PR14 reconciliations

Data table commentary and relevant IAP actions

Severn Trent
12 July 2019

WONDERFUL ON TAP

SEVERN TRENT

Contents

Commercially or security sensitive information has been redacted from this version of the commentary.

1. Responding to IAP actions

This document provides further commentary on our PR14 reconciliations data table submission which we have structured thematically. It also responds to a number of relevant initial assessment of business plan (IAP) actions. These are highlighted throughout the document and also summarised in the table below.

Action	Page
SVE.PD.A1 – "PR14 Land sales: The company should provide additional evidence to support the forecast trajectory reported in table App9"	28
SVE.PD.A2a/b/c – "PR14 Outcome delivery incentives: Severn Trent Water is required to provide a clear explanation of how the values in App27 have been calculated"	7,11
SVE.PD.A2d – "PR14 Outcome delivery incentives: Severn Trent Water is required to provide a clear explanation of how the values in App27 have been calculated in particular the payments for performance commitment 'customers rating our services as good value for money' (S-B1 and W-C1) for Severn Trent in 2018-19 and 2019-20"	10
SVE.PD.A2e - "PR14 Outcome delivery incentives: Severn Trent Water is required to provide a clear explanation of how the values in App27 have been calculated in particular the payments for 'A1: discoloured water contacts' performance commitment for Dee Valley Water"	11
SVE.PD.A2f – "PR14 Outcome delivery incentives: 'W-A3 Asset stewardship – number of sites with coliform failures (WTWs)': the company needs to include the underperformance payment for 2017-18 that is included in the annual performance report in its App27 table."	11
SVE.PD.A2g - "Severn Trent Water is required to update its forecast for 2019-20 performance to take account of the actual 2018-19 performance for all its performance commitments. We expect the company to pay particular focus where we found the evidence provided in its business plan for the 2018-20 forecasts to be insufficient which was for: [list]"	12
SVE.PD.A3a - "PR14 Residential retail: The company should clarify what the correct value is in table R9 for actual number of wastewater-only customer in 2017-2018."	29
SVE.PD.A3b – "PR14 Residential retail: The company should provide further evidence to support its forecasts for unmetered wastewater-only customers in 2018-2019 and 2019-2020."	29
SVE.PD.A3c – "PR14 Residential retail: The company should provide further evidence to support its forecasts for metered water customers in 2018-2019 and 2019-2020."	29
SVE.PD.A3d – "PR14 Residential retail: The company should provide further evidence to support its forecasts for metered water and wastewater customers in 2018-2019."	29
SVE.PD.A4 – "PR14 Service incentive mechanism: The company should provide more evidence to support the forecast trajectory in table R10."	22

SVE.PD.A5a – "PR14 Totex: The company should amend the PR14 final determination controls and targets data in tables WS15/WWS15 in order for it to match the values agreed with Ofwat."	31
SVE.PD.A5.b – "PR14 Totex: The company should provide more detailed and numerically sound explanation of its forecasted totex for years 2018-2019 and 2019-2020. It should also either re-submit the model without the changes made to cells L97-98, M97-98, N97-98, P97-08; or alternatively it should provide a credible explanation of why it has used a hard-coded value, rather than the formula."	31
SVE.PD.A6 – "PR14 Wholesale revenue forecasting incentive mechanism: The company should use consistent values for the 2018-19 and 2019-20 wastewater recovered revenue values in its model and business plan table WWS13."	32
SVE.PD.A7 – "PR14 reconciliations: Further to the actions we have set out to address our concerns over the evidence provided in its business plan for the individual reconciliations, we will require the company to refresh all of its PR14 reconciliations to replace its 2018-19 forecast performance with 2018-19 actual performance and update the evidence for its forecast 2019-20 performance taking into account of the actual 2018-19 performance."	5

2. Summary of PR14 reconciliation adjustments for Severn Trent England (SVE)

In the Draft Determination (DD), Ofwat identified the following action:

SVE.PD.A7 – "PR14 reconciliations: Further to the actions we have set out to address our concerns over the evidence provided in its business plan for the individual reconciliations, we will require the company to refresh all of its PR14 reconciliations to replace its 2018-19 forecast performance with 2018-19 actual performance and update the evidence for its forecast 2019-20 performance taking into account of the actual 2018-19 performance."

We have updated the PR14 reconciliations for 2018-19 actual performance and updated 2019-20 forecast performance in line with our budget forecast. The following table summarises the adjustments and changes from our plan submission.

	Business plan submission		July update		Variance to business plan	
£m	**RCV**	**Revenue**	**RCV**	**Revenue**	**RCV**	**Revenue**
ODI	-	120.4	REDACTED	REDACTED	REDACTED	REDACTED
Totex Sharing	(111.4)	4.0	(70.2)	14.2	41.2	10.2
WRFIM	-	(35.1)	-	(24.2)	-	10.9
Retail True-Up	-	1.2	-	(7.5)	-	(8.6)
Land	(19.3)	-	(25.6)	-	(6.3)	-
PR09 Legacy	(141.1)	(5.6)	(139.5)	(5.5)	1.6	0.1

Except for the WRFIM model, which Ofwat has modified to accommodate the border variation, we have had to make some adjustments to the totex and residential revenue reconciliation models to ensure the models correctly calculate the rewards and penalties as a result of the border variation. The following changes to the models for the border variation have been made:

- Totex menu model – the 'Additional income (applied at the FD)' lines in rows 97 and 98 of the 'Calcs' sheet have been overwritten with the values determined for the counterfactual companies at PR14. We explain the reason for this further below under 'Totex menu reconciliation'.
- Residential retail revenue model – additional inputs and calculations have been added to the 'Inputs' and 'Calcs' sheets to enable the model to apply separate modification factors to customers in the areas formerly served by each of the legacy companies.

3. Counterfactual cross checks

As we did for the business plan submission, we have created the counterfactual reconciliations to demonstrate that in aggregate the rewards and penalties would have materially been the same as if the border variation had not taken place. The table below summaries the reconciliation adjustments for SVE and Hafren Dyfrdwy (HDD) compared to the counterfactual companies - Severn Trent (SVT) and Dee Valley (DVW).

Reconciliation adjustments	Counterfactual			Factual			Diff
	SVT	DVW	Total	STE	HDC	Total	
PR09 Legacy							
Water: RCV	10.9	(0.3)	10.6	10.7	(0.1)	10.6	(0.0)
Water: Revenue	(7.3)	0.1	(7.2)	(7.2)	0.0	(7.2)	0.0
Waste: RCV	1.0	-	1.0	1.0	0.0	1.0	0.0
Waste: Revenue	1.7	-	1.7	1.7	0.0	1.7	(0.0)
Water: CIS inflation	(70.7)	(1.9)	(72.6)	(71.3)	(1.3)	(72.6)	-
Waste: CIS inflation	(79.9)	-	(79.9)	(79.9)	(0.0)	(79.9)	-
Adjustment to RCV from disposal of land							
Water: Land	(10.4)	-	(10.4)	(10.4)	(0.0)	(10.4)	-
Waste: Land	(15.3)	-	(15.3)	(15.3)	(0.0)	(15.3)	-
Outcome delivery incentive reconciliation adjustments to be applied at PR19							
ODI in-period revenue	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	(0.4)
ODI end of period revenue	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	0.0
ODI end of period RCV	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	(0.1)
Wholesale total expenditure outperformance sharing							
Water: Totex revenue	33.7	(0.5)	33.2	34.4	(0.8)	33.7	0.4
Water: Totex RCV	125.3	0.1	126.3	127.8	(1.7)	126.1	(0.2)
Waste: Totex revenue	(20.2)	-	(20.2)	(20.3)	(0.0)	(20.3)	(0.0)
Waste: Totex RCV	(199.0)	-	(199.0)	(198.0)	(1.0)	(199.0)	(0.0)
Wholesale revenue forecasting incentive mechanism							
Water: WRFIM	(15.6)	6.9	(8.7)	(11.5)	2.1	(9.4)	(0.8)
Waste: WRFIM	(13.1)	-	(13.1)	(12.7)	0.4	(12.3)	0.8
Reconciliation of household retail revenue							
Residential retail	(8.0)	0.0	(8.0)	(7.5)	(0.5)	(8.0)	(0.0)
Total incentives and penalties	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	REDACTED	(0.3)

There are a few areas where our approach has resulted in more than £1k compared to the counterfactual. We discuss these further below:

1. Totex revenue and RCV adjustments: We have calculated a weighted average PAYG rate for HDD based on DVW and SVT, which results in a slightly higher allocation of the totex adjustment to revenue (+£392k) and

a lower allocation to RCV (-£271k). Overall there is a net increase of £18k for water. This is balanced by slightly lower values for both revenue and the RCV for waste (-£6k in total).

2. WRFIM adjustment: Compared to the counterfactual, there is a positive movement of +£80k for water, which is offset by an equal negative movement for waste. The differences arise due to the base revenue figures for 2018-19 following the variation being based on the allowed revenue in the PR14 Ofwat financial model. These are different from those that would result from the application of PR14 K factors because the PR14 calculation of K was not consistent with the construction of the price limit within the licence.
3. ODIs: The separation of performance targets and restatement of historical data for low pressure results in a difference of £0.41m between SVE and HDD and the counterfactuals. A full reconciliation of the cross check to the counterfactuals has been set out in section 4 Outcomes.

4. Outcomes

IAP actions relating to App27

SVE.PD.A2a/b/c - PR14 Outcome delivery incentives: Severn Trent Water is required to provide a clear explanation of how the values in App27 have been calculated

As a company with in period ODIs (including part deferrals of the rewards) and which has had incentive rates and targets reallocated for the border variation, we recognise that the reconciliation between APR table 3A, App5 and App27 will not be as straightforward and transparent as it will for other companies. We have therefore set out below the approach we have taken to determine the values that have been submitted in App27.

AMP6 annual performance

The annual reported values in App27 have been sourced from APR table 3A for years 2015-16 to 2018-19 and from App5 for 2019-20. For the first three years of the AMP, where Ofwat has made an in period determination, we have shown the actual amounts that were determined by Ofwat in each of the determinations.

SVE	2015-16	2016-17	2017-18	2018-19	2019-20	Total
ODI performance 2015 - 2020						
Table 3A						
Summary						
Actual performance 2015-16 to 2018-19 (APR table 3A)						
Water in period	0.055	-0.767	-29.915	-5.340		-35.967
Water end of period revenue	0.000	0.000	0.000	-0.036		-0.036
Water end of period RCV	0.000	0.000	-0.463	-3.704		-4.167
Waste in period	19.767	41.039	88.206	3.388		152.400
Waste end of period revenue	0.000	0.000	0.000	2.389		2.389
Waste end of period RCV	0.000	0.000	0.000	0.000		0.000
Total	19.823	40.272	57.828	-3.303		114.620
Check	0.000	0.000	0.000	0.000		
Company in period ODI claim (will all be allocated to SVE up to 2017-18)						
Water in period - SVE	-0.981	-1.628	-22.635			-25.243
Waste in period - SVE	19.767	40.016	87.815			147.598
Water in period - HDD			-0.170			
Waste in period - HDD			0.391			
Total	18.786	38.388	65.401			122.575
Ofwat in period final determination (will all be allocated to SVE up to 2017-18)						
Water in period - SVE	-0.981	-1.628	-29.558			-32.167
Waste in period - SVE	19.767	39.994	87.816			147.577
Water in period - HDD			-0.172			
Waste in period - HDD			0.388			
Total	18.786	38.366	58.474			115.626
Table App5						
Summary						
App5 forecast performance						
Water in period				-5.340		
Water end of period revenue				-0.036		
Water end of period RCV				-3.704		
Waste in period				3.388		
Waste end of period revenue				2.389		
Waste end of period RCV				0.000		
Total				-3.303		
Check to 3A/ App5				0.000		
Total ODI performance - 2015-2020						
Water in period	-0.981	-1.628	-29.730	-5.340		
Water end of period revenue	0.000	0.000	0.000	-0.036		
Water end of period RCV	0.000	0.000	-0.463	-3.704		
Waste in period	19.767	39.994	88.204	3.388		
Waste end of period revenue	0.000	0.000	0.000	2.389		
Waste end of period RCV	0.000	0.000	0.000	0.000		
Total	18.786	38.366	58.011	-3.303		

REDACTED

AMP6 total performance to be applied at PR19

For the 'Total to be applied at PR19' column in App27, we have calculated the rewards and penalties on the amounts that we want to claim for at PR19. This will include deferred in period wastewater ODIs for years 2016-17 and 2017-18, in period ODIs for years 2018-19 and 2019-20 as well as end of period ODIs for the AMP.

Deferred ODIs

To reduce the impact on wastewater bills, for years 2016-17 and 2017-18 we agreed with Ofwat to defer part of the rewards on wastewater performance until PR19. For 2016-17, £27m of the £39.994m net reward was deferred and for 2017-18, £63.203m of the £87.815m net reward was deferred.

As the 2016-17 deferred payment was earned by Severn Trent before the border variation, we have allocated the deferred reward of £27m between Severn Trent and Hafren Dyfrdwy using the revenue adjustment we agreed with Ofwat as part of the NAV process.

For 2017-18, Ofwat's 2018 in-period determination allocated £62.925m of the deferred payment of £63.203m to Severn Trent, with £0.278m allocated to Hafren Dyfrdwy

We have also added an adjustment for financing to the deferred payments for both years in line with the guidance set out in Ofwat's information note (IN18/17).

