Completed acquisition by Pennon Group plc of Bournemouth Water Investments Limited

Appendices and glossary

Terms of reference and conduct of the inquiry

Terms of reference

1. On 8 June 2015, the CMA referred the completed acquisition by Pennon Group plc of Sembcorp Bournemouth Water Investments Limited for an in-depth (phase 2) merger investigation:

    1. In the exercise of its duty under section 32(b) of the Water Industry Act 1991 (the **Act**) the Competition and Markets Authority (**CMA**) believes that:

        (a) it is or may be the case that a merger of two or more water enterprises has taken place, in that a water enterprise carried on by or under the control of Pennon Group plc has ceased to be distinct from a water enterprise carried on by or under the control of Bournemouth Water Investments Limited;[1] and

        (b) the exclusion stipulated in section 33(1) of the Act does not apply, because the value of the turnover of the water enterprise being taken over and the water enterprise already belonging to Pennon Group plc both exceed £10 million.

    2. Therefore, the CMA, in exercise of its duty under section 32(b) of the Act, hereby makes a reference to it chair for the constitution of a group under Schedule 4 of the Enterprise and Regulatory Reform Act 2013 in order that the group may investigate and report on the following questions in accordance with paragraph 3(2) of schedule 4ZA to the Act[2] and section 35(1) of the Enterprise Act 2002:[3]

        (a) whether a water merger has taken place; and

        (b) if so, whether the merger has prejudiced, or may be expected to prejudice, the ability of the Water Services Regulation Authority (Ofwat), in carrying out its functions by virtue of the Act, to make comparisons between different water enterprises.

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[1] Named Sembcorp Bournemouth Water Investments Limited until 16 April 2015.
[2] As given effect to by The Water Mergers (Modification of Enactments) Regulations 2004 (as amended).
[3] As modified and applied to water mergers by The Water Mergers (Modification of Enactments) Regulations 2004 (as amended).

Sheldon Mills
Senior Director, Mergers
Competition and Markets Authority
8 June 2015

Initial enforcement order

2. The CMA made an initial enforcement order on 24 April 2015 and derogations were granted on 28 April, 7 May, 11 May, 14 May and 18 June 2015. The order and redacted derogations granted were published on our webpages.

Conduct of the inquiry

3. We published biographies on the members of the inquiry group conducting the inquiry on 16 June 2015 and the administrative timetable for the inquiry was also published on the CMA's webpages on 16 June 2015.

4. We invited a wide range of interested parties to comment on the acquisition. These included customers and customer view groups, other water companies, relevant professional bodies and government departments. Evidence was also obtained from third parties through hearings, through telephone contact and through written requests. Summaries of hearings can be found on our webpages.

5. We received written evidence from Pennon and a non-confidential version of its main submission is on our webpages, along with Ofwat's main submission and both their responses to each other's submissions. We also held a technical roundtable with both Pennon and Ofwat on 28 July and separate hearings with Pennon, BW and Ofwat on 18 August 2015.

6. On 3 July 2015 we published an issues statement on our webpages, setting out the areas of concern on which the inquiry would focus.

7. On 9 July 2015 members of the inquiry group, accompanied by staff, visited the offices of SWW and BW, as well as undertaking a tour of SWW's contact centre and a tour of BW's treatment works.

8. In the course of our inquiry, we sent to Pennon and Ofwat, and other parties where appropriate, some working papers and/or extracts from those papers for comment.

9. A non-confidential version of the provisional findings report has been placed on the CMA's webpages.

10. We would like to thank all those who have assisted us in our inquiry so far.

Current regulatory approach

Introduction

1. A summary of the current regulatory approach for England and Wales is set out in paragraphs 3.1 to 3.24 of the report. This appendix provides a more detailed description of key aspects of Ofwat's 2014 price review (PR14). The price controls set out in Ofwat's PR14 final determinations apply for the five-year period from 1 April 2015 to 31 March 2020. In PR14, for the first time, Ofwat set separate revenue controls for wholesale water; wholesale wastewater (where applicable); household retail; and non-household retail.[1] We focus particularly on Ofwat's approach to wholesale cost assessment since this relates to the largest component of value of the PR14 price review.

Background to PR14

2. After Ofwat set price limits for the previous price control period (PR09) in November 2009 it began an in-depth review of its price setting and quality standards regulation.[2] In November 2011 it consulted on proposals for the high-level principles that would guide the further development of price setting.[3] The revised process for the 2014 price review began in May 2012, when Ofwat published 'future price limits, statement of principles' that set out the high-level principles that Ofwat intended to use in its next round of price setting. It consulted on the methodology for PR14 in March 2013 and published the final methodology for the price review in July 2013. The process continued until final determinations were published for each WoC, or WaSC, in December 2014.

3. Ofwat said that the price-setting methodology it adopted in PR14 built on many of its tried and tested approaches and encouraged companies to develop innovative, efficient solutions to long-term delivery for their customers and for the environment. Ofwat said that its approach allowed companies to use flexibility and the tools it had given them to respond to the challenges, and allowed Ofwat to focus its regulatory interventions on where they were really needed. Ofwat said that this allowed it to step back where it was assured that companies' business plans reflected good information and

[1] Retail activities are defined in each water company's licence, and include billing, meter reading and handling customer complaints. Wholesale activities are defined as everything which is not retail, and include treating water so it is fit to drink, and transporting it through a network of pipes to a customer's property.
[2] See Future price limits statement of principles.
[3] See Future price limits – a consultation on the framework.

sufficient evidence, extensive engagement with customers and environmental and quality regulators, where boards had been fully engaged, and where the outturns were in line with its expectations on costs and the cost of capital.[4]

4. PR14 saw changes to both the regulatory framework and process compared to PR09. Ofwat required each company to focus on customer priorities and establish an independent customer challenge group (CCG) to review and challenge the way companies engaged customers and took customer views into account and to provide assurance to Ofwat about the quality and effectiveness of companies' direct engagement with their customers.[5]

5. Companies were required to submit business plans to Ofwat by December 2013. Each company's business plan was assessed by Ofwat against objective criteria[6] in a risk-based review and the companies with plans judged to be of exceptional quality were given 'enhanced status' and benefited from an early draft determination (ie less scrutiny from Ofwat) and some financial rewards. The companies that Ofwat assessed to pre-qualify for enhanced status were announced in March 2014 as SWW and Affinity Water. The results of the risk-based reviews for other companies were announced in April 2014. These other companies were requested to submit revised plans in the light of Ofwat's risk-based review. Following this, Ofwat announced its draft determinations for non-enhanced companies in August 2014 (May 2014 for Welsh Water and Northumbrian Water) and its final determinations in December 2014. Price controls were effective from 31 March 2015.

Basic principles of Ofwat's price controls

Aggregate revenue control for wholesale activities

6. The 'price controls' on water companies operate as restrictions on revenues rather than restrictions on specific prices or tariffs. The wholesale price control operates as a restriction on the percentage annual change in a measure of the total charges/revenues attributed to companies' wholesale activities but does not specify the individual prices or tariffs that companies charge for water services (such as unit charges, standing charges, or business tariffs). There are separate regulatory processes, policies and rules that apply to companies' decisions on the level of individual tariffs.[7]

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[4] Ofwat, Annual report and accounts 2013-14, and *Setting price controls for 2015-20 – final methodology and expectations for companies' business plans*.
[5] Ofwat (2014), *Setting price controls for 2015-20 – Overview*.
[6] Ofwat modelled totex.
[7] These tariffs tend to be set annually, subject to the overall constraints from the aggregate revenue control.

