on-year performance of modelled compared to observed demand in London

Two years ago we disaggregated the modelling of demand in the Provincial area into a family of models, one for each of the Provincial water resource zones. This was done to improve our ability to model the spatial sensitivity of demand to regional rainfall patterns. During this process we developed a “RADAR” plot of the peakiness (the ratio of CP:AA) for each resource zone to help present a number of aspects of the characteristics of areas and the prevailing weather conditions in each area over time.

Figure 11 shows a comparison of the RADAR plots for both observed and modelled time series for the Provincial sub-regions. The equivalent plots to Figure 10 for the Provincial areas are shown miniaturised around the RADAR plot of modelled response for the Provincial sub regions.

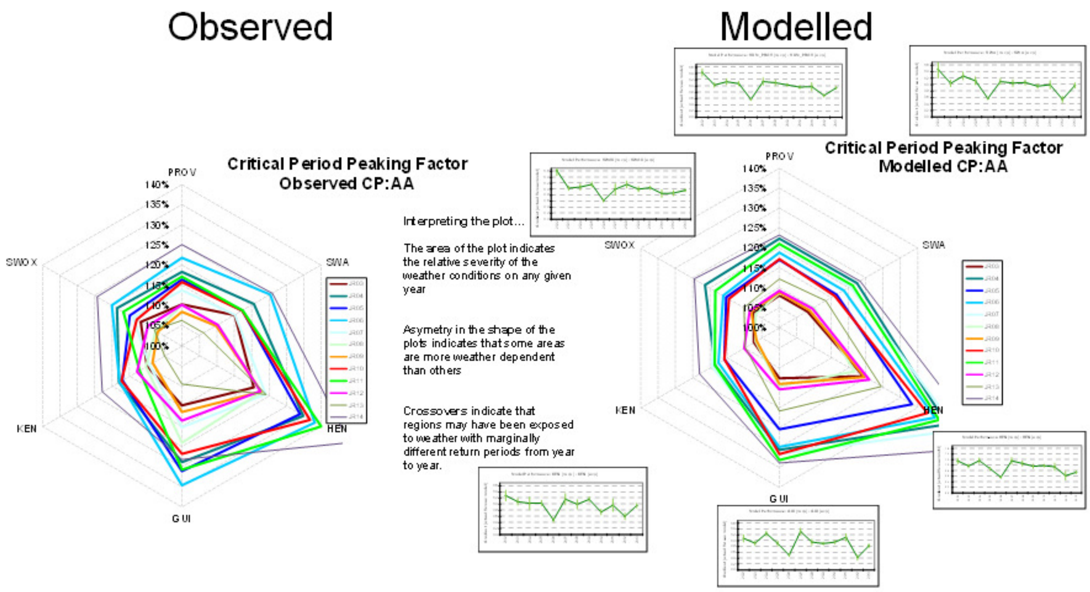


Figure 11: Year-on-year performance of modelled compared to observed demand in Thames Valley WRZs

The time-series plots of model performance surrounding the modelled RADAR plot show the same overall message as described in the previous section for Figure 10. The models show year-on-year consistency in their ability to track changes in the observed demand with 2006 and in most cases, 2012 standing out as exceptions that can be attributed to demand restrictions being in place during that year.

The RADAR plots of observed and modelled ratio of CP:AA broadly agree in terms of the relative peakiness of the zones (based on the overall shape of the polygons) and the severity of the years (the size of the polygon for each year). There are some interesting deviations in shape (both between modelled and observed, and from year-to-year on the observed. We will continue to investigate what these discrepancies may be telling us about the weather and the regions and the models.

Appendix 9: Significant Errors in the Reported Rainfall Data for London

During the peak-week, the model in London significantly under-reported demand by as much as 100 Ml/d. Figure 12 shows a plot of the measured and modelled demand. On closer inspection, the demand in the model was clipped on the 12th July because of a reported rainfall figure of 6.6 mm for the day. The model performance was being closely monitored during that week because demand was reaching peak.