SVE		2015-16	2016-17	2017-18	2018-19	2019-20	Total
ODI performance to be applied at PR19							
Deferred ODIs							
SVT Ofwat final in period final determination - Deferred outperformance payments							
Water in period		0.000	0.000				0.000
Waste in period		0.000	27.000				27.000
Total		0.0000	27.000				27.000
SVE Ofwat final in period final determination - Deferred outperformance payments							
Water in period				0.000			0.000
Waste in period				62.925			62.925
Total				62.925			62.925
SVE allocation of SVT ODIs							
Water	99.4%						
Waste	99.6%						
Ofwat final in period final determination - Deferred outperformance payments - SVE share							
Water in period		0.000	0.000	0.000			0.000
Waste in period		0.000	26.881	62.925			89.806
Total		0.000	26.881	62.925			89.806
Deferred outperformance payments - SVE share adjusted for financing							
Year payment due to be taken		2017-18	2018-19	2019-20			
Number of years to 2019-20		2	1	0			
WACC	3.6%						
Water in period		0.000	0.000	0.000			0.000
Waste in period		0.000	26.881	62.925			89.806
Total		0.000	26.881	62.925			89.806

End of period ODIs

For end of period ODIs, the net payments earned by Severn Trent and Dee Valley before the border variation have been allocated between Severn Trent and Hafren Dyfrdwy using the revenue adjustments agreed with Ofwat as part of the NAV process. This is set out below.

SVE		2015-16	2016-17	2017-18	2018-19	2019-20		Total
End of period ODIs								
SVT end of period ODI's								
Water end of period revenue		0.000	0.000	0.000				0.000
Water end of period RCV		0.000	0.000	-0.463				-0.463
Waste end of period revenue		0.000	0.000	0.000				0.000
Waste end of period RCV		0.000	0.000	0.000				0.000
SVE share of SVT end of period ODI's								
Water	99.4%							
Waste	99.6%							
Water end of period revenue		0.000	0.000	0.000				0.000
Water end of period RCV		0.000	0.000	-0.460				-0.460
Waste end of period revenue		0.000	0.000	0.000				0.000
Waste end of period RCV		0.000	0.000	0.000				0.000
DVW end of period ODI's								
Water end of period revenue		0.025	-0.008	0.021				0.038
Water end of period RCV		0.000	0.000	0.000				0.000
Waste end of period revenue								0.000
Waste end of period RCV								0.000
SVE share of DVW end of period ODI's								
Water	39.8%							
Waste								
Water end of period revenue		0.010	-0.003	0.008				0.015
Water end of period RCV		0.000	0.000	0.000				0.000
Waste end of period revenue								0.000
Waste end of period RCV								0.000

Summary of ODI performance to be applied at PR19

The table below provides a summary of the ODI amounts that we are claiming for at PR19.

SVE		2015-16	2016-17	2017-18	2018-19	
ODI performance to be applied at PR19						
Water in period		0.000	0.000	0.000	-5.340	REDACTED
Water end of period revenue		0.010	-0.003	0.008	-0.036	
Water end of period RCV		0.000	0.000	-0.460	-3.704	
Waste in period		0.000	26.881	62.925	3.388	
Waste end of period revenue		0.000	0.000	0.000	2.389	
Waste end of period RCV		0.000	0.000	0.000	0.000	
Total		0.010	26.878	62.473	-3.303	

Ofwat identified a number of other actions in relation to the reporting of outcomes in App27.

SVE.PD.A2d - PR14 Outcome delivery incentives: Severn Trent Water is required to provide a clear explanation of how the values in App27 have been calculated in particular the payments for performance commitment 'customers rating our services as good value for money' (S-B1 and W-C1) for Severn Trent in 2018-19 and 2019-20

For 2018/19 we have allocated the value for money outperformance payment between Severn Trent and Hafren Dyfrdwy. This ensure that the incentive follows those customers in Powys who have received the level of service during the year. We allocated the incentive based on the following revenue splits:

	England	Wales
Water service	99.42%	0.58%
Wastewater service	99.56%	0.44%

Subsequently, due to the wastewater cap being breached in Powys, we have removed the outperformance payment for HDD.

The measure is not recorded for HDD in 2019/20, but following the 2018/19 approach we have continued to use the above splits to forecast the outperformance payments for Severn Trent in 2019/20. As such, we are forecasting to claim £0.124m for the water service and wastewater service in 2019/20.

SVE.PD.A2e - PR14 Outcome delivery incentives: Severn Trent Water is required to provide a clear explanation of how the values in App27 have been calculated in particular the payments for 'A1: discoloured water contacts' performance commitment for Dee Valley Water

Ofwat identified an inconsistency with our calculation of the forecast ODI values for this measure (A1). We had incorrectly multiplied the value by a factor of 100, using the ODI rate per 0.01 contacts rather than per contact.

We have corrected this error both in our APR19 submission and our restated App5 tables.

SVE.PD.A2f - PR14 Outcome delivery incentives: 'W-A3 Asset stewardship – number of sites with coliform failures (WTWs)': the company needs to include the underperformance payment for 2017-18 that is included in the annual performance report in its App27 table.

Ofwat identified an inconsistency in table App27 where we have not included the £0.463m penalty for Asset Stewardship – Coliforms within the ODI penalties accrued to PR19. We have corrected this error within our reforecast App27 tables.

In the DD, Ofwat made a number of interventions in relation to the values we reported in our business plan submission of App27. We have ensured that our updated App27 aligns to the values in the DD except where we have updated 2018-19 for actual performance and 2019-20 for our latest forecast.

We also note that for action **SVE.PD.A2a**, Ofwat states that

“We are including the following figures as per the 2018 in-period determination for ‘Net performance payment / (penalty) applied to revenue for in-period ODI adjustments ~ Water network plus’ in 2012-13 prices: • 2017-18: - £29.409 million • 2018-19: £7.304 million • 2019-20: - £0.602 million These replace the following figures for this line from Severn Trent Water’s 2018 business plan submission: • 2017-18: - £23.217 million • 2018-19: £7.429 million • 2019-20: - £1.829 million The net effect of the interventions is to increase the net outperformance payment applied to revenue for in-period outcome delivery incentives for the water network plus price control from £6.515 million to £7.799 million (2017-18 FYA CPIH deflated price base). Please see published draft determination outcome delivery incentives reconciliation model for Severn Trent Water”

We do not recognise the in period ODIs net penalty for water networks of £29.409m that Ofwat has assumed for 2017-18. The net penalty as published in the 2018 ODI in-period determination for SVE was £29.558m. We have aligned App27 to the net penalty of £29.558m.

IAP actions in relation to outcome forecasts

Ofwat raised the following action in relation to outcome forecasts.

SVE.PD.A2g - "Severn Trent Water is required to update its forecast for 2019-20 performance to take account of the actual 2018-19 performance for all its performance commitments. We expect the company to pay particular focus where we found the evidence provided in its business plan for the 2018-20 forecasts to be insufficient which was for:

- W-B3: Speed of response in repairing leaks (% fixed within 24 hours)

- S-C1: Improvements in river water quality against WFD criteria

- W-B7: Customers at risk of low pressure

- W-B10: Non-delivery of the outcome of the Birmingham resilience scheme -

- S-A1: Number of internal sewer flooding incidents

- S-A2: Number of external sewer flooding incidents

- S-A3: Partnership working

- S-C4: Biodiversity

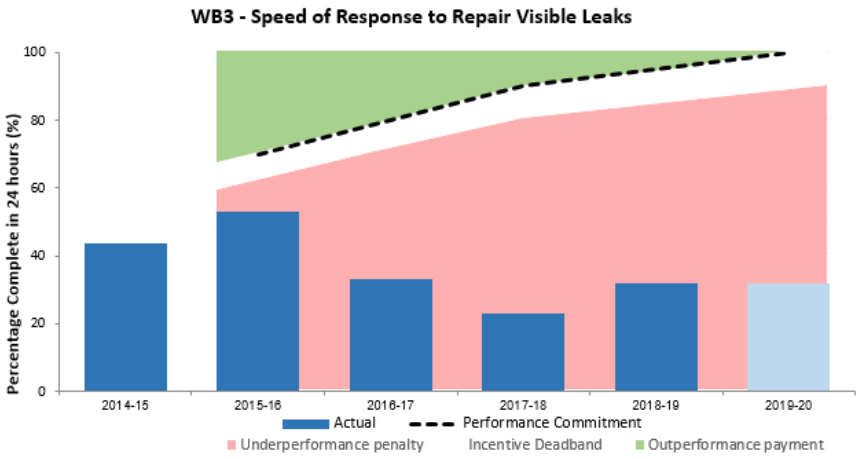
- S-C7: Overall environmental performance (basket of environmental measures)"

We discuss each commitment cited above in turn.

Speed of response in repairing leaks

We've previously reported that this measure is not delivering for our customers in the way it is intended to and it is in customers' best interests that we pay a penalty of £1.3m for our performance. As part of our plans for 2020-25 we have redesigned this measure to ensure it focuses on those leaks with the greatest impact due to their significance.

Our performance this year has improved slightly from the previous year, primarily because of the company wide drive on leakage. As part of this we increased our 'fix' resources to ensure we had more gangs working seven days a week – this had a positive impacts on the average time it takes to fix all leaks. At the same time, our new working processes which have sped up the time it takes to confirm leaks further reducing the total amount of time taken to fix them.



Looking forward, we are committed to hold performance flat through 2019/20 as we continue to focus on driving down leakage and work towards our improved measure for AMP7.

Water Framework Directive

Performance commitment S-C1: Improvements in river water quality against WFD criteria

Detailed definition of performance measure:

The number of WFD classification improvements Severn Trent Water delivers attributable to improvements in flow, with a point scored for each classification improvement.

Incentive type: Financial – reward and penalty.

Performance commitments

		Starting level	Committed performance levels				
	Unit	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
PC	No.						202

At PR14 we included our first real options mechanisms relating to the Water Framework Directive. At the time of the Final Determination (FD) our Water Industry National Environment Programme (NEP4) contained 92 defined schemes which reduced our impact on river water quality; these were classed as 'reasonably certain' within our submission. The programme ensured we contributed our fair share to deliver improvements in water classifications against the Water Framework Directive (WFD) criteria.

At the time of the FD the NEP5 obligations had still not been finalised due to the timing of the River Basin Management Plan process. So we designed the outcome delivery incentive to operate as a real option mechanism, automatically returning costs to customers where obligations were reduced or truing up the cost

of delivering a larger scale environment programme. This ensured a balance of protection between customers and the company.

Alongside the Environment Agency we designed a unique points scheme which converted the site specific NEP5 programme in to a more catchment based approached, aligning a point to a change in classification of an individual water body. For each stretch of river, as defined by the WFD, we mapped the site specific obligations to understand where completion of a single scheme will lead to an improvement in classification or where a combination of schemes was required to deliver the classification improvement. To simplify the operation we agreed an up-front average value per point of £0.75m.

At PR14 customers told us that driving improvements in our environmental impact was important to them, specifically in relation to water quality. Customers feel a strong affinity to the river ecosystem and place particular importance on its aesthetic and surroundings such as plant life and fish stocks. Our activities, in particular what we discharge to the river, can have a direct impact on this. So we designed our points system to allow us to drive further improvements above and beyond the mandatory programme where it is in the best interests of customers and the environment. Below we explain the changes to the mandatory NEP5 programme agreed following the FD and how we've taken discretionary opportunities to outperform.

Changes to the NEP5 programme

The original 202 points relates to the 'reasonable certainty' WFD programme that we assembled in 2013 for the price review. Following the FD, and as part of finalising NEP5, a series of changes to our planning assumptions led to a change in the scope of the programme. In summary these were:

- an update of some waterbody boundaries (which are integral to our point system), mainly through merging smaller units together;
- the Environment Agency issued their eutrophication weight of evidence;
- phosphate permit optimisers became available, which were far more accurate than the models used in NEP4;
- UKTAG announced revised phosphate target standards; and
- the RBMP2 river sample points were confirmed.

The NEP5 schemes were ultimately based on the more accurate information outlined above; whereas our reasonably certain programme was based on the former. The various changes made by the Environment Agency, coupled with the improved modelling tools, revealed a few significant challenges for our initial programme.

- We had included measures in PR14 list that would only improve part of a waterbody following the Environment Agency's revision of boundaries – this reduced the effectiveness of our programme in delivering the environmental benefits.
- We had set permits based on old phosphorus targets, so needed to update our programme to deliver the revised (more stringent) targets for river water concentrations.
- In some waterbodies we determined that additional schemes would be needed to ensure that enough river sample points were improved to result in a change in classification.

To overcome the issues noted above we worked collaboratively with the Environment Agency to redesign the shape of our programme for NEP5 and to deliver schemes which maximised the benefits for the river environment whilst ensuring our fair share contribution towards the WFD objectives. Through this process we also agreed the number of WFD points each scheme, or combination of schemes, would contribute towards our performance commitment.

Our revised list of mandatory schemes, confirmed by the Environment Agency in NEP5, delivered 225 WFD points against our original 'reasonably certain' programme of 202.

	2015/16	2016/17	2017/18	2018/19	2019/20
Number of schemes complete	1	4	11	28	61
Number of points delivered	0	8	16	53	148
Cumulative points	0	8	24	77	225

In addition to this, we have identified one site where we are confident the solution will deliver a greater level of improvement than initially required, leading to a tighter permit being accepted and an additional point being delivered through a further change in river water classification.

In total our NEP5 programme is delivering 226 points.

Discretionary outperformance opportunity

By working with the Environment Agency to understand the future obligations that are required to continue to meet our statutory duties in the future, we have identified a number of schemes where there is potential to deliver the obligation early through the AMP6 programme. We took the decision to explore the solutions to these schemes and began initial feasibility and design work. Once confirmed as part of the AMP6 programme the schemes are no longer considered as part of our preparations for AMP7.