RCV-based price control framework for wholesale activities

7. Ofwat's price control framework is based around the RCV.[8] This is a fundamental part of Ofwat's regulatory regime that applies to water companies across England and Wales. The RCV represents a notional value of investment in the business that is used for regulatory price control purposes.[9] At the price control review, Ofwat includes in its calculations an allowance for what it considers to be a reasonable level of return on the RCV, based on the WACC over the price control period.

Incentive regulation

8. Ofwat's price control framework is a form of incentive regulation. It places emphasis on seeking to develop and establish arrangements that provide financial incentives to encourage regulated companies to behave in a way that is consistent with Ofwat's duties (see paragraphs 3.34 to 3.35). Under this type of approach, the price control framework established at a price control review may include financial incentives intended to encourage companies to operate and invest efficiently or financial incentives relating to companies' quality of service.[10]

RPI indexation of the wholesale price control

9. The total allowed revenue attributed to a company's wholesale activities in a year is determined by Ofwat (or the CMA in a redetermination on appeal). It is measured by K plus the annual change in RPI (K may be positive or negative).

The role of cost assessment in the determination of wholesale price controls

10. Under the RCV-based approach, estimates or assumptions of each company's expenditure requirements over the five-year price control period are an input to calculation of the price control. Ofwat seeks to assess what each company's expenditure requirements would be if its spending was in line with that of an efficient company. Expenditure is treated as through revenue

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[8] Also known as the regulatory asset base or regulatory asset value, particularly in other regulated sectors besides water.
[9] The RCV reflects the flotation values of the subset of water companies privatised in 1989 and subsequent investments. It is not a measure of the economic value of the water company's assets. Its value changes over time due to RPI indexation, regulatory depreciation and new investment or expenditure added to the RCV.
[10] In some cases these incentives may take the form of an explicit incentive scheme or arrangement for financial rewards or penalties. In other cases, they may arise from the combined effect of different parts of the price control framework. The effectiveness of the financial incentives that companies face will also depend on companies' expectations about how the regulator will approach the next price control review and how the price control framework will operate in the future.

or through the RCV using the 'pay-as-you-go' (PAYG) and 'RCV run-off' regulatory tools to determine what proportion of expenditure is remunerated through revenue and the proportion that is remunerated through the RCV.

Objectives of retail price controls

11. Under the Water Act 2014, from April 2017 the market for non-household retail services of companies operating wholly or mainly in England will be opened up to competition. There are no current plans for similar measures for household retail services. The household controls are therefore intended to protect customers in the absence of competition, by setting a regulatory efficiency challenge and including a service incentive mechanism. Ofwat decided to allow companies to set default tariffs within a range of allowed average revenue per customer type to strike the best balance between intervention to protect customers and allowing the market to develop and companies to respond flexibly.

Ofwat's approach to wholesale cost assessment for PR14

12. Ofwat changed its methodology for PR14. The following subsection presents an overview of Ofwat's approach to cost assessment, highlighting key aspects.

Outcomes and increased role for customers in the review

13. Ofwat wanted to place greater emphasis on the outcomes that mattered to customers (this was the case for both retail and wholesale cost assessments). Historically, regulatory targets for delivery were set with reference to inputs (such as the construction of a length of pipe) or outputs (such as delivery of a particular engineering scheme).

14. The move to outcomes not only affected the form of regulatory targets, but also the form of business plans and incentives. Companies developed a set of outcomes that reflected what their customers needed, wanted and could afford. These outcomes would then be the subject of performance commitments and incentives (ODIs), which could be either financial or reputational. In assessing company business plans, Ofwat sought evidence to assess that the performance commitments proposed were challenging, appropriately incentivised each company to deliver and were supported by customer engagement.

15. In support of this move to outcome regulation, Ofwat required the companies to establish and work with local CCGs. The CCGs were set up with the intention of ensuring that customers' views would be taken into consideration

as part of the review, in particular in the choice of outcomes and associated investment programmes and ODIs.

A totex approach for wholesale costs

16. After PR09, stakeholders were concerned that the way Ofwat assessed, remunerated and incentivised opex and capex in different ways encouraged a focus on capital solutions (at the expense of potentially more innovative and sustainable solutions involving opex). The Cave[11] and Gray[12] reviews recommended that Ofwat take steps to address this.

17. In its final determinations for PR14, Ofwat said that the use of totex, already used within other sectors, was a key measure introduced to help redress the balance and incentivise efficiency and encourage companies to develop innovative and low-cost solutions to meeting the needs of their customers.[13]

18. Ofwat introduced a single wholesale expenditure allowance that covered both opex and capex. Ofwat did not seek to decompose this into separate allowances for opex and capex. Ofwat's new approach had the following features:

    (a) A fixed proportion of the wholesale expenditure allowance (a totex measure covering both opex and capex) was remunerated directly through revenues collected during the price control period. This proportion is given by the PAYG rate. The remainder was treated as post-2015 additions, to be added to the RCV and remunerated over a longer time period.

    (b) Regulatory depreciation on the opening value of the RCV at the start of the price control period was calculated using a reducing balance depreciation policy, with the applicable annual rate of depreciation given by the 'RCV run-off rate'.

    (c) Separate allowances in the calculation of the wholesale revenue controls for regulatory depreciation were made on the post-2015 additions (ie depreciation in the period to 31 March 2020 of the wholesale expenditure allowance not funded through the PAYG rate).

19. Under Ofwat's previous approach, only capex affected the RCV and regulatory depreciation. A company's RCV grew broadly according to the RPI

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[11] Cave, M (2011), *Independent Review of Competition and Innovation in Water Markets: Final report*.
[12] Gray, D (2011), *Review of Ofwat and consumer representation in the water sector*.
[13] Ofwat (2014), *Final price control determination notice: policy chapter A3 – wholesale water and wastewater costs and revenues*, p2.

indexation of the RCV and according to the level of enhancement expenditure.

Econometric benchmarking models

20. Ofwat placed emphasis on benchmarking analysis that compared measures of totex (modelled allowances adjusted for company-specific factors, reflecting both opex and capex).[14] Ofwat said that the use of totex, already used within other sectors, was a key measure introduced to help redress the balance between opex and capex and support the delivery of the right outcome for customers. Ofwat separately benchmarked water service totex and sewerage totex using comparisons across the 18 water companies and ten sewerage companies using several strands of analysis.

21. Ofwat used a suite of econometric and unit cost models to attempt to estimate how efficient each firm was, once company-specific factors that might lead them to have higher or lower costs were accounted for. Although Ofwat has departed from its approach in PR09 and used a more complex totex model, some form of econometric benchmarking analysis has been used in most if not all UK price controls by Ofwat.[15,16] Ofwat used the following modelling strands:

    (a) Econometric models using panel data to relate specified cost drives to the totex of industry participants. By controlling for known cost drivers Ofwat attempted to isolate the effect of management efficiency in the residual to the regression.

    (b) Econometric models which compared measures of base totex (botex)[17] between companies. A separate benchmarking analysis focused on enhancement expenditure.[18] This took different categories of enhancement expenditure separately. This expenditure was then added to botex to get to totex.