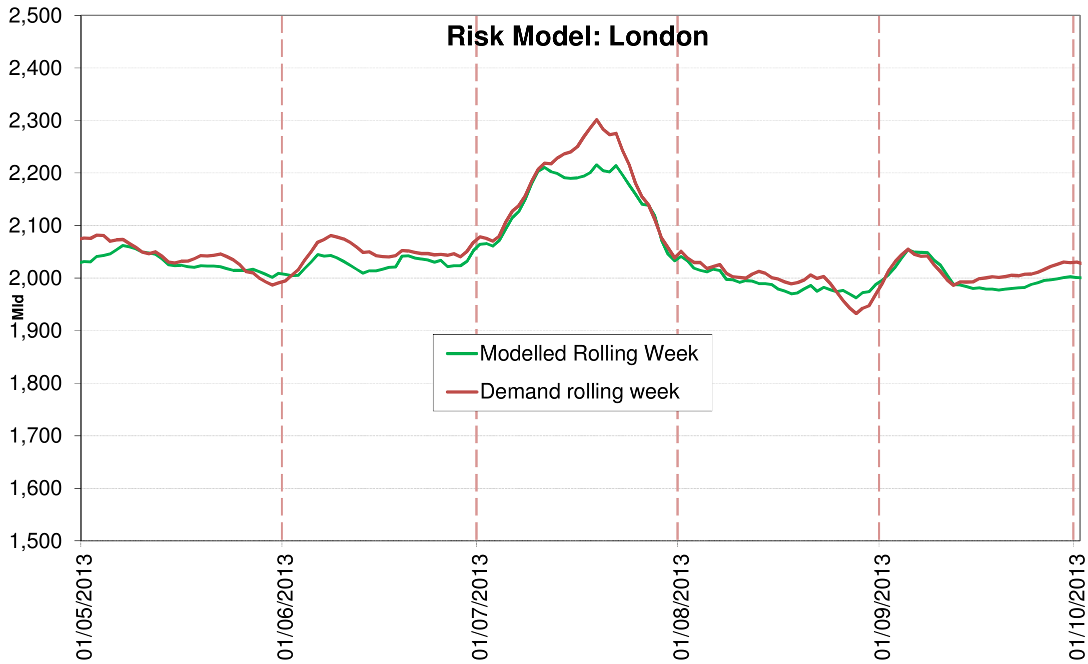


Figure 12: Modelling error during the CP in London due to erroneous rainfall data

Because we were monitoring the performance closely the deviation was caught as it happened and our own experience of the weather made us suspect the accuracy of the reported rainfall figure. We contacted the data providers who looked into the days and data in question. Our technical contact came back with the following response:

> *"I've done some investigating and it turns out that the Central London weather station that gave the 6.6mm rainfall reading on July 12th is St James's Park. This was confirmed by my meteorologists as a definite false reading and the equipment is being checked since that day.*
>
> *The July 16th reading of 2.6mm is also spurious but the cause is a little bit harder to explain so I will allow your account manager to get back to you on Monday with some clarification."*

When the rainfall figures for the 12th and 16th of July were corrected (to zero) the modelled demand aligned very well with the observed levels as shown in Figure 13.

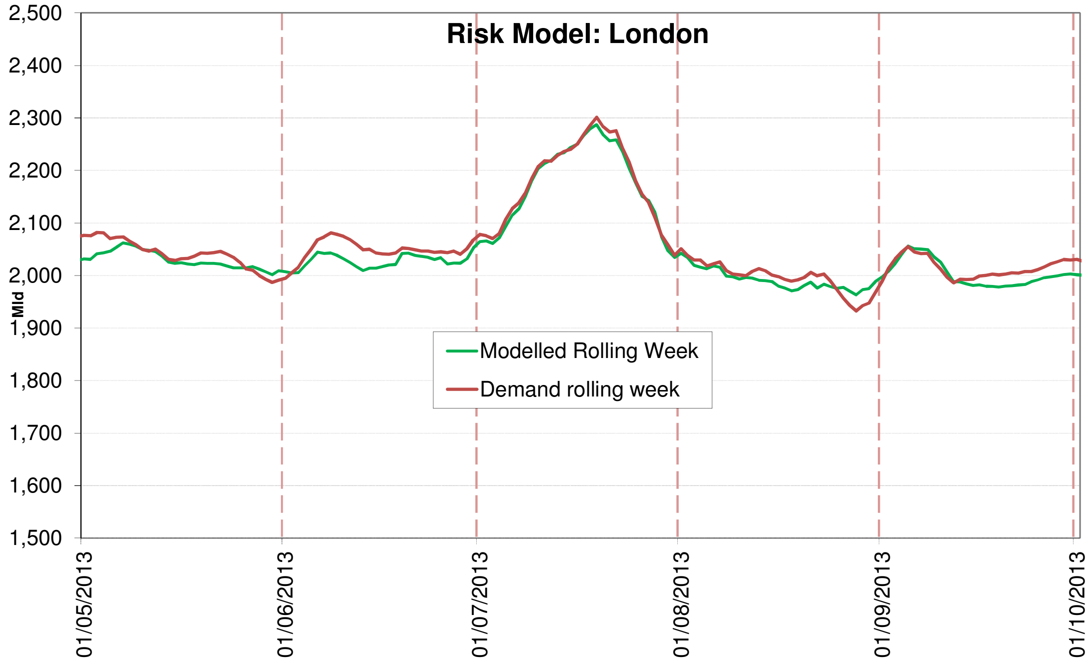


Figure 13: Modelling error during the CP in London using corrected rainfall data