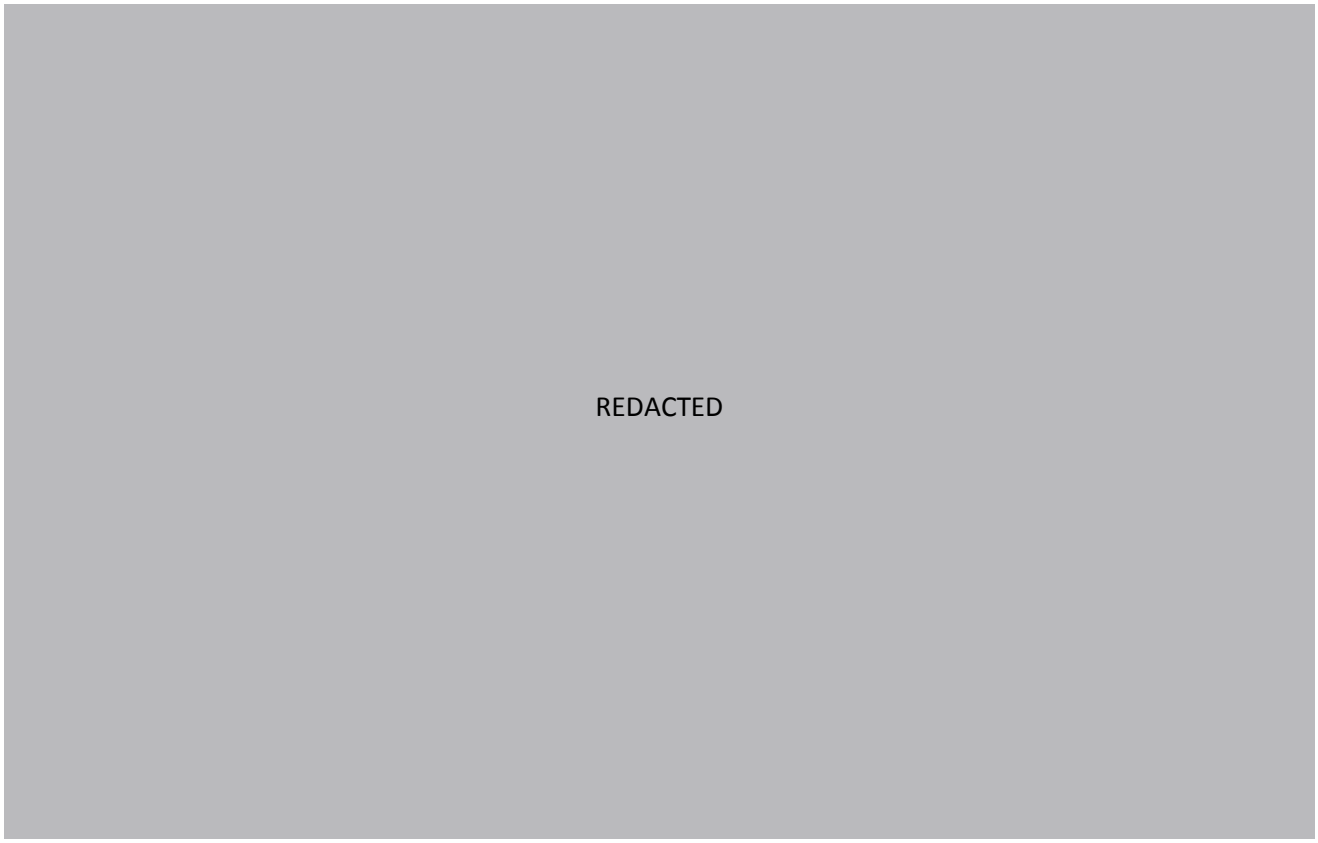
Within our forecast we have included a further 11 points where the schemes to deliver them are already promoted within our capital programme. Confirmation of delivery will be sought through the application for revised permits to discharge from the Environment Agency. We believe this is a great example of how the real options mechanisms work – incentivising us to deliver improvements earlier by accelerating capital investment where it is in the interests of customers and the environment. These schemes are:

Site	AMP7 TP limit mg/l	ODI points	Existing Process	Solution	Waterbody Name
Huntley STW	1.3	2	RBC + reed bed	Chemical dosing	Ley Brook - source to R Severn Estuary
Kempley STW	1	2	Oxidation ditch	Chemical dosing	Kempley Brook - source to River Leadon
Ripple Works STW	2.6	2	Filter works	Chemical dosing	Ripple Bk - source to River Severn
Welland STW	1.8	2	Filter works + reed bed	Chemical dosing	Bushley Longdon Brook - source to River Severn
Clive STW	2	2	Filters + reed bed	Chemical dosing	Sundorne Brook - source to River Severn
Colton STW	1.2	1	RBC + reed bed	Chemical dosing	Moreton Brook from Source to River Trent
Total		**11**			

There are further projects we are still exploring, namely one project at East Bridgeford, where we believe a solution is viable within AMP6. In June 2019 we agreed land-access rights which enable us to progress and complete the detailed design and construction of this solution. We have, therefore, included the potential ODI points associated with this project (8) within our forecast. This is another great example of where the real options mechanism has worked to deliver greater benefits for our customers and the environment much faster than the traditional route.

Within our forecast we have only included projects where the future permit tightening is well understood, and we are able to design, construct and commission the schemes within AMP6. Furthermore, there is the potential for us to deliver even greater improvements for the environment through solutions over delivering against the design and allowing us to accept tighter permit conditions than NEP5 requires. There is some risk to us by accepting permit limits beyond the design standard of the solutions we have implemented. At the same time, we cannot know with any certainty whether the solutions will out-perform until they are fully commissioned and operational.

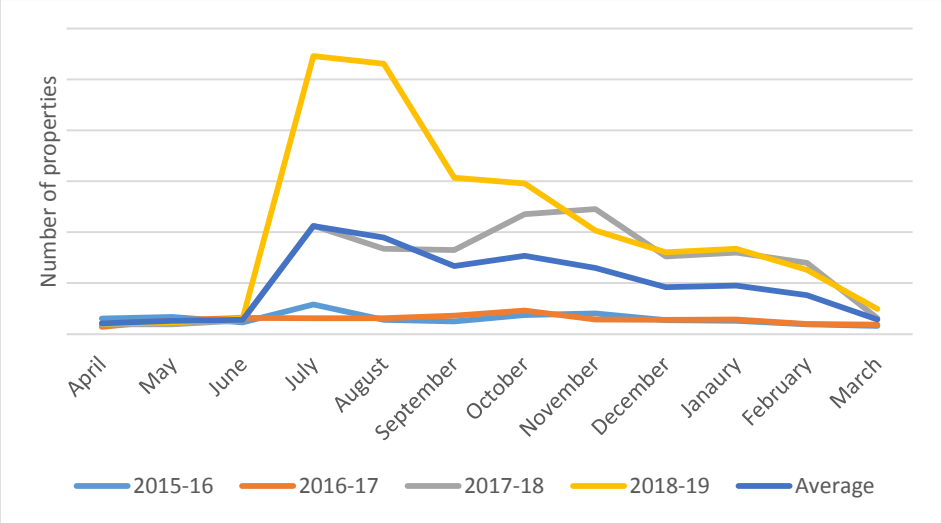
There are a further 7 potential ODI points available through outperformance of the solutions. Due to the uncertainty around these points we have not included them within the forecast.



Low pressure

Our customers have told us that issues with pressure are their most experienced service failure. Whether this is for a short, one-off period or something that occurs regularly it prevents our customers from going about their daily routine.

The profile of properties experiencing low pressure issues throughout the year was normal, however the absolute number of properties was exacerbated by the dry weather experienced in the summer of 2018. The increase in demand across the network put greater strain on some parts, leading to customers experiencing a drop in pressure. As can be seen from the chart below. The external factors impacting on low pressure during the 2017-18 and 2018-19 report years led to significant summer increases compared to 2015-16 and 2016-17.



Our historic performance demonstrates that we can deliver against this measure even when the exogenous factors lead to significant increases within the year. This gives us confidence that our solutions will enable us to continue to meet this commitment in 2019-20.

Steps to improve
Throughout the year we have completed a number of both operational and capital schemes to alleviate low pressure issues. We changed our approach to design, build and commission these solutions to reduce the end to end time to complete. This more agile approach was in part due to our move to use more tier two contractors.

Our solutions include a combination of rezoning, creating new trunk main inlets and splitting of DMAs which allows us to find and fix burst mains quicker, reducing the pressure variations further down the network.
We have also shown great collaboration across teams to find optimal solutions. We had considered a number of capital solutions to one particularly difficult scheme, but could not find an optimal solution at an acceptable cost. Instead our operational teams identified an opportunity to split the DMA and rezone the network whilst installing pressure release valves in optimal places.

Forward look
We are confident of meeting our target in 2019/20 as our analysis continues to focus on properties at future risk of low pressure. At all times we will continue to look for solutions that offer multiple benefits.

Birmingham resilience project

We have included a detailed explanation in Appendix 1.

Sewer flooding (internal and external)

This year we have locked in the improvements we've made over recent years by agreeing even tighter targets with Ofwat. This means our customers will see even greater benefits. Looking forward we are committed to hold performance relatively flat from 2018/19 with some small improvements as we continue to drive reductions in flooding for our customers.

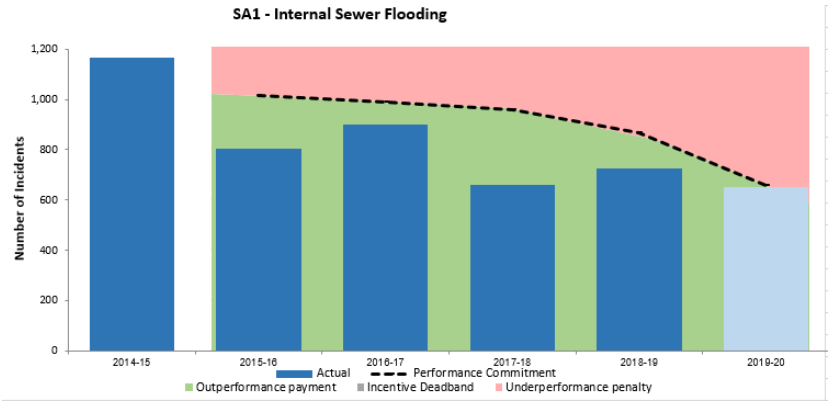
Drivers of performance

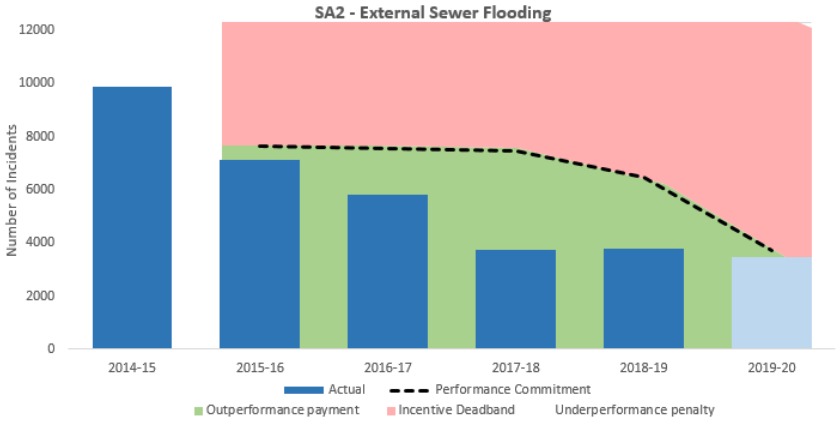
We've shown that the way we combine multiple data sources, analytics and our focus on driving performance can deliver a significant step change in performance. This year we have sought to refine and learn more about these approaches as we embed them across our wastewater services.

Our cluster analysis and prevention of repeat incidents has continued to be our key success story. By using the information available to us we are able to better understand customers who are at an increased risk of sewer flooding and proactively cleanse the network – preventing a problem before it occurs.

This approach has enabled us to maintain a balance between proactive and reactive interventions and retain our focus on the health of the underlying assets.

As can be seen from the graphs below, our performance across the AMP gives us confidence that we will achieve the forecast for 2019/20, even against the more stretching targets agreed as part of the uncapping determination.





Steps to improve

We are committed to preventing issues before they occur. By continuing to work with fast food outlets within the community we are reducing the amount of fats, oils and greases (FOG) that enter our sewers. Where our engagement doesn't work, we continue to prosecute those who misuse and abuse our network and put our customers and communities at a higher risk of external sewer flooding.

We've also successfully trialled a chemical solution to the build-up of FOG, also known as Fatbergs, in our sewer network. The chemical has been great at preventing the build of FOG in sewers and maintaining the

hydraulic capacity of the sewers. We'll continue to use this in our highest risk areas to complement our customer engagement and prevention activities.

We've also worked hard to improve our performance on sewer blockages, which indicate the underlying asset health of our wastewater network. Initiatives such as our Blockbuster campaign help ensure that customer education continues to be a primary tool in changing the behaviour of our customers to minimise the risk of sewer flooding.

Sharing best practice

Our customers and the environment are benefitting from the improvements we have made in recent years. We want to share what we have learnt with other water companies so that all customers get to see these benefits. Ofwat also think it is important for us to do this.

So far we have:

- met with other water companies to share experiences;
- presented to the 'Fighting a Fatberg Conference' in February 2019 on our approach to dealing with Fats, Oils and Greases being discharged from commercial premises;
- presented to the Urban Drainage Group Autumn Conference on our approach to partnership working; and
- presented our strategy and approach to the industry experts, the Sewerage Infrastructure Network.

Partnership working

Detailed definition of performance measure:

The number of projects where Severn Trent Water works in collaboration with other recognised public and not-for-profit organisations to help drive wider benefits for the community, in terms of reducing flooding, reportable on a financial year basis.

Incentive type: Financial – reward and penalty.