    (c) In addition to the benchmarking analysis, Ofwat made a series of adjustments for special cost factors to capture specific areas of

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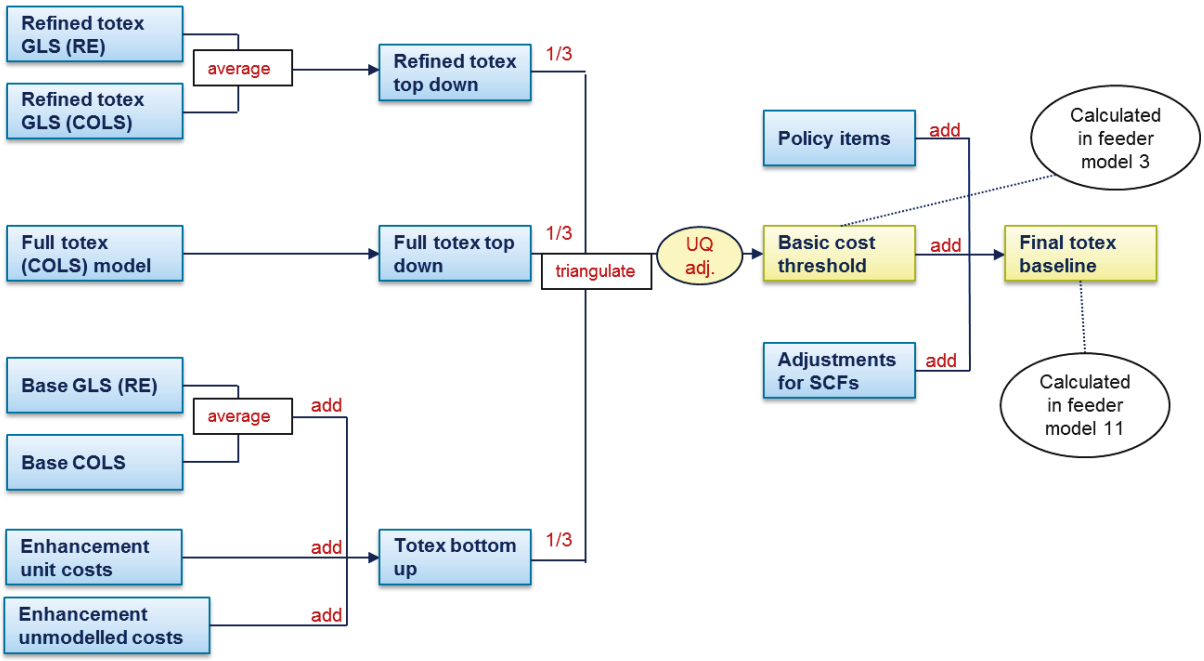
[14] Companies were able to submit requests for special cost factors to be taken into account by Ofwat where they considered that the Ofwat models did not reflect their individual circumstances.
[15] The measure of totex for each company for each year in the data sample is a measure of opex attributed to wholesale activities in that year plus average capex attributed to wholesale activities in the last five years.
[16] Ofwat's consultants, CEPA, adopted an approach of 'smoothing' capex over a five-year period before making benchmarking comparisons between companies.
[17] Botex is opex + capital maintenance expenditure (capex required to maintain existing assets) but excluding capex attributed to enhancement projects.
[18] Enhancement is defined as a level of service delivered better than previously defined. Examples of enhancements include: fewer supply interruptions for customers; fewer disruptions for the public in general; and less pollution.

companies' costs that may not have been assessed sufficiently well by the benchmarking exercise. This was done based on company submissions rather than Ofwat-driven analysis.

22. Figure 1 below shows the different modelling strands used by Ofwat in PR14. Ofwat benchmarked the wholesale costs of companies against each other using a variety of econometric models and unit costs. The econometric water models relied on historical data of the 18 comparators (opex from 2008/09 to 2012/13 and capex from 2005/06 to 2012/13). The efficiency scores derived from these historical performance models were used to set the upper quartile efficiency target applied at PR14. The upper quartile was situated between the fifth and the sixth ranked companies, at 93.47% (calculated by reference to out-turn totex used in the wholesale cost modelling divided by modelled totex after triangulation). This upper quartile was then applied to the modelled costs to set efficient cost targets.

Figure 1: Ofwat's modelling strands in PR14



Source: Ofwat.

23. Econometric models attempt to estimate the efficiency of each company whilst controlling for factors that differ between companies. For instance, if one firm extracts most of its water from bore holes, whereas another extracts most of its water from reservoirs, they may have very different costs driven by different input costs rather than efficiency levels. Econometric models attempt to control for such factors. However, econometric models are not capable of perfectly controlling for all differences between companies, so there will be some uncertainty around the estimates they produce. In order to account for

this uncertainty regulators commonly set benchmarks that are below the efficiency frontier derived from the models

Incentivising companies to go beyond average performance and move towards frontier efficiency and service performance

24. There is no clear-cut methodology for choosing where on the distribution of possible efficiency scores it is appropriate to set the efficiency benchmark. Approaches previously used by other regulators to control for this uncertainty include techniques which attempt to account for noise, such as stochastic frontier analysis, mechanistic rules for establishing the benchmark such as UQ, upper third or median,[19] and regulatory judgements on the required adjustment, such as adjusting the gap by a predetermined percentage.[20]

25. In PR09 Ofwat chose to set the efficiency challenge at the efficiency frontier and median for its respective opex and capex models, but limited the companies which could form the frontier benchmark to ensure that the efficiency challenge was obtainable by all firms in the industry.[21] In contrast in PR14, Ofwat chose to move away from the frontier approach and set the efficiency challenge at the UQ, and allow all firms to contribute towards the benchmark efficiency rather than defining a set of representative companies.

26. Due to the uncertainty in the econometric models, it is reasonably clear that it is not appropriate to set the benchmark at the efficiency frontier when all firms are included in the benchmarking. However, it is less clear what the appropriate point on the efficiency distribution is to set the benchmark. In PR14 Ofwat chose to use the UQ (which was also used by Ofgem in the RIIO-ED1 distribution price control)[22] as it provided a challenging benchmark for the majority of firms in the market, whilst mitigating some of the risk of using a frontier efficiency measure around which there might be a significant margin of error.

27. Ofwat said that by providing such incentives customers benefited in the long term from a better value service. Ofwat also set a high evidential bar for

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[19] See for example, Ofgem (2009), *Electricity Distribution Price Control Review Final Proposals – Allowed revenue – Cost assessment*, p4.
[20] See for example, Ofwat (2004), *Future water and sewerage charges 2005-10 – Final determinations*, p153.
[21] In PR09 Ofwat used relatively simple cross-sectional econometric models to assess opex efficiency and a unit cost comparison across firms to assess capex efficiency. It then set the benchmark for efficiency at the frontier, subject to the following conditions: *(a)* Ofwat had to have no concern about the consistency of the company's data with its reporting requirements; *(b)* The company must have had no special characteristics that were outside of the control of the management and that significantly reduced its costs relative to the industry norm; *(c)* Ofwat must have had no concerns about the independence of the company's data; and *(d)* the company's turnover must have represented a reasonable proportion of the industry. The threshold was be equivalent to the size of the smallest WaSC (which tends to represent between 2.5 and 3% of water services turnover).
[22] Ofgem (4 March 2013), *Strategy decisions for the RIIO-ED1 electricity distribution price control. Tools for cost assessment. Supplementary annex to RIIO-ED1 overview paper*.

companies to demonstrate why their position was different from others within the sector, assessing any claims consistently against set criteria.

28. Where Ofwat's forecast of efficient costs was significantly above the company's own forecast as suggested by the company's business plan, Ofwat adjusted its forecast downwards. This adjustment was only made for companies that were not fast-tracked, with Ofwat choosing to set the cap at 5% based on the difference between efficient costs and business plan costs for the two firms that were fast-tracked at PR14. It is not clear that if the cap were used in a future price review whether it would be reset based on the fast-tracked firms in that price review. The cap only applied to one firm at PR14 – Thames Water.

Benchmarking analysis was a starting point for further assessment

29. Ofwat's approach to benchmarking analysis and its use of econometric models was complemented by the wider process for company-specific analysis and special cost factor adjustments. Ofwat accepted that its benchmarking models could not capture every company's specific cost drivers. Ofwat therefore, where appropriate, took into account company-specific factors that might not be captured so well in its benchmarking models. For example, one company may need to build a new reservoir, or another may have a large industrial customer accounting for a significant percentage of its total volume supplied.

Incentives for improved business plans

30. As stated in paragraph 5, Ofwat conducted a risk-based review of the companies' business plans. Plans judged to be of exceptional quality (in the areas of proposed outcomes, the cost of delivering those outcomes, the balancing of risks and rewards between the company and its customers, and affordability and financeability) were classified as pre-qualified for 'enhanced' status. Companies that accepted the criteria necessary to qualify as enhanced were fast-tracked to an early draft determination in April 2014 (as opposed to August for companies with 'standard' plans).[23] They were protected against later changes by Ofwat to the cost of capital and other interventions (the 'do no harm' principle) and also benefited from an initial financial reward. Ofwat also did not intervene to make major changes to the business plans of companies with enhanced status. Fast tracking meant that those companies with enhanced status were able to start focusing on how

[23] Or May for Welsh Water and Northumbrian Water.

they were going to deliver the outcomes promised in the plans several months earlier than companies which were not fast-tracked.

31. Ofwat told us that the risk-based review process was intended to encourage companies to take ownership of their business plans and to submit realistic plans (rather than try to 'game the regulator'). As part of its review, Ofwat looked for evidence that companies' boards had taken ownership of their plans and provided assurance that its outcomes were consistent with relevant statutory requirements and licence obligations.

32. Ofwat applied a 'menu regulation' scheme for PR14, under which Ofwat compared each company's totex in its business plan with Ofwat's own totex estimates derived from its models. Depending on how far above or below Ofwat's estimate the company was with its estimate determined the extent to which cost efficiencies or overruns over the price control period would be shared between shareholders and customers. In addition, the menu scheme provides rewards and penalties for forecasting below or above Ofwat's cost assessment. Companies with enhanced status received an additional incentive under the totex menu.

33. Ofwat's view was that its menu regulation scheme would provide extra incentives for companies to provide accurate expenditure forecasts, allow some extra flexibility in setting totex baselines, provide some additional flexibility in setting efficiency sharing factors and allow companies to better manage risks and rewards.[24] Ofwat also intended to use its PR14 menu scheme to provide flexibility to companies, in particular in terms of the level of cost sharing incentive that each company faces.[25]

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[24] Ofwat (2013), *Setting price controls for 2015-20 – final methodology and expectations for companies' business plans*, p88.

[25] Perhaps the core feature of the menu scheme is that it determines the cost-sharing incentive as a declining function of the company's expenditure forecast. The higher the company's expenditure forecast relative to Ofwat's wholesale cost baseline, the lower the cost-sharing incentive (and the greater proportion of any variations in out-turn expenditure that is passed through to consumers). This feature of the scheme enables it – under certain assumptions – to provide financial incentives for the regulated company to submit an expenditure forecast that reflects its own expectations of what it will need to spend during the price control period (hence Ofgem's terminology of its comparable scheme as the Information Quality Incentive). A second relevant feature of the menu scheme is that the wholesale expenditure allowance, which feeds into the calculation of the maximum allowed revenue for the company in the price control period from 1 April 2015 to 31 March 2020, is not simply Ofwat's best assessment of the company's efficient expenditure requirements (if it operates and invests efficiently) over that period (ie Ofwat's wholesale cost baseline). Instead, it is a weighted average of Ofwat's cost assessment and the company's forecast. The greater the company forecast, the higher is the allowed revenue in the price control period from 1 April 2015 to 31 March 2020.

Cost of capital

34. In its final determinations, Ofwat set a wholesale weighted average cost of capital (WACC) of 3.60%. There were some exceptions:

- enhanced companies[26] were awarded a higher WACC of 3.7%; and
- Portsmouth Water and BW were allowed a small company uplift on the cost of debt of 0.25%, equating to a 0.15% uplift on the overall cost of capital.

35. Ofwat considered that it was not in customers' interest to set the cost of capital based on embedded debt costs of individual companies as this would reduce the incentives for companies to finance themselves efficiently. Instead it assumed a notional level and cost of debt. In setting the notional cost of debt, Ofwat considered the cost of debt of companies and how that compared to corporate benchmarks.

36. Ofwat did not consider that small WoCs had a higher cost of equity but accepted that on average they faced a higher cost of debt. It considered that a 0.25% adjustment to the efficient notional cost of debt was appropriate as a small company premium on debt costs, after comparing the costs of debt of small water companies with those of WaSCs and corporate benchmarks. However Ofwat considered that companies had to demonstrate that this allowance was in the customer interest (the benefits test). The benefits test assessed whether the customer benefits from providing the uplift more than offset the incremental financing costs. Ofwat accepted that the other small WoCs had a higher cost of debt (than included in the industry wholesale WACC) but that there was no robust evidence of an offsetting customer benefit.

37. For calculating the cost of equity, Ofwat used the capital asset pricing model. This requires estimates for the risk-free rate, and equity market returns, as well as requiring a company-specific estimate for 'beta' (the systematic risk). Ofwat's estimates for these were based on:

- **risk-free rate**: current gilt yields adjusted for forward-looking expectations, alongside regulatory precedent;
- **equity market return**: historic equity returns and dividend growth models, as well as regulatory precedent (controlling for RPI methodology changes); and

[26] SWW and Affinity Water.

- **beta**: estimated from the three publicly listed WaSCs and applied to all water companies, with no company-specific uplift/small company premium allowed.

38. Finally, Ofwat implemented an 'appointee-wholesale' adjustment in order to ensure that companies are not compensated twice – once in the retail margin, and again in the returns from capital. Ofwat stated that, since the retail businesses generated positive margins, these represented a return in the retail control which should be netted off the appointee WACC to give a wholesale water-only WACC. This would ensure that returns were not included twice. This was because the household retail price control did not introduce significant new risks. As a result, this margin reflected a transfer of capital and risk from the wholesale control and should be deducted in its entirety.[27]

Retail price controls

39. PR14 was the first review where Ofwat explicitly split its price control between retail and wholesale activities. In PR14, the traditional price control discussed above was set for wholesale only, with retail prices being regulated as a margin over costs (including both separate retail costs and wholesale costs).

40. In PR14, Ofwat regulated these retail costs by means of an ACTS. To calculate this, it first ensured that each company's 2013/14 costs were correctly allocated between wholesale and retail, household and non-household, and metered and unmetered customers. It then removed from each company's retail costs any company-specific adjustments resulting from matters outside management's control and added in any material new retail costs projected for 2015/20 where it accepted that these were necessary, before calculating the average retail cost to serve across all companies (separately for metered and unmetered customers). These ACTS levels for each customer type were then used as benchmarks by Ofwat. It applied an efficiency challenge, requiring each company whose forecast costs were above the ACTS to bring its costs down to at least the ACTS level over a three-year glide path. Efficient companies whose costs were below the ACTS were allowed their forecast costs. Ofwat then added back in any approved company-specific adjustments before applying a net margin (1% in the case of households) to calculate each company's allowed retail revenue (expressed both as a total and as a per customer amount based on forecast customer numbers).

[27] Ofwat (2014), *Setting price controls for 2015-20 – risk and reward guidance*, p34.