Performance commitments

	Unit	Starting level	Committed performance levels				
		2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
PC	No.	7					21

The ODI is based on an individual scheme being completed. Within the FD it, along with a number of other PCs, had the incentive rate stated as "per year" instead of over the AMP which we consider left some ambiguity (albeit we recognise this was presentational since the different presentation of the incentive rate was not listed as an intervention in the DD or FD documentation). As such we included within our APR15 document our understanding of the intention of the incentive rate, based on the PR14 plan submission, and our intention of how we would use the rate to claim any outperformance. The extract below is from our APR15 document.

SA3 – Partnership working

Our customers support us working in partnership with stakeholders to address flooding issues of mutual concern.

This PC is defined as the number of projects where we work in collaboration with other recognised public and not-for-profit organisations to help drive wider benefits for the community, in terms of reducing flooding.

Our committed performance level is to deliver 21 partnership schemes by 2019/20; there are no annual targets. It has both financial rewards and penalties applied on the basis of the total number of completed projects delivered by 2019/20.

In our Final Determination, the incentive rate is expressed per year. However, as indicated in our business plan the intention was that five years' worth of penalty or reward would be applicable for any under or over performance. We have informed our external assurance providers, the Water Forum and Ofwat of our understanding and intention.

Our commitment for the AMP is to deliver 21 partnership schemes. To date we have completed 13 schemes through a variety of partnership and solutions as explained below:

1. Newark - alongside Nottinghamshire County Council to reduce flood risk to 10 properties from sewer flooding, surface water flooding and flooding from highway drains;
2. Kenilworth - with Warwickshire Highways and Warwickshire County Council to reduce flood risk to 10 properties from sewer flooding, surface water flooding and flooding from highway drains;
3. Hucknall - with Nottinghamshire County Council and Ashfield District Council to reduce flood risk to 11 properties from fluvial flooding, surface water flooding and sewer flooding;
4. Codsall - in partnership with Staffordshire County Council to reduce flood risk to 33 properties from sewer flooding and surface water flooding;
5. Normanton - with Leicestershire County Highways, Leicestershire County Council and Anglian Water to reduce flood risk to 11 properties from sewer flooding, surface water flooding and flooding from highway drains;
6. Heanor - with Derbyshire County Council Highways to reduce flood risk to 27 properties from sewer flooding, surface water
7. Hanley, Stoke on Trent – during repaving of the Hanley area of Stoke, an increase in storm water run-off would be diverted to the combined sewer which did not have the spare capacity to accept it. Working with Stoke on Trent City Council, we developed a surface water management strategy that enable the repaving work to continue whilst reducing the flood risk to ten commercial properties.
8. Hagley, Worcestershire – There was significant customer and local MP concern about multiple flooding problems in Hagley. The project completed jointly with Worcestershire City Council, Wyre Forest District Council and the Environment Agency. It alleviates combined sewer flooding at 14 properties and 3 areas at risk of highway flooding.
9. Chesholme Road, Coventry – Joint scheme with Coventry City Council to address a long standing complex flooding issue affecting 14 properties. This innovative scheme delivered by multiple partners over different phases included surface water separation, property flood resilience measure, underground storage tanks and above ground grassed swale.
10. Badsey Brook, Broadway, Worcestershire – The scheme consists of a £4million flood storage area in an 18 acre field holding up to 135,000m3 of flood water delivering reduced flood risk to over 250 properties. The Environment Agency delivered scheme also delivered benefits in terms of reduce risk of flooding from the sewer, increased resilience of our sewer system and treatment works, and reduction in the size and cost of future work on the sewerage system.

11. Carisbrooke Road, Leicester – Joint scheme with Leicester City Council to reduce risk to a high profile flooding location. Property flood resilience measures (such as flood doors and flood gates) installed at 9 properties. Jointly funded by Severn Trent and Leicester City Council.
12. Slimbridge, Gloucestershire – Joint scheme with Gloucestershire County Council to address a persistent and complex flooding location. Together the different elements of the scheme reduce risk of flooding to 14 properties and 5 areas. Innovative scheme involving removing infiltration from the sewers by flood grouting, lining, replacement and sealing; replace and repair highway drainage and culverted watercourse; and separating surface water from our combined sewer by disconnecting impermeable areas from the sewer and connecting to the new highway culverted (this element was delivered by GCC and we paid them to do this for us).
13. Mansfield, Manvers Street – Joint scheme with Nottinghamshire County Council delivered by Severn Trent. Property flood resilience measures (such as flood doors and flood gates) installed at 8 properties, addressing a complex sewer and surface water flooding issue. Jointly funded by Severn Trent and NCC.

We have a further 14 partnership schemes in our programme of work, of which 11 are progressed sufficiently for us to have confidence that completion will occur before 31st March 2020. This includes a commitment from the various partners, agreement to the relevant contributions, sources of funding and detailed design solutions. This brings our total for the AMP to 24 which is the forecast included in App5. We are continuing to progress the other three schemes, although a combination of partnership engagement and solution design leading to delays has meant we are not including them within our forecasts for completion this AMP.

REDACTED

Biodiversity

Detailed definition of performance measure:

The number of hectares of designated areas improved, measured through improvements made to Sites of Special Scientific Interest (SSSIs) on Severn Trent Water's land and its contribution to improving other designated areas in its region such as Special Areas of Conservation (SACs).

Incentive type: Financial – reward and penalty.

Performance commitments

		Starting level	Committed performance levels				
	Unit	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
PC	No.	334					409

Our customers value the natural environment and want us to play our part in preserving and enhancing it. Research as part of PR19 further supported this, as customer told us to do more to enhance biodiversity both on sites they can access, such as visitor centres, but also on sites that are closed to the public.

Within AMP6 we had a relatively modest target of a 75 hectare improvement, our current forecast is to hit a cumulative 588 hectares which is an increase of 254 hectares across the AMP. We've listened to our customers and sought opportunities to further the natural environment now rather than waiting for AMP7. The majority of these opportunities are linked to the National Environment Programme, where small changes to the solutions we are installing at our sewage treatment works will also deliver biodiversity benefits. The biodiversity programme is therefore heavily weighted to the final year of AMP6 where the vast majority of the Water Framework Directive schemes will complete and the benefit realised.

Each site is covered by a detailed action plan agreed in advance with Natural England. Upon completion of the action plan we are able to claim the site as improved which negates the need for Natural England to formally assess the site. Schemes will, of course, be subjected to approval by the Environment Agency where a change in permit limits is required. Our forecast, therefore, is primarily driven by the area covered by pre-agreed action plans where the completion of enhancement works is linked directly to our statutory obligations in NEP5.

REDACTED

Overall Environmental Performance

We can confirm that this measure is deliverable for 2018/19 based on four years' of actual performance and a forecast for 2019/20. We have claimed this commitment within our Annual Performance Report for 2018/19 so do not discuss it further here.

Service Incentive Mechanism (SIM)

SVE.PD.A4 –" PR14 Service incentive mechanism: The company should provide more evidence to support the forecast trajectory in table R10**."**

The SIM 19/20 forecast has been removed in line with the PR19 Customer Measure of Experience (C-MeX): guidance for the C-MeX shadow year 2019-2020 issued on 8th March 2019:

"As set out in the Final Methodology, from 2019-20, the Service Incentive Mechanism (SIM) will be replaced by an alternative incentive mechanism called C-MeX, designed to encourage water companies in England and Wales to provide better customer service for their household customers. For the shadow year, only the reputational incentives (ie no financial incentives) will apply."

And

"SIM is not being operated in the 2019-20 reporting year, and is instead being replaced by the shadow year of C-MeX."

Other significant changes in performance commitment forecasts

Sustainable sewage treatment

Detailed definition of performance measure:

This measure is the number of works where future capital investment is avoided by the development of innovative solutions to reduce capacity pressures at Sewage Treatment Works to accommodate growth.

Incentive type: Financial – reward only.

Performance commitments

		Starting level	Committed performance levels				
	Unit	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
PC	No.						0

At PR14 we included a commitment to help drive innovation in our wastewater treatment service. Specifically it was designed to drive encourage the use of novel technologies and pre-treatments to accommodate growth in the catchment, therefore mitigating the need to install additional current treatment capacity, such as activated sludge plants.

The ODI is based on the population equivalent that additional capacity is provided. Within the FD it, along with a number of other PCs, had the incentive rate stated as “per year” which we consider left some ambiguity. As such we included within our APR15 document our understanding of the intention of the incentive rate, based on the PR14 plan submission, and our intention of how we would use the rate to claim any outperformance. The extract overleaf is from our APR15 document.

SC5 – Sustainable Sewage Treatment Solutions

In our business plan, we proposed some PCs that were designed to encourage innovation – particularly in areas where we might not ordinarily be incentivised to do so. This PC is designed to incentivise the delivery of different, more sustainable approaches to sewage treatment which would deliver longer term benefits to customers and the environment.

It is defined as the number of works where future capital investment is avoided by the development of innovative solutions to reduce capacity pressures at sewage treatment works to accommodate growth. It has a target of zero by 2020 (reflecting that this is an experimental approach) and a financial reward incentive only should any successful schemes be delivered.

In our Final Determination, the incentive rate is expressed per year. However, as indicated in our business plan the intention was that five years' worth of penalty or reward would be applicable for any over performance. We have informed our external assurance providers, the Water Forum and Ofwat of our understanding and intention.

Whilst we have not delivered any qualifying schemes this year, over the next 12 months we will continue to look for opportunities. We are looking at new technologies with our research and development team and identifying areas where trade or domestic growth is forecast.

Throughout AMP6 we have considered many different solutions at a number of our works but when designing the commitment we specifically referenced one potential site where we were in the early stages of solution design at our Rugby sewage treatment works (STW). We've reviewed each potential solution against three high level tests:

- Does the solution include the installation of traditional treatment technology?
- Is the solution delivering additional capacity to accommodate growth in the catchment?
- Is the solution innovative?

Having reviewed all possible sites against the above criteria we have just two candidate sites remaining; these are the site at Rugby STW and our Finham STW.

Our forecast for 2019/20 includes just the Rugby STW scheme based on the level of certainty we have around it meeting the criteria above. We are still building the evidence case for Finham STW, including speaking to our Water Forum and independent technical assurance partners.

Rugby STW

Our site at rugby requires expansion to accommodate growth or just under 15,000 population equivalent in the drainage catchment. The traditional solution would be to build additional activated sludge channels to compensate the current works design.

We believe that the solution we have chosen is a first in the UK water industry. Through the installation of a pre-treatment phase at Rugby STW, using the BioMag^{TM} technology, we can free up reactor capacity for multi-stage treatment process, enabling enhanced levels of nutrient removal beyond current activated sludge ability. The system has been demonstrated to at least double the treatment capacity of existing works under certain circumstances.

The BioMag^{TM} system uses magnetite to ballast conventional biological floc which in turn leads to enhanced settling rates and increase performance of exiting processes. We can easily integrate the system in to the existing design of Rugby STW at a much lower cost than the traditional solution. However, as this is the first use of the technology within the UK we are taking on additional process risk as we learn how to use and optimise the solution at our sites.

REDACTED

Finham STW

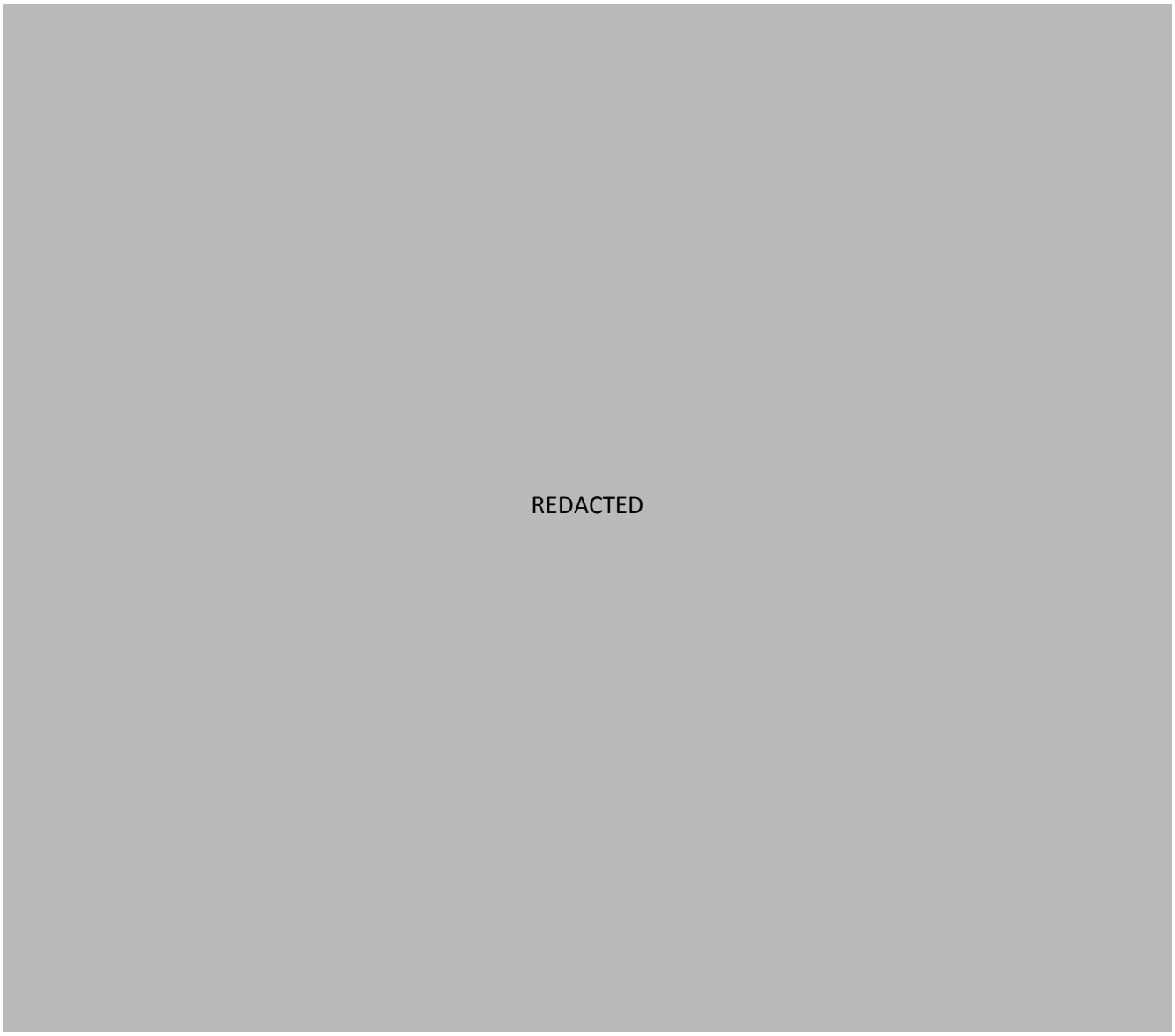
We have one further candidate site at Finham (population equivalent increase of c60,000). The solution here is to install a different pre-treatment phase, IFAS. Whilst this site clearly meets two of the tests (no traditional technology being built and investment to accommodate growth) we are still building the evidence case to confirm that this solution meets the innovation criteria. As part of this we are having discussions with our independent technical assurance providers and our customer challenge group, the Water Forum.