Reconciling 2010 to 2015 performance

41. Part of Ofwat's final determination included a number of mechanisms to reconcile performance against the PR09 final determination with actual performance delivered.

Service incentive mechanism

42. SIM is designed to encourage companies to provide better service to customers. It also allows customers to compare the performance of their company with others. The SIM was introduced following PR09 and replaced the Overall Performance Assessment that had been in place in previous price reviews. The SIM measures two aspects of customer service delivery:

    - where customers have made contact when something has gone wrong, for example, phoning about a billing error or writing to the company to complain; and
    - how well the companies have handled all types of customer contacts, not just when things have gone wrong. This is measured using a customer survey.

43. Ofwat calculated the three-year average SIM performance of companies for the years 2011/12, 2012/13 and 2013/14. The rewards or penalties each company received were presented as wholesale revenue adjustments in the next control period, in the range +0.5% to –1.0% of company regulated turnover in 2013/14. In making its decisions on rewards and penalties for SIM, Ofwat assessed companies' performance relative to the industry average and looked at the degree of standard deviation from this average on a company by company basis.[28]

Outcome delivery incentives

44. Previous price reviews provided incentives for companies to become more efficient and provide better service but there was concern that there was little incentive for outperformance and consequently companies depended on higher WACCs in their business plans to provide adequate returns for investors. For PR14, companies were encouraged to set financial incentives (both reward and penalty) directly linked to performance above and below their performance commitments underlying each outcome and relative to

[28] ibid.

allowed totex.[29] The incentives were directly linked to customer priorities and willingness to pay, to align reward for investors with benefits to customers.

45. The PR14 process to incentivise outcome performance was designed to reduce direct regulatory oversight and give companies flexibility on the approach to managing their resources, whilst focusing on directly benefiting customers in areas they care about.

46. The intention behind the design of ODIs was that these should be based on customer research and agreed with the CCGs. Companies were asked to come up with their own list of broad specified outcomes (eg 'reliable supply') underpinned by metrics and targets (PCs), based on the customer research. This also included determining the type and size of reward/penalty that is appropriate for exceeding/failing the measure.

47. Ofwat chose to intervene in a number of these areas, particularly regarding the target levels of service required. In some cases, it did this to ensure that companies were targeting UQ level performance, as Ofwat told us that customers were unaware of the level of service that other companies were providing, so could not accurately assess this for themselves.

[29] If actual performance is within a so-called 'deadband' around the performance commitment level, no reward or penalty arises. If performance is above the reward deadband, the company earns a reward (or pays a penalty if performance is below the penalty deadband). The aggregate financial impact of rewards and penalties is capped at +/- 2%.

Ofwat's use of comparators and planned reforms

Introduction

1. Ofwat told us that it currently used comparators across three main areas of activity:

   - to set price limits;
   - to monitor and incentivise service quality; and
   - to carry out ongoing monitoring, enforcement and spreading best practice.

Comparisons used to set price limits

Wholesale cost modelling

2. As discussed in Appendix B, paragraph 21, Ofwat used a suite of econometric and unit cost models to determine wholesale cost allowances at PR14. For water, Ofwat used several econometric models as inputs to a final assessment of totex using panel data from 18 companies over a five-year period. Modelled outcomes were compared with companies' business plans to generate efficiency scores which could then be compared between companies.

Wholesale special cost factor claims

3. In determining the totex allowance, Ofwat considered a number of special cost claims from companies, some of which were assessed through comparisons between companies. For example, it assessed one company's claim for additional energy cost allowances by comparing its pumping head and energy costs as a percentage of totex across the industry to establish if the company was different from others. Other examples included comparisons between companies in respect of claims related to density of their operations, nature and quality of water resources and treatment requirements.

Retail average cost to serve

4. As discussed in Appendix B, paragraph 40, Ofwat's assessment of household retail price limits used an industry-wide ACTS as its starting point. Drawing on data from each of the 18 companies, it calculated separate ACTS for different customer types, ie for measured and unmeasured water-only, wastewater-

only, and water and wastewater customers. Ofwat also considered whether any company-specific (or special factor) adjustments should be made, particularly relating to the area of bad debt costs.[1]

5. In relation to non-household retail services, Ofwat set limits on the average revenue per customer for each customer type ('default tariffs'). For companies operating wholly or mainly in England, this was intended to help protect all non-household customers before and after they are able to choose their supplier for retail services for water (and sewerage) services – which is expected to be in 2017.

Bad debt

6. In PR14, Ofwat compared bad debt claims across companies as well as levels of deprivation using an econometric model. Its assessment of bad debt cost related adjustments included comparisons of companies' bad debt management practices and the relative deprivation of the areas served by each company.

Other

7. Ofwat told us that it also used comparisons between companies in areas such as pension deficit levels, companies' approaches to cost allocation between wholesale and retail and household and non-households, PAYG and RCV run-off rates, accounting policies (for example on infrastructure renewals expenditure under the International Financial Reporting Standards accounting standards), the tax treatment of capex, gearing levels and debt costs, and target credit ratings and forecast financial ratios.

Comparisons used to monitor and incentivise service quality

ODIs and performance commitments

8. As discussed in Appendix B, paragraphs 44 to 47, at PR14 companies were required to propose their own PCs and ODIs. They did so across a wide range of areas, most of which were company specific and some of which were common across the industry. Ofwat carried out a comparative analysis on the ODIs and PCs that were most common across the industry. Ofwat used comparative assessment to identify UQ performance commitments for three ODIs in relation to water (supply interruptions; water quality customer contacts; and water quality standards) and to intervene to ensure that companies

[1] Other areas were also considered, for example input price pressure and new cost claims.

were only able to access rewards for genuinely stretching performance. For some company-specific PCs and ODIs, Ofwat also made use of comparisons where there were similarities in a subset of the companies. It also used cross-company comparisons to identify gaps, and in these areas it intervened to introduce additional ODIs.

Service incentive mechanism

9. The SIM is described in Appendix B, paragraphs 42 to 43. As companies are rewarded or penalised financially for their performance relative to the rest of the industry, comparisons are critical to the operation of the SIM. The SIM is incorporated into the household retail price control for all English and Welsh companies. In the absence of the opening of retail activities to competition for all non-household customers in Wales, Ofwat told us that it used a separate SIM to measure and incentivise non-household retail performance of the two Welsh water companies. This used comparisons of the performance of the Welsh companies with those in England.

Company performance measures (KPIs)

10. Ofwat said that it monitored and published company performance against a range of service quality and other measures. The KPIs that it published related to customer performance in respect of:

- **customer experience**: the SIM score, internal sewer flooding incidents and water supply interruptions;
- **environmental impact**: greenhouse gas emissions, sewerage pollution incidents, serious sewerage pollution incidents, discharge permit compliance and satisfactory sludge disposal; and
- **reliability and availability**: water non-infrastructure serviceability, water infrastructure serviceability, sewerage non-infrastructure serviceability, sewerage infrastructure serviceability, leakage and security of supply index.

Comparisons to carry out ongoing activities in relation to monitoring, enforcement and spreading best practice

11. Ofwat said that its use of comparators in this area was largely qualitative rather than quantitative. In this section, we deal with Ofwat's use of comparators in respect of customer issues, company behaviour and operating practices, and accounting and reporting of data.

Customer issues

12. As part of PR14, Ofwat assessed the information companies had provided on customer engagement and willingness to pay. It said that companies whose business plans did not score well in this assessment were able to learn from the best practice approaches adopted by companies rated as ‘exceptional’.