At this point we have not included Finham within our forecasts included within App5. We will keep Ofwat updated of our progress with this site, and the discussions with our stakeholders throughout 2019/20 an in particular as part of the submission in August 2019 relating to the slow track DD submissions.

Other changes from September 2018

We explain in the table below the differences between the original forecast submitted in September 2018 and the revised forecast of July 2019. We explain in more detail the differences in the commentary section that follows. All values reflect the ODI payments in £m.

REDACTED



Cross check to the counterfactual

Comparing the 2018-19 performance to the counterfactual views results in a difference of £0.43m; this is driven by (all values in £m):

	Measure	SVE	HDD	Counterfactual	Difference	Reason
WB2	Leakage levels	(2.2546)	0.0000	(2.2386)	0.0160	Due to the underlying level of leakage in Powys being favourable; on the counterfactual this would net off against the penalty incurred.
WB4	Number of minutes customers go without	(7.7199)	-0.2794	(7.7660)	0.2333	The application of the 5-minute event cap in Powys would not have been

	supply each year					triggered in the counterfactual view.
WB7	Customers at risk of low pressure	-0.01975	0.00474	0.064	0.0790	We have restated historic data and taken account of this in the APR19 submission. The counterfactual is based on in year performance.
SA4	Asset stewardship - blockages	0	(0.0810)	0	0.0810	The post-NAV target for Powys was not met, but the counterfactual combined target was.
SB1	Customers rating our services as good value for money	0.1245	0.0000	0.1500	0.0005	The wastewater cap being triggered in Powys
SC7	Overall environmental performance	2.389	0.000	2.400	0.011	A proportion of the ODI being allocated to Hafren Dyfrdwy, which is then subject to the wastewater cap.
A1	Discoloured water contacts	0.0019	-0.0011	0.0017	0.0001	Due to asymmetric outperformance and underperformance incentive rates.
B1	Average duration of interruptions	0.0074	0.0089	0.0209	0.0046	Due to the outperformance cap being breached in one area but not in the counterfactual view.

Our forecasts for 2019/20 have assumed that the performance commitments in Powys are delivered, nullifying the impact of any ODIs. As such the counterfactual balances for 2019/20 with the exception of:

	Measure	SVE	HDD	Counterfactual	Difference
WC1	Customers rating our services as good value for money (based on tracker survey)	0.1243	0	0.125	0.0007
SB1	Customers rating our services as good value for money	0.1245	0	0.125	0.0005

For APR19 we split the incentive rate between Severn Trent Water and Hafren Dyfrdwy to ensure that the incentive is allocated between customers in line with the revenue adjustments agreed for the NAV. However, this measure is not active in Powys in 2019/20 and as such the small inconsistency between the factual and counterfactual exists of £13k.

5. Land sales

The following action was identified for land sales:

SVE.PD.A1 – "PR14 Land sales: The company should provide additional evidence to support the forecast trajectory reported in table App9"

Severn Trent aims to realise £100m through land sales over the course of 10 years; the actual and forecast numbers included in the land sales adjustment reflects that ambition.

Following the 2018-19 outturn, we have updated our forecast for 2019-20 to align to our detailed land sales plan for the year, as we now have greater clarity of which land sales are likely to complete within the year and the forecast value of those transactions.

6. Residential retail revenue

As part of our APR process and updating for the PR14 reconciliations we have identified two areas where the historical reported numbers submitted in table R9 were incorrect:

- actual customer numbers; and
- reforecast customer numbers

We discuss these issues in further detail below.

Actual customer numbers

During APR19, we identified some historical errors in the way APR Table 2F (which R9 uses to derive its historical customer numbers) was compiled. Following the identification of these initial errors, we performed a further investigation into all of our properties and volumes reporting in the last AMP to understand if any other errors had occurred. As a result, we have restated the customer numbers in table R9 for 2016-17 and 2017-18. The errors found are listed in order of materiality below.

- In 2016-17 and 2017-18, approximately 70k low RV non billable properties were incorrectly included in the total number of unmeasured waste properties.
- In 2017-18, we have identified that unmeasured water only properties were significantly lower than both years prior and after APR18. After further investigation we have identified that approximately 20k bulk supply properties had been temporarily placed into void during APR17 to allow our customer billing teams to ensure the accounts were being correctly billed. As a result, we have amended the unmeasured water only line for 2017-18 as these properties were subsequently brought back into charge and were billed for the period during 2017-18.
- In 2016-17, we have identified a data transposition error on the number of household properties that understated the number of measured water only properties by approximately 7k.
- In 2016-17, approximately 3k of non-household properties which were not eligible to enter the open market, and therefore remained in our billing system, were excluded from Table 2F in error. They were included in 17/18 onwards.

We are restating the 2016-17 and 2017-18 property numbers and have noted our historical properties and volumes reporting as a departure in our APR Compliance Statement. We have undertaken a deep dive investigation to understand the root causes of these errors and will be implementing a number of improvement actions going forward including greater automation of our MI process to compile our property numbers and reviewing the methodology of the reports as well as further training.

Reforecast customer numbers

Following a thorough review of all the customer numbers in table R9, we have identified that the reforecast customer numbers that were also submitted in table R9 for years 2016-17 and 2017-18 did not align to the forecast numbers that were used in setting charges. We are therefore restating the 2016-17 and 2017-18 reforecast customer numbers in table R9 as follows:

	2016-17	2017-18
Unmetered water-only customer	144,716	144,896
Unmetered wastewater-only customer	454,509	454,906
Unmetered water and wastewater customer	1,610,738	1,661,763
Metered water-only customer	119,958	119,652
Metered wastewater-only customer	270,123	297,282
Metered water and wastewater customer	1,387,085	1,262,912

IAP actions

Ofwat identified four actions relating to residential retail in the DD.

SVE.PD.A3a - "PR14 Residential retail: The company should clarify what the correct value is in table R9 for actual number of wastewater-only customer in 2017-2018."

We recognise that there was a difference in the 2017-18 unmetered wastewater-only customers reported in table R9 due to late changes made in APR table 2F that were not reflected in table R9.

As set out above, we have restated the customer numbers for 2017-18 and this action has therefore been superseded by the restated number.

Taking the following three actions together:

- **SVE.PD.A3b – "**PR14 Residential retail: The company should provide further evidence to support its forecasts for unmetered wastewater-only customers in 2018-2019 and 2019-2020."
- **SVE.PD.A3c –** "PR14 Residential retail: The company should provide further evidence to support its forecasts for metered water customers in 2018-2019 and 2019-2020."
- **SVE.PD.A3d –** "PR14 Residential retail: The company should provide further evidence to support its forecasts for metered water and wastewater customers in 2018-2019."

We have updated 2018-19 for the actual customer numbers reported in APR table 2F.

Following query SVE-DD-PD-001, the 2019-20 forecast of actual customer numbers have been updated for our latest view of the customer numbers. The view is based on updating the 2018-19 actual number of customers for the same movement in customer numbers as used in our previous forecast. A review of the underlying assumptions used in the original forecast indicates that the growth in customer numbers has not materially changed from our previous forecast.

Interventions

In the DD, Ofwat made an intervention (**SVE.PD.C008.01, SVE.PD.C008.02 and SVE.PD.C008.03**) on the modification factors that we used in the retail revenue model for our business plan submission.

Ofwat stated

"We are intervening to include an updated weighted average modification factor for allowed retail service revenue per unmeasured water customer in 2018-19 and 2019-20. This is because the PR14 modification factors were different for Severn Trent Water and Dee Valley Water unmeasured water customers and it is appropriate to use a weighted average for the merged company."

As explained in 'Appendix 3 - Technical issues' of our DD response, the licences of both Severn Trent and Dee Valley (after the border variation) were updated to reflect the separate modification factors that should apply to the areas formerly served by each of the legacy companies. The modification factors can be found in the updated table 4 of Condition B.21 of the two licences. The relevant FD modification factors were also used to set charges for 2019-20.

For these reasons (and as per our DD response), we do not agree with Ofwat's intervention in this instance as the weighted average modification factors would not comply with the relevant factors in our licence. We have therefore reset the modification factors back (rounded to 2 decimal places) to the relevant factors used in our business plan submission.

Forecast customer numbers

As mentioned in the 'Accounting for past performance' chapter of our business plan, the pre-populated forecast customer numbers were not consistent with table 5 of our FD letter or the PR14 Financial model. Whilst the correct forecast customer numbers are now being used for Severn Trent England, the incorrect customer numbers are still pre-populated in the counterfactual version of the tables.

The correct forecast numbers for the counterfactual are as follows;

A	Forecast customer numbers	2015-16	2016-17	2017-18	2018-19	2019-20
1	Unmetered water-only customer	148,935	145,669	142,456	139,298	136,191
2	Unmetered wastewater-only customer	457,614	448,424	439,058	429,612	420,223
3	Unmetered water and wastewater customer	1,690,922	1,653,833	1,617,363	1,581,500	1,546,234
4	Metered water-only customer	113,721	118,388	123,162	128,046	133,039
5	Metered wastewater-only customer	245,434	256,997	268,890	281,012	293,172
6	Metered water and wastewater customer	1,216,989	1,266,928	1,318,022	1,370,282	1,423,719

7. Totex menu reconciliation

We have set out our responses to the two actions on totex below.

SVE.PD.A5a – "PR14 Totex: The company should amend the PR14 final determination controls and targets data in tables WS15/WWS15 in order for it to match the values agreed with Ofwat."

The apportionment of the allowances and revised menu ratios resulting from the border variation were agreed with Ofwat during the NAV process. It was also agreed as part of the NAV process that:

- the PR14 allowances would not be re-opened and would instead be apportioned between the companies using appropriate drivers;
- the totex allowances for the final two years of the AMP would therefore be allocated in line with the split of expenditure between the two regions; and
- the original FD menu ratios would assume to apply for the first three years of the control and the ratios for the latter two years re-calculated based on the revised boundaries.

However, as the totex model is designed to calculate the totex allowance and rewards and penalties on the basis of 5 years inputs, the approach agreed with Ofwat would have resulted in a considerable amount of model redevelopment to perform the pre and post variation totex reconciliations. We therefore considered that it was appropriate to recalculate the menu ratios on the basis of three years of baseline totex and the company's plan totex as per the original FD plus two years of baseline totex and the company's plan totex based on the split of expenditure between the two regions. The overall difference to the totex allowance agreed as part of the NAV process is immaterial at 0.2% (£5.3m).

We have demonstrated that customers are no worse off as a result of the variation by creating the counterfactuals reconciliations which show that the rewards and penalties would have been similar if the original boundaries had continued until the end of AMP6.

SVE.PD.A5.b – "PR14 Totex: The company should provide more detailed and numerically sound explanation of its forecasted totex for years 2018-2019 and 2019-2020. It should also either re-submit the model without the changes made to cells L97-98, M97-98, N97-98, P97-08; or alternatively it should provide a credible explanation of why it has used a hard-coded value, rather than the formula."

2018-19 and 2019-20 performance

We have updated the 2018-19 numbers for actual performance in the submitted model. We note that the actual position for the wholesale services is around £30m higher than our previous forecast (after removing the impact of the NAV asset transfers, as set out in 4B commentary in the APR). This is in large part down to the costs of the hot weather – which was ongoing at the time we were preparing our plan and not factored into our budget plan at that time. We have also incurred some additional capital spend to address worsening performance in our water service, and get this back on track.

For 2019-20, the costs included in the true up are based on our internal budget for the year, which was less certain at the time of our PR19 submissions. This is £72m higher than in our previous submissions due to the

fact that we plan to reinvest further efficiency gains to ensure we enter AMP7 with the best possible customer performance.

For both years we have also adjusted the 3rd party costs and totex to remove the intercompany bulk supply charges from our true ups, as these were not adjusted for in the FD when the NAV changes were agreed. Whilst the costs and revenues net to zero between HD and SVE overall, as the true up relates solely to cost the values do not net to zero. In order to eliminate this difference, we have removed these intercompany transactions from the true up. The values for 2018-19 can be found in the APR 4B table commentary.

Totex model hardcoded values

In response to the second part of the action, the totex model is designed to calculate all of the rewards and penalties as well as the outturn menu ratio based on inputs for the company's original business plan, determination and actual expenditure. This approach creates an issue for the varied companies as it calculates a new menu ratio which in turn, causes the model to re-calculate the PR14 "additional income" lines in rows 97 and 98 of the "Calcs" sheet. The additional income calculated in lines 97 and 98 is then deducted from lines 101 and 102 ("Reward / (penalty) excluding additional income") to calculate the reward/ penalty to be taken forward into AMP7.

As part of the NAV process, it was agreed that PR14 would not be re-opened as a result of the border variation. The "additional income (applied at the FD)" are amounts that are already included within the revenue controls of SVT and DVW (and are thus "baked in" to the revenue controls of SVE and HDD). Rather than revising several calculations in the model to accommodate the NAV, we considered it was prudent to overwrite the "additional income (applied at the FD)" in the model with the values applied at FD.

8. Wholesale revenue incentive forecasting mechanism

SVE.PD.A6 – "PR14 Wholesale revenue forecasting incentive mechanism: The company should use consistent values for the 2018-19 and 2019-20 wastewater recovered revenue values in its model and business plan table WWS13."

We have updated the 2018-19 numbers for actual performance in the table. For 2019-20, we are forecasting that we will outturn in line with the allowed revenue and therefore there will be no adjustment for WRFIM for the year.

In response to the action, we have corrected the issue on table WWS13, where the revenue recovered did not correctly align to the revenue in the 'Calc' sheet of the model.

Appendix 1: Birmingham resilience project

The Birmingham resilience project (BRP) delivers enhanced resilience to our customers in two principal ways:

- Allows Birmingham to be supplied without reliance on Elan Valley sources – River Severn and Strategic Grid will enable supplies to be maintained in the event of a failure of the aqueduct / reservoirs,
- Allows the aqueduct to taken off line for 30 days each year enabling proactive maintenance – Manages the risk associated with our most strategic and efficient water source.

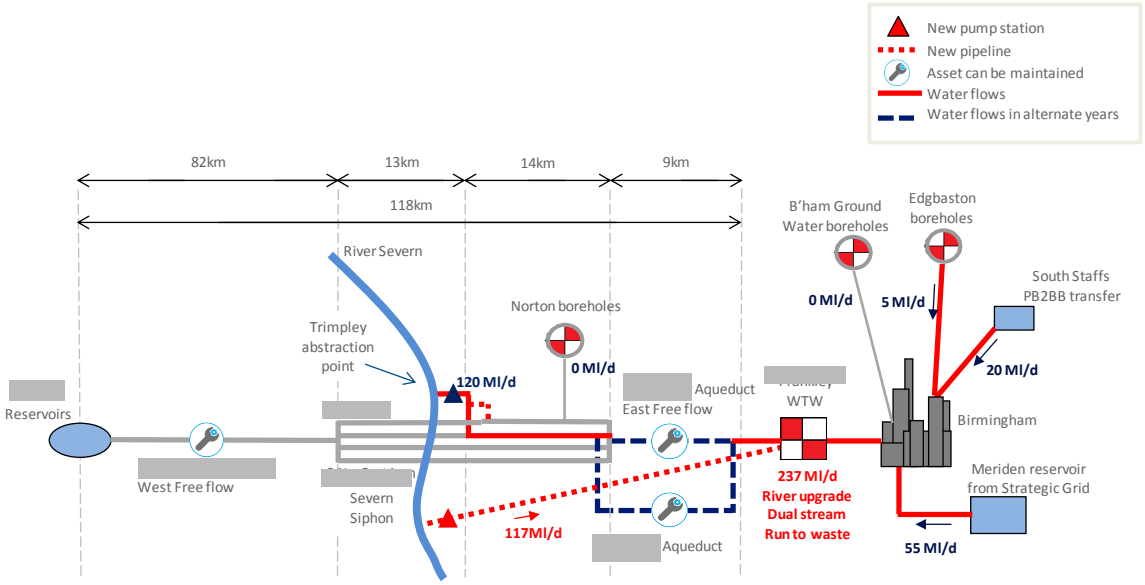


Figure: Overview of Birmingham Resilience Project (source PR14 business plan)

The fundamental deliverables necessary to enable the resilience outcomes as documented in the PR14 FD (PR14 performance commitment W-B10) were:

- **A new river intake and pumping station** from the River Severn (117 ML/d at Lickhill)
- **A pipeline** conveying river water from the intake to Birmingham WTW (117ML/d)
- **An upgrade of Birmingham WTW** to allow the treatment of river water sufficient to allow the 30 day maintenance window (237ML/d: 117ML/d from Lickhill and 120ML/d from an existing intake at Trimpley)

The PR14 FD commits us to delivering each of the three components by the end of AMP6. This is set out in PR14 performance commitment W-B09 and illustrated below:

	Unit	Starting level	Committed performance levels				
		2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Pumping station					Progress milestone		Completion
Pipeline					Progress milestone		Completion
Treatment works upgrade					Progress milestone		Completion

The Birmingham Resilience Project is one of the largest and most complex water enhancement projects we have ever attempted. **We remain on track to deliver the stated PR14 benefits (and more) consistent with the agreed timeline.**

Delivering on time (Outcome W-B09)

The three project outputs necessary to deliver our PR14 FD commitments are being closely managed by our BRP team. The major remaining activities are set out in the figure below. We have also set out the additional testing and commissioning we are undertaking to ensure the project delivers the best possible outcome for our customers.

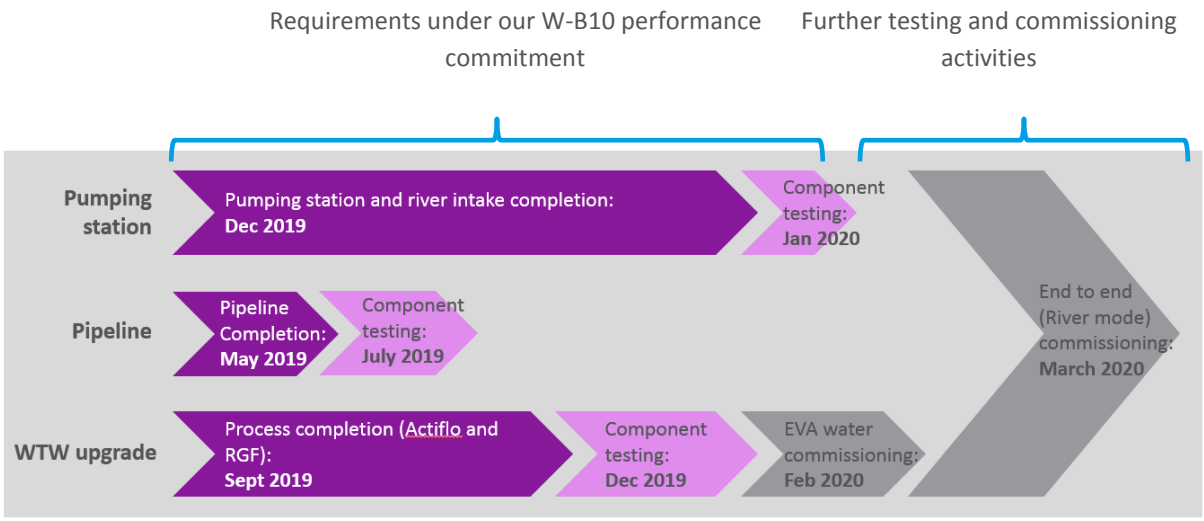


Figure: High level BRP project timetable

For each activity described above we have comprehensive project plans and milestones in place. The delivery against the full project plan is closely monitored and reported through to the BRP project director. The delivery of the project sits on the company Enterprise Risk Management log (ERM). Progress is reported to Severn Trent Executive Committee on a monthly basis and to Severn Trent Board on a 6 monthly basis.

In summary:

- Line 1 of W-B10 - the raw water workstream (constructing the new Lickhill river intake and pumping station and the pipeline to Birmingham) will continue until December 2019. All substantive components other than the intake structure are due for completion and associated component commissioning by September 2019. This will conclude the substantive construction of the Pumping station and Pipeline components in line with the PR14 FD requirement.
- Line 2 W-B10 - The fundamental components of the treated water workstream (constructing the necessary WTW upgrade at Birmingham) are due to be completed in September 2019. This will conclude the substantive construction of the treatment works upgrade in line with the PR14 FD requirement.
- Line 3 of W-B10 - treated water component commissioning and testing will then lead into a full scale test using EVA water that is due to conclude in February 2020. This will include a full stability test of the treatment process.

We are also undertaking additional commissioning and testing which will occur on completion of the aqueduct water stability test of the treated water workstream, and the component testing of the raw water workstream. This will involve a final river water stability test and commissioning, which will use the raw and treated water assets end to end. This commissioning phase will require a 10 day build up period, a 21 day test, and a 10 day close down period. It is due to be undertaken in early 2020 with completion planned for the middle of March 2020.

Our delivery plan satisfies the PR14 performance commitments, allowing the three BRP components of the outcome to be realised in full and on time. Recognising the importance of the additional end-end testing, and the complexity of the project, we consider it appropriate to explain how the project is finalised and the benefits delivered to customers to give Ofwat additional assurance that customers are protected.

Delay penalties associated with the PR14 FD commitment are split out into six components (pumping station, pipeline and four relating to the WTW upgrade) – All of these components are planned to be completed by December 2019.

We recognise that the full customer benefits requires the components to operate collaboratively. The progress and timetable for the completion of the individual components and wider project commissioning are described in turn below to provide additional assurance that we are delivering the best value for customers.

Construction of fundamental BRP components

River intake and pumping station

This component involves the construction of the River Severn intake structure, a short bored tunnel leading to the pumping station shaft and installation of the associated pumps necessary to lift the water to Birmingham WTW.

Construction has complicated by the partial failure of a coffer dam in the River Severn that is necessary for the installation of the intake structure. However, this has been mitigated by an increased use of divers and additional temporary works. The tunnel has now been cut and the pumps and associated pipework have been installed. The current project plan shows a substantive completion of the raw water assets (as per the PR14 FD requirements) by December 2019.

Plate: Pumps installed at Lickhill Pumping Station May 2019 (top and bottom of shaft)

Pipeline

This component includes:

- Construction of 25km of large diameter pipeline split into nine segments. This has involved open cut installation, or tunnelling in more complex locations (e.g. crossing of M5 motorway and duel carriageways).
- Construction of a Break Pressure Tank with Powdered Activated Carbon (PAC) dosing plant at Romsley, allowing water pumped from Lickhill to gravitate to Birmingham WTW.

The laying of the pipeline from Lickhill to Birmingham and construction of the Break pressure tank/PAC plant has been substantively completed. The pipe for the final bored section (RDX3) has now been pulled through and reinstatement is commencing. The remaining construction tasks relate to the completion of the linkages between the nine segments that will be completed following the in situ pressure testing of each of the pipeline segments. Four of the nine segments have undertaken (and completed) the test. The remaining five segments are due have been tested by July 2019.

Plate: Romsley Break pressure tank (March 2019) and pipeline installation (May 2018)

Birmingham WTW upgrade

This component includes the construction of the following substantive assets:

- Sand Ballasted Lamella (SBL) Actiflo Clarification process
- Rapid Gravity Filter (RGF) process and associated backwash systems
- Chemical dosing and chlorination systems
- Sludge treatment facilities
- Emergency Return Pumping Station
- Connecting pipework from raw water storage reservoir and between processes
- Electrical and control systems

We have project plans in place to complete the construction of the substantive components of the treatment stream by September 2019. This is being undertaken by a workforce and dedicated project team of more than 300 FTE. At the conclusion of the construction phase, we will have delivered a water treatment works upgrade in accordance with the FD. This will then allow us to release the treatment stream for component commissioning.

During this component commissioning phase, construction will continue on subsidiary aspects of the programme that are not fundamental to the testing of the treatment processes. This includes a pumping station to feed water when the raw water storage reservoir is at a low level.

Plate: Progress on treatment process: View from SPL Actiflo clarifier roof and RGF outlet channels (April 2019)

Plate: Installation of Sludge treatment Lamella no1. (March 2019) and Emergency Return Pumping Station ready for pump installation (April 2019)

Commissioning completed assets to deliver customer benefit

Once the substantive components identified in the FD commitments have been constructed and individually tested, the project will then move into a detailed and exhaustive programme of commissioning and stability testing. There are two major project commissioning stages which we discuss below.

Commissioning the new treatment stream using aqueduct water (Stage 18 to 20)

Commissioning stage 18 (WTW upgrade operated using aqueduct water running to waste): Planned to conclude on 16 Jan 2020

Commissioning stage 20 (WTW upgrade operated using aqueduct water inputting into supply): Planned to conclude on 13 Feb 2020.

We will have demonstrated a fully functioning WTW upgrade at the conclusion of this commissioning stage.

This commissioning phase can commence once the construction of the third treatment stream has been completed in September 2019 and all of the individual components tested. We are planning to undertake this commissioning phase in January 2020, running into February 2020.

The test will involve the routing of aqueduct water from Birmingham Reservoir into the new third treatment process stream, whilst the existing WTW continues to treat aqueduct water from Birmingham and Bartley Reservoirs. Water from the new stream will then be returned to the Birmingham raw water reservoir using the newly constructed emergency return pumping station. This ensures that no water enters into supply during this testing phase. This closed cycle means that the availability of water for treatment and supply through the existing treatment streams is unaffected with very little flow from the closed cycle loop running to waste (sample water). Consequently, the test can be undertaken concurrently with the ongoing operation of the existing WTW. Birmingham Reservoir will be sampled and tested during this phase to ensure returned water remains treatable.