13. Ofwat said that it had also used qualitative comparisons to identify those companies which were ‘leaders of the pack’ with respect to the implementation of alternative dispute resolution processes. These companies were then asked to take a prominent role in taking the industry forward. Qualitative comparisons also spread best practice in areas such as social tariffs and affordability measures. It also told us that when companies published their codes of practice and compensation schemes, there were reputational incentives to be at least as good as their peers.

14. Ofwat said that although it had moved away from detailed scrutiny of individual companies’ tariff policies, companies had to assure Ofwat that their tariffs complied with its policies. As a result of Ofwat’s assessment of companies’ charges for 2015/16, companies were allocated to three assurance categories according to the issues it identified with the information provided.

Company behaviour and operating practices

15. Ofwat published a commentary in June 2014 on all companies’ codes of governance, board leadership and transparency, and encouraged companies that it regarded as not performing well in this area to move towards the best practice demonstrated by the stronger performers.

16. Ofwat told us that it compared companies’ compliance with obligations and market rules to identify companies which needed additional input. Where it had carried out investigations, it said that it had in the past made observations that helped to spread best practice for future casework investigations.

17. Ofwat said that it used comparators to assess the robustness of company claims for changes to price limits during a control period. When assessing these claims, it aimed to identify the change in costs which an efficient company would have incurred as a result of the change in circumstances and, if so, whether that justified a change in a company’s price control. As part of this, it made comparisons across the industry to understand whether a company had been particularly affected by the circumstances which it claimed had given rise to the additional costs incurred and whether the company had taken appropriate steps to mitigate the effects of those circumstances on its costs.

Accounting and reporting of data

18. In 2015, Ofwat published a Company Assurance Framework for consultation. It said that the aim was to provide a framework to help companies, customers and others benefit from providing open and transparent information. Ofwat said that companies were graded according to its assessment of past performance to determine assurance requirements. It said that these arrangements required water companies to take ownership of the information they collected and to provide customers and stakeholders (including Ofwat) with assurance that the information could be trusted.

19. Ofwat told us that it had compared across companies to highlight best practice with respect to transparency and companies' approach to reporting, and had encouraged others to adopt it. As part of PR14, it had expected companies to be transparent about their business plans and had established a high bar in respect of the publication of information that was used in making its decisions in the price review. In some instances, it had made use of comparisons where companies had argued that publication of a specific piece of information might seriously or prejudicially affect their interests.

20. Ofwat said that as its approach to regulation had evolved and companies had been required to report on a more disaggregated basis, it had reviewed and challenged companies' approaches to cost allocation to ensure allocations were consistent with reporting guidance. In the past, it had undertaken a targeted review of cost allocations for retail activities. More recently it had published best practice guidance in respect of costs for upstream services.

How Ofwat's use of comparators could change in the future

21. Ofwat told us that its use of comparators could change in the future arising from:

    - implementing the Water Act reforms and preparing for PR19; and
    - changes to how it monitored sector performance.

    The need for comparators could also change if, for example, Ofwat were to make significant changes to the form of its benchmarking models in future price reviews, or if it changed the extent to which it intervened in the way companies set their ODIs.

Implementing the Water Act reforms and preparing for PR19

22. Ofwat said that its approach to setting price limits at PR14 was a step towards its longer term objectives for the sector. It said that the methodology adopted

at PR14 was in the context of an approach where it would continue to adapt and evolve its approach to setting price limits to take account of changes in the water and sewerage sectors. It had very recently commenced a programme of work, 'Water 2020', which would among other things:

- develop and implement the English upstream market;
- develop and deliver an efficient and effective methodology for the 2019 price review;
- support the development of retail competition for non-households; and
- consult on the approach to its new resilience duty.[2]

23. While water sector comparisons are likely to continue to be important in assessing wholesale costs, Ofwat has indicated that its approach to the retail cost to serve for households was likely to evolve from an average cost to serve approach to a UQ approach (and potentially, over time, to frontier efficiency benchmarking) as it assumed that companies' retail costs to serve would converge reasonably quickly.[3]

24. In respect of ODIs, Ofwat said that all companies were incentivised to reach current UQ performance by the middle of the 2015–2020 period and so it was unclear on what basis it would carry out any comparative assessment of ODIs for subsequent control periods. It said it might set a dynamic UQ target for service and efficiency performance.

25. In respect of the SIM, for the purpose of its assessment of detriment in the case of this merger, Ofwat assumed that there would be no benefit from SIM beyond 2025, and that water companies were unlikely to provide as much value as retail comparators beyond 2015–2020 as they had in the past, as it could offset the loss of a water company benchmark by greater reference to other sectors (ie retail operations in sectors other than the water industry).

26. Ofwat told us that effective non-household retail competition could remove the need to use comparisons for non-household control. It said that while competition was developing there was likely to be a continuing need for reporting, transparency and monitoring. Hence the focus of comparisons would move from an ex-ante to ex-post basis. It said that if competition

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[2] Ofwat published its consultation document, *Towards Water 2020 – meeting the challenges for water and wastewater services in England and Wales*, in July 2015.
[3] In the PR14 methodology impact assessment, Ofwat assumed that companies would eliminate 75% of the difference between their cost and that of the most efficient company within 20 years.

developed sufficiently, it might be possible to remove regulatory reporting requirements and monitoring.

27. Ofwat said that an abstraction incentive mechanism was expected to be introduced in 2015 as a reputational incentive based on a ranking in a league table, moving to a financial incentive in 2020–2025 that encouraged companies to trade water where this was the most efficient option for balancing supply and demand. It said that the objective of the mechanism was to incentivise companies to reduce abstraction of water from environmentally sensitive sites at environmentally sensitive times such as low river flows.

28. Ofwat said that it expected the introduction of separate network plus non-binding sub-limit controls from 2015–2020 to encourage efficiency by improving transparency of costs and revenues. If network plus sub-limits were used for subsequent controls, their impact on the use of comparators was unclear. It said that, on the one hand, the importance of water sector comparators in wholesale cost assessment could increase but, on the other hand, if a move to more focused controls led to better specified models, and therefore more robust results, then this might reduce the reliance on individual comparators. It also said that, in the long term, it might introduce binding service level sub-limits. It said that the impact was likely to be similar to network plus non-binding sub-limits, although it would if anything increase the need for robust comparative models.

29. The PR14 methodology confirmed that Ofwat would consider the introduction of network management reporting for water networks and the wastewater networks relevant to sludge. Ofwat said that this might allow the potential for longer term changes from upstream competition which included storing, treating and distributing water and collecting and disposing of sewerage. It said that the introduction of competition in specific upstream areas could require the allocation of RCV across the value chain. It told us that, while competition would provide a greater customer focus on price and service, this could increase the need for ex-post comparisons and monitoring in the short term as competition developed, but that over the longer term, competition, when sufficiently developed, could reduce the need for comparators.

Monitoring sector performance

30. Ofwat has recently published a consultation on the framework under which it would monitor the financial stability of the regulated water companies.[4] Ofwat told us that the intention was to have a clearer and broader view of solvency,

[4] Ofwat consultation on financial monitoring framework.

liquidity, risk management and longer term financial viability in light of anticipated investment programmes. This would enable it to identify those companies whose financial metrics were deteriorating over time. It said that comparative reporting in this area would create a reputational incentive for all companies to be transparent about their ownership, financial and governance structures.

31. Ofwat said that it expected to continue to take in-depth, targeted reviews of specific issues that were important for monitoring company performance and spreading best practice, and which could also be relevant to how it gathered comparative data that may be relevant to setting price limits in the future. It said that it expected to carry out a targeted review in January to March 2016.

32. Ofwat said that it was currently consulting on the approach to its new primary duty under the Water Act to further the resilience objective.[5] It said that it would need to create the right regulatory framework to enable, incentivise and encourage companies to plan and invest for resilient systems and services now and in the future. As it developed its approach to the duty, it might draw comparisons between companies in this context.

33. Ofwat told us that it had challenged companies to agree a set of service levels for their developer services activities against which they would regularly report their performance. Companies agreed these in April 2015 and published their first quarterly report in July 2015. It said that commitment that companies would regularly report their performance would not only improve transparency, but would encourage those companies lagging behind to catch up. Ofwat has also asked all water companies to review the information on their websites about the self-lay option for developer services and how customers accessed the information and services they needed for this. It said that it was undertaking a comparative analysis of the information companies provided with a view to sharing good practice that will better enable an effective self-lay market.

[5] Ofwat consultation on its new role in resilience.

Impact on the precision of Ofwat's wholesale cost models

Ofwat's wholesale cost modelling approach

1. Ofwat's wholesale cost modelling approach estimates the level of cost allowance that each company should receive under the wholesale price control solely according to each company's cost drivers, other than efficiency, in order to isolate a measure of management efficiency.

2. Ofwat uses a number of different models in its modelling approach at PR14, and each has an equation of a similar form to that in the simplified example below. In this example, each of the β's represents the relationship between cost drivers (for all water companies) and their cost expenditure – controlling the impact of other cost drivers on expenditure. These β's are called 'coefficient estimates' and are estimated using econometric regression analysis.

Simplified example of coefficient estimates in Ofwat's econometric models

$$cost\ expenditure = \beta_0 + \beta_1 costdriver1 + \beta_2 costdriver2 + \beta_3 costdriver3 + \text{error} \ldots$$

3. Ofwat uses these coefficient estimates for the relationships between water companies' historical cost drivers in each model to obtain forecast cost for each water company.

4. Ofwat then combines the forecasts in each model together by taking a weighted average across all its modelling strands[1] to obtain an 'overall econometric totex estimate', a forecast cost curve for each water company's cost's over the next five years.

5. Finally, Ofwat adjusts its forecast cost curve to the level of the UQ firm to obtain its UQ benchmark, the starting point for Ofwat's calculation for each water company's cost allowance under its price review.

6. Since the merger has a minimal impact on the precision of the forecasts for individual water company's cost drivers,[2] both we, Ofwat and Pennon have focused on the impact that the merger has on the precision of coefficient estimates by looking at the precision in the historical cost curve for water

[1] As described in Appendix B.
[2] However, it may be that for example certain smaller companies have less accurately forecasted cost drivers than other companies – but we have received no evidence from Pennon or Ofwat to suggest this.

companies' costs over the 2009 to 2013 period. And in doing so, we all assume that estimated changes in the level of precision in Ofwat's 'historical econometric totex estimate' equate to changes in the level of precision in the overall econometric totex estimate.

Recent advancements to Ofwat's modelling

7. Ofwat made a number of significant changes to its wholesale cost modelling at PR14 compared with previous price controls which are relevant to considering the potential loss of precision resulting from the merger:

   (a) First, it introduced the use of panel data, with the models including five years of data for each water company. Using panel data in its econometric models allowed Ofwat to use both variation in company data over time as well as the variation in data between companies.

   (b) Second, it modelled combined totex, whereas previous reviews had considered opex and capex separately.

   (c) Finally, Ofwat used a UQ benchmark as the basis for its efficiency targets, whereas previous reviews had used different approaches (eg a frontier target for opex and a median cost target for capex).

8. In general, we would expect the use of panel data to reduce the impact of the loss of a comparator on the overall precision of Ofwat's models, compared with a model based only on cross-sectional data. However, as discussed below, the important factor is the extent to which the loss of a comparator firm reduces the degree of useful variation in the data which is used to estimate Ofwat's models.

Measuring a statistical reduction in precision

9. A standard principle of statistical theory is that fewer data points will lead to less precise econometric estimates. We would expect larger samples to be more likely to represent the population from which they are drawn (ie closer to the true values they are trying to estimate). Intuitively, the larger the sample upon which an estimate is obtained, the lesser the extent to which the randomness in the observations drawn from the population it wants to estimate, affects that estimate.

10. By reducing the number of independently managed companies in the industry by one, the merger reduces the number of observations available for Ofwat to use in its current econometric models from 90 to 85 (five years of annual observations for one company). One possible adverse impact of the merger is

to make Ofwat's estimates less precise because of the smaller sample size that is available to generate these estimates. This reduction in precision will in turn reduce the reliance that Ofwat can place on these estimates and so measures of relative cost inefficiency that it needs to derive.

11. Further SWW and/or BW may have some characteristics which make them particular good, or bad, comparators. In controlling for water companies' heterogeneity, Ofwat's modelling approach estimates the extent to which relevant factors determine a water company's costs by exploiting differences in the relationship between the relative variation in these water companies' relevant factors and their cost expenditure. Therefore, if as opposed to the new merged firm, BW or SWW were to contain characteristics that provided more variation in certain relevant factors, the merger may result in poorer precision in Ofwat's models.

12. The precision of a coefficient estimate can be measured by estimating the width of its confidence interval. The confidence interval gives an estimate of the range within which we can be confident that the true value of the coefficient estimate lies with a given level of probability.[3] The width of a confidence interval provides a measure we can use to compare the precision of different estimates, where the greater the % width of the confidence interval (as % of the predicted values of the model), the less reliable the estimate.

13. The width of a confidence interval is determined by the standard error, the standard deviation of the sampling distribution of a statistic.[4] The standard error can be thought of as a statistic which provides an estimate of the uncertainty that should be attached to an estimate, given the variation in the data used to derive that estimate.[5]

14. The size of a standard error is determined by a combination of: [6]

    (a) the number of data points upon which a coefficient estimate is based;

    (b) the amount of variation in the variables used to calculate a coefficient estimate;

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[3] To give an example, a 95% confidence interval for a parameter might stretch from 2 to 6, suggesting that given the extent of variation in the data, we can be 95% confident that the true value of the parameter lies between 2 and 6. The confidence width in this example would be 4 (the upper bound of the confidence interval minus the lower bound).

[4] Specifically, typically the upper bound and lower bounds of the confidence interval would be +/- 1.96 multiplied by the standard error from the base coefficient estimate.

[5] Theoretically, the standard error of a coefficient estimate is given by the simplified formula in Annex 1.

[6] These are nt, $SSX_j(1-Rj^2)$, SSR and k in the simplified standard error formula in Annex 1.

(c) how closely the overall econometric model estimate 'fits' the current data;[7] and

(d) the complexity of the overall econometric model being estimated in terms of number of variables used and the correlation between them.

15. In addition to standard errors and confidence intervals one can also look at prediction intervals and prediction errors to assess the precision in Ofwat's model. Prediction intervals provide the range within which we can be confident that the true value of the model predicted values for each water company lies with a given level of probability. And just as standard errors are used to derive confidence intervals prediction errors are used to derive prediction intervals[8].

16. Standard errors, confidence interval widths, prediction errors and prediction interval widths all provide a statistical estimate of the reduction in precision in Ofwat's models.

17. Assessing the precision of Ofwat's models is very challenging given the complex nature of its econometric modelling technique. In particular, one cannot completely separate out the change in precision from the change in variation in water company efficiency due to the merger. This is because water company efficiency is not directly estimated by Ofwat's econometric models, and is instead reflected in the model residuals (ie the difference between each company's actual costs and the costs predicted by the model). If a merger leads to a narrower range of relative efficiencies between water companies, this would entail a reduction in the average size of the residuals estimated by the model, which might suggest that the model is becoming more precise. However, what we really want to know is the extent to which the merger leads to a reduction in the precision with which Ofwat can model the other key determinants of wholesale costs aside from company efficiency, rather than how the merger affects the distribution of relative efficiency performance.