On satisfactory completion of the closed loop testing on aqueduct water, the treatment stream will then be diverted into supply and undergo a period of hydraulic capability and stability testing. This involves running the new treatment stream in automated mode, with limited manual input and adjustment, for an extended period of time (21 days). It will ensure that the processes perform in accordance with treatment requirements and to provide confidence in the functionality of the plant. Should there be any Water Quality issues during this period the treated water from this stream will be returned to Birmingham Reservoir using the emergency return pumping station, and the existing WTW streams ramped up to meet demand.

Subject to the satisfactory completion of the stability testing on aqueduct water, and the commissioning of the raw water components, we will then be able to move to the river mode commissioning phase. This will use the BRP assets from end to end (i.e. raw water abstracted from Lickhill, conveyed to Birmingham and then treated using the upgraded WTW).

Testing of the new treatment process using River Severn water (Stage 22 to 23)

Commissioning stage 22 (Transition from aqueduct to river mode commissioning – water remains into supply): Planned to conclude on 23 Feb 2020.

Commissioning stage 23 (River water stability testing – demonstrating the stability of the end to end process for 21 days): Planned to conclude on 15 March 2020.

Under these states we are testing the end-to-end process (ie, previous tests assess each of the three component individually).

This commissioning phase can commence following the satisfactory completion of the aqueduct water test and the component testing of the raw water assets workstream. This is projected for February 2020.

The river mode commissioning will involve the abstraction of river water at the Lickhill river intake and pumping station, conveyance to Birmingham using the new pipeline and then treatment using the third treatment stream. The aqueduct water will be diverted entirely to Bartley reservoir and the existing streams fed from Bartley during the river testing period of the new stream, and will continue to supply water whilst the new stream transitions to river treatment operation.

The river water from Lickhill (and the existing Trimpley abstraction), will be dosed with PAC and fed directly into Birmingham reservoir which will initially be full of aqueduct water but will transition through a blend of aqueduct / River water to entirely river water as river water is fed into the reservoir and water withdrawn for treatment by the new stream. The transition period from aqueduct to River Water will take up to 10 days. During this period water from the new stream will go into supply via blending with aqueduct treated water from the existing treatment processes. Should there be any Water Quality issues from the new stream, the treated water will be returned to Birmingham reservoir using the ERPS and the existing treatment streams ramped up to meet demand.

The third treatment process stream will again undergo stability testing whilst being fed from the river. This involves running the treatment stream for an extended period of time (21 days) to ensure that the processes perform in accordance to expectations. At the end of this period, the third stream can transition back to aqueduct treatment by stopping the river water pumping and returning aqueduct flows to Birmingham Reservoir, or be trialled in Resilience mode by instigating the network changes and stopping treatment of aqueduct water completely, running the new stream on river water into supply as the sole output of Birmingham WTW.

This river water testing is due to conclude by mid-March 2020 and we are engaging with the DWI on the timetable and associated points. We recognise that whilst the three outputs specified in W-B09 will be completed well before the end of the financial year, there could be a desire to have the additional activities completed earlier as well. However we believe, along the DWI, that we should not reduce the robustness of our proposed testing and commissioning programme despite the fact that the programme of work runs close to the end of the financial year.

Delivering on time: Summary

As per the current construction and commissioning programme milestones identified above, we remain committed to delivering the outputs from B-B09 and the customer benefit of the Birmingham Resilience scheme by the end of AMP6. Specifically:

- Line 1 of W-B10 - the raw water workstream (constructing the new Lickhill river intake and pumping station and the pipeline to Birmingham) will continue until December 2019.
- Line 2 W-B10 - The fundamental components of the treated water workstream (constructing the necessary WTW upgrade at Birmingham) are due to be completed in September 2019.
- Line 3 of W-B10 - treated water component commissioning and testing will then lead into a full scale test using aqueduct water that is due to conclude in February 2020.

We recognise that the additional testing and commissions activities are due to complete towards the end of the financial year, which raises the risk of a very small delay. In the event this looks likely we would keep Ofwat informed, however we consider this is likely to be immaterial to the scheme given:

- Completion of all of the individual asset components as listed in PC W-B9 (anticipated December 2019):
- Full commissioning of a subset of components (e.g. treatment benefits delivered following successful completion of commissioning stage 20 – anticipated February 2020)
- Partial customer benefit in 2019/20 (i.e. benefits actively flowing to customers following completion of commissioning stage 22 – anticipated February 2020)
- Greater customer benefit in 2020/21 than the FD once commissioning is concluded (i.e. 51 weeks of benefit in the event of a 1 week delay in project commissioning)
- the veracity of our testing and commissioning processes (as supported by the DWI) (ie, we do not want to reduce our activity here simply to reduce risk that the end-end commissioning finishes before the end of the financial year).

Delivering to specification (outcome W-B10)

We are delivering the following assets as part of our Birmingham resilience project:

	PR14 FD commitment	2019 BP commentary	Current	Comments
Pumping station	117Ml/d	237Ml/d	130Ml/d	Marginal increase in capacity matched to peak daily demand requirements.
Pipeline	117Ml/d	237Ml/d	Hydraulically tested to >140Ml/d	PR19 Business Plan commentary erroneously matched capacity of raw water assets to treatment upgrade capacity
WTW upgrade	237Ml/d But, additional Actiflo (4x30Ml/d) and RGF capacity (20x6Ml/d) of only 120Ml/d	Actiflo clarification: 3x80Ml/d RGFs: 18x16Ml/d	287Ml/d* Actiflo clarification: 3x104Ml/d units* RGFs: 18x17Ml/d units* Sludge treatment sized for the WTW flow Emergency return pumping station	*Note that the 287Ml/d value is treated water at peak daily flow during the diurnal maximum. This value will be post process losses. Consequently, the flow the entering treatment processes will need to be greater (312Ml/d). At this flow, the Actiflo clarifiers have a hydraulic loading rate of 62m/h – within the guaranteed process performance range. The RGFs will have a filtration rate of 7.6-8.6m/h depending on the availability of filters and the backwash cycle – within our design parameters. For a like for like comparison to the PR14 FD, our current assumption for average daily treated flow for the upgraded WTW when in river mode is 234Ml/d. Note also that the physical sizing of the Actiflo clarification and RGF units has not changed since the 2019 business plan. The variance here entirely relates to the measurement of raw water inflow rather than treated water outflow and the flow through the assets at Peak diurnal flows (in line with design criteria).

Table: Summary of assets being delivered as part of the BRP

We have undertaken a significant amount of testing to ensure that the scaling and performance of these raw and treated water assets will be sufficient to treat the volume and quality of raw water anticipated to satisfy the required demand. Sizing and technical performance of installed assets needs to consider:

- the volume of treated water that Birmingham WTW will need to output into distribution (both average and peak daily demands and consideration of diurnal peaks and troughs);
- the process losses seen through the treatment stages; and
- the expected input raw water quality across a range of attributes (when operating in 'river mode' we will need to be able to treat raw water that has been extracted solely from the River Severn).

These key assumptions are set out in the following two tables. Together they govern the required hydraulic and treatment performance of the new raw water and treatment assets. This information is then forms the design specification for our chosen interventions.

Flow assumption		Raw Water: pumping station/ pipeline	Raw Water limiting factors	Treatment upgrade (WTW input)	Treatment upgrade (WTW output)	Treatment limiting factors
PR14 FD assumption		117Ml/d	Note: Assumes no process losses	Not specified	237Ml/d*	Note: Flow reflects daily average
Current assumption (post design)	Average daily flow	130Ml/d	Installed pumping capacity 130Ml/d In total 250ML/d of raw river water can be delivered to Birmingham*.	252Ml/d*	234Ml/d	Not constrained: Processes operating within hydraulic loading rates necessary for raw water envelope Note: The majority of process water (WTW output – input) will be returned to Birmingham raw water storage post sludge processing. This reduces the raw water requirement.
	Peak daily flow			271Ml/d*	247Ml/d	
	Peak daily flow plus diurnal max		The diurnal maximum demand at peak daily flow cannot be maintained indefinitely but is managed by Birmingham raw water storage.	312Ml/d*	287Ml/d	

Assumes 120ML/d can be delivered from Trimpley using existing assets

Table: BRP raw and treated flow assumptions necessary to deliver under average and peak daily demand. Process loss assumptions included as variance between WTW input and output (however majority of process water is returned to raw water storage.

Water quality attribute	Unit	Assumed River Severn Raw water envelope							Clarification target assumed in pilot
		Raw River Severn Water			Post Birmingham reservoir settlement				
		Min	Ave	Max	Min	Ave	95%ile	Max	
Colour	*Hazen*	0.6	21	150	0.3	10.5	19.5	75	10
Turbidity	*NTU*	0.03	50	234	5	15	22	70	2

Table: Extracts from the River Severn raw water quality envelope. Values are shown pre and post settlement in Birmingham raw water reservoir.

We can demonstrate the delivery of assets to the appropriate specification in two ways:

- **Design specification:** By review of signed off designs and associated hydraulic and mass balance modelling. This needs to confirm that the selected interventions will deliver for customers in line with our input flow and water quality assumptions.
- **Factory acceptance and site testing** of components: This demonstrates that components can perform in accordance with their design parameters through physical demonstration on-site and in-situ.

These are described in turn in the sections below for each of the major components of the BRP scheme.

Confirming the specification of the raw water (pumping station and pipeline) assets

Design specification

The PR14 FD sets a 117Ml/d commitment for both the pumping station and pipeline components of the BRP. This is aligned with the assumption that 120Ml/d can be supplied from Trimpley via the existing intake and aqueduct.

Following our detailed design work, the design standard for all raw water assets (intake, pumping station and pipeline) **has been increased to 130Ml/d**. This will allow us to operate in accordance to peak (as well as average) daily demand. To support the additional design capacity an **abstraction licence has been agreed for 140Ml/d**. Whilst a raw water capacity of 130Ml/d from Lickhill is the designed capability of the assets installed, there is capacity within the system to potentially deliver greater flows – in-line with the abstraction allowance – should it prove to be necessary during an outage.

The increase in raw water capacity relative to our original 117Ml/d target has been delivered primarily by an increase in the pumping capacity installed at Lickhill rather than by increasing the hydraulic capacity of the pipeline (e.g. by changing diameter, length, or roughness coefficient).

Factory acceptance and site testing

The Intake screen, pumping station pumps and pipeline and have been factory acceptance tested.

The completed pipeline is being in-situ pressure tested up to 140Ml/d. This testing is ongoing with completion expected in July 2019.

Four pumps have been installed in the Lickhill pumping station. These will operate with three duty pumps and one standby. The pumps have been factory acceptance tested. Each pump has been tested to show a design capacity of 1807m^3/h with a dynamic head of 307m (i.e. at the optimum pump efficiency). When considered together, and in conjunction with our pipeline headloss assumptions and pump efficiency losses over time, this gives a tested capacity of 130Ml/d. However, the test curves also show that the pumps may be capable of operating at higher capacities for shorter periods and still retain a sufficient dynamic head.

The completed raw water workstream will undergo in-situ testing through to January 2020 and will then form part of the overarching river water stability testing concluding in March 2020. Commissioning is discussed in detail in a separate section.

Confirming the specification of the WTW upgrade assets

Design specification

Current configuration

The current design capacity of Birmingham WTW is to treat 450Ml/d of Elan Valley water. This is delivered through two Dissolved Air Flotation (DAF) clarification plants and 40 rapid gravity filters (RGFs) which are split into four groups called Quad A to D. There is also the capability to treat 120Ml/d of River Severn water for a time limited period (1 week, twice a year).

The river water is conveyed to Birmingham using a pumped main diverted into a short section of the existing aqueduct from a river abstraction at Trimpley. The treatment of river water requires more complex treatment processes to remove increased pollutants and turbidity. Given the installed process characteristics, the treatment of this volume of river water can only be delivered through DAF plant one (which has an associated GAC plant) and when blended 50/50 with Elan Valley water. Without the above mitigations (i.e. for longer periods or without Elan Valley blending), the river water treatment capacity would fall to 60Ml/d.

Understanding and delivering the required WTW upgrade

The PR14 FD top level requirement is to "upgrade Birmingham WTW to allow it to treat 237 Ml/d of river water". This is an increase of 120Ml/d relative to the existing (time limited and blend contingent) river water treatment capacity. These additional capacity values are set out in the incentive rates table of the W-B10 performance commitment in the FD.

Whilst this marginal capacity increase may be relevant for calibrating ODI penalties in the event of complete non-delivery of the project, it does not equate to the river water treatment capacity we will need to install in order to successfully deliver the full Birmingham Resilience project. This is because the use of the BRP in a planned maintenance mode will require 234Ml/d (average daily flow) of river water to enter distribution (without any aqueduct support) for 50 days – a 30 day maintenance window, with 10 days for transitioning in and out. Consequently, the existing 120Ml/d of partial river water treatment capacity cannot be used for this purpose.

At the start of the project we undertook significant detailed design work in order to understand the optimal treatment process interventions. Through this process we confirmed that the best way to deliver the additional process capacity was though the provision of a third treatment process stream in addition to the two process streams in the existing WTW.

A range of options of how to deliver the necessary river treatment capacity were presented to the project steering group in January 2015. This included consideration of both the clarification and filtration aspects of treatment which will need to operate in series (set out in figure below).

The choice of treatment needs to consider the efficacy, compatibility and deliverability of each of the required processes. Actiflo is more effective at particle and turbidity removal than the installed DAF process and is more effective in responding to rapid changes in volume and water quality. The reduced hydraulic flow of DAF plants means that, at the elevated Turbidity load levels of river water, either; increased clarification capacity is required, a lower hydraulic loading (reducing capacity) is needed, or a lower quality of effluent in turn enters the RGF leading to reduced filter run lengths between backwashes (reducing capacity, or requiring increased filters).

Filtration process selection needed to consider the effectiveness of the process and the deliverability of any treatment upgrade. The existing DAF stream RGFs are configured for aqueduct river water. Consequently, use of the existing RGFs would require an upgrade to increase the effectiveness of the filter for lower higher Turbidity loads. This refurbishment would need to be undertaken whist retaining the capacity of the existing

WTW. This would have required the provision of temporary RGFs to enable the existing filters to be taken off line.

Through our design process it became clear that it is not practical or desirable to provide 20 temporary RGFs of this scale. Such an approach would lead to increased water quality and supply interruption risks. The provision of a separate set of filters as selected means that we can deliver a higher specification RGF (with full clogging head and a more effective forward rinse process more suited for river water treatment). It also allows the new clarification process to be fully commissioned offline and will enable more effective and efficient maintenance of the filters in the future.

		Treatment process 2: Filtration options	1. Construct new RGFs – **as delivered**	2. Refurbish 10 RGFs and build 10 new RGFs – **in PR14 plan**	3. Refurbish 20 RGFs (to river standard) – **in PR14 plan**
		£m	36	34	24
Treatment process 1: Clarification options	£m	Risk/Opportunity (RAG)	• Higher technical spec • 3rd stream for commissioning	• Delivery risk partially mitigated	• Lower technical spec • 1 AMP delivery risk
1. Separate 237Ml/d Sand Ballasted Lamella ('Actiflo') stream – 2. **as delivered**	24	• Provides additional treatment redundancy in aqueduct mode	**Chosen combination of treatment processes**		
3. Replace DAF1 with 237Ml/d Actiflo stream	28	• Missed opportunity for treatment redundancy			
4. Supplement DAF1 with upstream roughing Actiflo unit	33	• Head constraints reduce max flow • More complex switchover			
5. Refurbish DAF1 and 2 to enhance river treatment performance	12	• 1 AMP delivery risk • Increased treatment risk			
6. Refurbish DAF and supplement with parallel Actiflo unit	25	• Increased treatment risk	N.a. Options not compatible		N.a. Risk not considered appropriate

Figure: Options considered in order to satisfy River Severn water treatment upgrade commitment. Risks, costs and compatibility of Clarification and filtration aspects are identified. Capex figures are as known at the time of treatment process decision making (January 2015).

Our detailed process design has also changed the number of units that have been installed in the third (enlarged) process stream. This decision was primarily based on engineering constraint, whole life cost and acknowledgment that the enlarged units provided increased resilience relative to the FD configuration. The process units that have been installed are as follows:

- 1st stage (Clarification): 3 x 104Ml/d SBL Actiflo units
- 2nd stage (Filtration): 18 x 17Ml/d Rapid Gravity Filters
- Sludge Treatment Plant capable of handling sludge from river treatment operation at 287MLd.

In each case these flows all reflect the delivery of 287Ml/d of treated water into distribution (Peak daily flow at diurnal maximum).

In addition to the treatment process requirements, the FD also required the provision of a return pumping station to return sub-standard quality water to the treatment process rather than into supply. This has been specified and constructed to match the treated water flows of the WTW treatment streams.

Performance of the clarification and filtration processes to deliver in accordance with the required flow rates and raw water treatment envelope

Due to the need to manage a more complex and varied raw water chemistry, our chosen clarification process is to use a Sand Ballasted Lamella (SBL) clarifier. Our mass balance calculations for the SBLs that are being constructed (3 x 'Actiflo' SBL units each with a mirror area of 70.2m^2) set out a range of scenarios through which we can test the adequacy of the designed process.

In simplistic terms, the clarification assets need to be of a size where an appropriate hydraulic loading can be maintained such that the appropriate clarification can occur in order to satisfy the requirements of the downstream processes (and eventually water quality requirements). As flow through the process increases, so too will the hydraulic loading rate (effectively reducing the opportunity for particles to settle out). We need to make sure that the asset is appropriately sized to make sure that, at higher hydraulic loading rates, the required level of clarification can be achieved for the full raw water envelope prior to it leaving the clarifier.

An important metric controlling process performance is the assumed hydraulic loading rate (HLR) or mirror velocity. HLR has a unit of $m^3/m^2/h$ (or m/h). Our stated assumption is that the maximum mirror velocity for SBL clarifiers should be specified for a design value of 50m/h, a maximum of 67m/h and with the potential to operate at peaks of 80m/h. This has been agreed as a process guarantee with Veolia - the clarification process contractor.

Regarding RGF design, the Severn Trent design manual has been followed and complied with, with the exception of the hydraulic loading rate of 7m/h. A pilot plant was installed at Trimpley and the data from that plant was used to determine an acceptable hydraulic loading rate of between 8.5-9.0 m/h.

Our detailed mass balance calculations across all the treatment processes have been shared with Jacobs as part of our assurance (DNMA Mass Balance Calculation Document C20038-B-50-DEL-PRO-CS-18050). The table below extracts the headline information with respect to the anticipated SBL and RGF hydraulic loading rates.

	Average daily flow – 40 diurnal effect	Average daily flow	Peak daily flow	Peak daily flow + 40 diurnal effect	Resilience flow Average daily flow + 40 diurnal effect
Raw water entering upgraded treatment stream in river mode (MLd)	209	252	271	312	296
Treated water exiting upgraded 3rd treatment stream in river mode (MLd)*	194	234	247	287	275
SBL Hydraulic loading rate (Mirror velocity m^3/m^2/hour)	42	50	54	62	88 (assuming 2/3 SBLs available)
RGF Hydraulic loading rate (Mirror velocity m^3/m^2/hour)	5.4	6.9	7.0-7.4	7.7-8.6**	8.2

*Due to process losses/sludge removal, dosing and sampling

**Range considers the potential for a filter being offline and the interaction with the backwashing cycle.

Table: Extract from mass balance calculations showing identified flow and associated process hydraulic loading rates

The table shows that that under average and peak flows, the hydraulic loading rates are in accordance with our assumed design values (SBL: 50-67m/h and RGF 8.5-9.0m/h). We note that the resilience flow mass

balance scenario could marginally breach the SBL assumption of operating for isolated peaks up to 80$m^3/m^2/h$. However, such a scenario would only eventuate if an Actiflo SBL unit outage coincided with the diurnal maximum for the average demand when operating in river mode.

To confirm our SBL hydraulic loading rate assumptions, we have undertaken an exhaustive 10 month pilot investigation using a package Actiflo SBL unit at Trimpley WTW. This has tested the performance of the process in treating River Severn water at a range of hydraulic loading rates. The detailed report of this pilot has been shared with Jacobs as part of our assurance.

The tables below summarises the River Severn Raw Water quality envelope assumptions and results of the pilot across a range of attributes.

	Unit	Raw water samples from pilot observations			Pilot post clarification (river mode – laboratory results)								
					Mirror velocity 45-67 Temp <5degC			Mirror velocity 45-67 Temp >5degC			Mirror velocity 67-80 Temp <10degC		
		Ave	95%ile	99%ile	Ave	95%ile	99%ile	Ave	95%ile	99%ile	Ave	95%ile	99%ile
Colour	*Hazen*	16.5	24.2	24.8	4.1	5.2	5.5	4.5	7.1	9.1	3.0	4.3	4.5
Turbidity	*NTU*	9.6	37.9	62.9	0.9	1.1	1.2	0.9	1.4	1.6	1.3	1.9	2.1

Table: Summary of Timpley pilot project. Colours show performance relative to clarification target (10 Hazen and 2 NTU)

The pilot concluded that the SBL design range assumption of 50-67m/h mirror velocity can be verified. Additionally, in most cases, the clarification targets can be satisfied at higher mirror velocities (up to 80m/h).

Managing Actiflo SBL clarification unit outage

As noted above, our detailed process design has changed the number (and capacity) of the SBL clarification units relative to that assumed in our original business plan. This decision was primarily based on treatment requirement, engineering constraint and whole life cost. Our testing has also shown that, in the majority of scenarios, operating with only two of the three installed SBL units would still retain a hydraulic load rate as per the design assumption of operating for isolated peaks up to 80m/h. However, given that this is at the limits of our planning assumptions, we have undertaken detailed contingency planning of how we would manage such a scenario.

During future aqueduct maintenance windows we have set a requirement for a 7 day emergency return to service. In the event of a failure of an SBL unit and the remaining two SBLs not being able to deliver the necessary clarification to meet demand, we could return the DAF treatment streams to service. These would be fed from retained aqueduct water in raw water reservoir storage until the aqueduct raw water is returned to service.

If the failure of an SBL clarifier unit occurred concurrently with a failure of the aqueduct, any mitigating use of the DAF treatment streams would be time limited as the stored aqueduct raw water cannot be recharged. Consequently we would need to be able to promptly repair the offline SBL or provide alternative temporary treatment. To support this, we have identified the potential SBL failure modes and will be mitigating with provision of standby mechanical equipment on each stream (e.g. spare mixer gearboxes).

Treatment duel streaming

The PR14 FD assumed that Birmingham WTW be duel streamed. This was based on the original expectation that the river treatment upgrade would be delivered through an upgrade of the existing treatment streams rather than be provided for in a discrete 3rd process stream. Ensuring full duel streaming of the original two stream WTW would have provided partial treatment capacity in the event of the failure of one process stream under BAU aqueduct operating mode. This was originally assumed to require interventions in the two existing two WTW process streams (e.g. separation of chemical dosing assets).

However, the chosen solution (a discrete 3rd treatment stream) significantly improves the resilience protection offered in the event of the failure of a process stream under BAU aqueduct operating mode. Following commissioning of the BRP assets, the failure of any one of the three Birmingham process streams will now be fully (rather than partially) supported by the remaining two process streams. **This gives an improved level of customer benefit than originally anticipated in the business case and PR14 FD.**

Demonstration of the capacity of the assets constructed (Factory acceptance and site testing)

Factory acceptance tests have been completed for the following treated water components:

- MCC panels across the various processes.
- Pumps from the emergency return pumping station.
- Electrical transformers across the site.

As discussed earlier, we also have mass balance and hydraulic modelling for both the clarification and filtration process components. The design assumptions of both have been tested using pilots installed and undertaken at Trimpley. For the clarification process, we also have a process guarantee from the delivery contractor (Veolia) for the treatment of actual river water.

The sizing design of the sludge lamellas and centrifuges have also been tested using our mass balance assumptions.

On-site testing of components have been scheduled as the construction phase concludes in September 2019 through to December 2019.

The completed treatment process stream (the WTW upgrade) will be tested and commissioned in January 2020 as part of the aqueduct water stability testing. This is discussed in detail in separate section.

Delivering to specification: Summary

Our Birmingham Resilience Project interventions not only comply with the specification set out in our PR14 business case, but **will ensure customers receive greater resilience benefits,** as set out. The way in which the BRP assets will operated under the various configurations is set out in the table below.

Configuration	Birmingham resilience project operation	Customer benefit relative to present
Current configuration	Raw water from aqueduct (310Ml/d supplemented by River Severn Water from Trimpley as necessary 40 Ml/d up to 120Ml/d) approx. Treated using existing WTW (two process streams DAF 1 and DAF2)	
Future BAU configuration	Raw water from aqueduct (approx. 310Ml/d) Treated using three process streams. Stream 1 and 2 at a fixed flow with variability managed using the new 3rd stream.	Improved operational efficiency and maintenance scheduling at our most strategic WTW
aqueduct maintenance window or aqueduct failure	Raw water from River Severn via Lickhill (130Ml/d plus existing Trimpley abstraction) Treated using third process stream only (Treated water: Average flow – 234Ml/d; Peak flow +diurnal maximum – 287Ml/d) Additional treated water necessary to meet Birmingham demand rezoned from Strategic grid and other sources (not treated at Birmingham)	Full protection of supply in event of failure of aqueduct or Elan Valley reservoirs. Allows effective maintenance extending the asset life of our most

		strategic and efficient water source.
Failure of one treatment stream when in aqueduct mode	Raw water from aqueduct (approx. 310Ml/d) Treated using the remaining two process streams	Full protection of supply in event of treatment process stream failure.

Table: Operational configurations before and after the BRP has been completed

Viewed in isolation, there may appear to be some variance between our deliverables and some of the more granular PR14 FD commitments. However, consistent with the outcomes approach, this flexibility is allowing us to deliver even greater customer benefits than a narrow interpretation of the FD, as described below.

Delivery of raw water pumping station and pipeline from River Severn to Birmingham

- PR14 FD values (117Ml/d) considered only average daily flows and did not account for treatment process losses (raw water flows need to reflect WTW input - plus returned process water, rather than treated water delivered).
- Interventions deliver:

  Appropriately scaled raw water assets (130Ml/d) that will match average WTW input requirements (and usage of Birmingham raw water storage to manage diurnal demand and facilitate returned process flows).

  Assets constructed to a specification that will allow for shorter term increases in capacity (pumping capacity, pipeline pressure testing and abstraction licence sufficient for operation at 140Ml/d for shorter timescales).

Delivery of WTW upgrade in order to treat river water

- PR14 FD values (237Ml/d) considered only average daily flows and did not account for: diurnal variation that cannot be managed in the distribution network; or treatment process losses. SBL and RGF capacity also accounted for current partial river water treatment capability which will not be useable in BRP modes.
- Interventions deliver:
  - Most effective clarification and filtration interventions needed of non-blended river water to satisfy peak and diurnal demand requirements (287Lm/d) for the full BRP mode duration.
  - Mitigation of timing and commissioning risks of the new assets and removal of the need for temporary processes that would be required to maintain existing capacity during construction.
  - Enhancement of the WTW duel streaming requirement to provide full rather than partial protection (mitigating any treatment single points of failure when in aqueduct operation).
  - Effective management for the potential failure of individual SBL and RGF process units in order to maintain customer benefit.
  - A more efficient way of operating and maintaining our assets with in BAU aqueduct mode.