Does the merger lead to a statistical reduction in precision?

18. To estimate the statistical reduction in precision due to a loss of a comparator, we have looked at four main methods:

[7] Specifically, the unexplained variance in the data.
[8] However, Pennon have also used prediction errors to derive 'confidence intervals'. Further to clarify when we refer to the prediction error we means the standard error of the prediction (the 'predict, stdp' command in Stata).

(a) Ofwat's and Pennon's interpretations of the General Approach as used by the CC in past water mergers.

(b) Pennon and Ofwat's simulations of the merger where they both re-estimate the econometric models under pre- and post-merger assumptions in their own interpretations of the Specific Approach as used by the CC in past mergers.

(c) Ofwat and Pennon's bootstrapping simulations which estimate the change in the bias of standard errors pre- and post-merger.

(d) Our own Qualitative Approach which looks at the theoretical statistical reduction in precision that may arise from the loss of BW's independent observations.

The General Approach

19. The theoretical impact of the merger in terms of a loss of generalised data points can be measured by changing the degrees of freedom in standard errors or prediction errors. The degrees of freedom in standard errors or prediction errors are measured according to the sample size and the complexity of the econometric estimate.[9] Because the merger reduces the sample size by 5 data points[10] one can simulate the loss of 5 'generalised' data points (which provide no extra variation in Ofwat's data) by adjusting the number of degrees of freedom used in standard errors, prediction errors, prediction intervals and confidence intervals. The theoretical increase in standard errors due to this loss of generalised data points is 3 to 4% in each of Ofwat's models.[11]

20. In broad terms, the General Approach involves looking at how the loss of a comparator following a merger is likely to affect a given 'error band' around the benchmark in Ofwat's current wholesale models. This can be approximated by perturbing the coefficient estimates for the slope in Ofwat's models by plus or minus one standard error, and then repeating this calculation for the removal of data points.[12,13] In principle, the General Approach thus measures how much more or less challenging Ofwat's efficiency benchmark

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[9] Both nt and k in the standard error formula in Annex 1.
[10] Pre-merger, SWW and BW both reported annual observations for five years giving ten observations. Post-merger the combined entity will report annual observations for five years giving five observations.
[11] Pennon's initial submission, p18.
[12] With standard errors adjusted for the post-merger reduction in a degrees of freedom.
[13] Perturbing by plus or minus one standard error is a method for generating an error band which can be compared between and after the merger. It is an ad hoc assumption in that it would be possible as an alternative to perturb by more or less than a standard error to produce a different error band, but this is unlikely to have a significant impact on the results, and is consistent with the approach taken in past water merger cases investigated by the CC.

for each water company might become post-merger if Ofwat's estimate were to be out by a given amount of error.

21. There is one main caveat to this approach. The estimated increase in the error band due to the merger is not specific to the loss of the data points related to the merger (ie BW), as a specific loss would also have an impact on the size of the residuals and the variation in Ofwat's data.

22. Both Pennon and Ofwat had different interpretations of when and how to use the General Approach.

Ofwat's interpretation

23. Ofwat separated out its estimate of a reduction in precision under the General Approach into two parts:

    (a) a reduction in precision in its historical overall econometric totex estimate (that is, the cost curve that predicts each water company's costs according to their cost drivers which is used to derive the UQ benchmark); and

    (b) a reduction in precision in its UQ benchmark (the efficiency challenge in Ofwat's calculation for each water company's cost allowance under its price reviews).

A reduction in precision in the overall econometric totex estimate

24. Ofwat stated that a reduction in precision in its overall econometric totex estimate made it harder to have confidence in the benchmark it sets. Specifically, it argued that if the precision in its overall econometric totex estimate was reduced, this might lead to firms requesting a specific adjustment to their cost allowance or Ofwat having to reduce the level of its efficiency challenge under its benchmark.

25. To illustrate the level of increased imprecision in its models due to a loss of a comparator, Ofwat looks at the precision of its historical overall econometric totex estimate for PR14 (the historical cost curve for each water company's costs over the 2009 to 2013 period). By creating an error band around it and seeing how that error band increased due to the loss of five generalised data points (representing the five that would be lost due to the loss of BW as a comparator)[14].

[14] Adjusting the standard errors for a reduction in the degrees of freedom.

26. Ofwat performs this calculation in five steps:

27. First, Ofwat calculates the predicted values for the historical cost curve[15] estimated by its econometric totex model in three scenarios:

    (a) The current historical overall econometric totex estimate.

    (b) A scenario where the predicted values of the historical overall econometric totex estimate was perturbed by plus one prediction error[16].

    (c) A scenario where the predicted values of the historical overall econometric totex estimate was perturbed by minus one prediction error.

28. Table 1 shows the different annual average predicted costs[17] for each water company in each of these three scenarios.

Table 1: Predicted values for each water company under different prediction error scenarios

Water company	*The current econometric totex estimate*	*The econometric totex estimate plus one prediction error*	*The econometric totex estimate minus one prediction error*
ANH	301	316	287
WSH	234	245	234
NES	267	277	257
SVT	481	502	461
SWW	145	152	139
SRN	148	155	141
TMS	680	723	640
NWT	416	433	399
WSX	103	108	97
YKY	280	291	270
AFW	194	202	186
BRL	68	71	65
DVW	16	17	15
PRT	28	29	26
BW	27	29	26
SEW	139	145	133
SSC	79	82	75
SEC	41	43	39

Source: Ofwat's initial submission.

29. Second, it looks at how far away each of these predicted values are from the observed out-turn costs of companies for each of the three scenarios (where if actual out-turn costs are greater than the predicted costs this is classified as an efficiency and if actual costs are less than predicted costs this is classified as an inefficiency). This is calculated as the difference between the observed

[15] For water companies' costs over the 2009 to 2013 period.
[16] Where the prediction errors were calculated using the standard error of the prediction ('the predict stdp command in stata)
[17] Note that these predicted costs are distinct from the model forecast costs used to calculate the basic cost threshold. These are based on the forecasts for each cost driver according to the current cost curve.

out-turn costs in and the historical overall econometric totex estimates in the different prediction error scenarios (as shown in Table 2).

Table 2: Inefficiencies for each water company under different prediction error scenarios

£ million

Water company	*Current model inefficiency*	*Inefficiency plus one prediction error*	*Inefficiency minus one prediction error*
ANH	2	16	–12
WSH	–23	12	–33
NES	18	28	8
SVT	21	42	1
SWW	23	30	16
SRN	–3	5	–9
TMS	38	81	–2
NWT	–13	4	–30
WSX	–1	5	–6
YKY	11	21	1
AFW	5	13	–2
BRL	–15	12	–18
DVW	1	2	0
PRT	2	4	1
BW	4	6	3
SEW	10	17	4
SSC	–5	8	1
SEC	1	1	–4
Total inefficiencies	**84**	**259**	**–83**

Source: Ofwat's initial submission.

30. Third, it takes the total of the annual 'inefficiencies' across all water companies in each of the two scenarios (plus and minus one prediction error), and subtracts these totals from the average annual inefficiency under the current predicted values with no error (£84 million). The resulting range (£176 million to –£166 million) gives an estimate of the extent to which predictions of the model may be wrong. Ofwat then uses the absolute average of the bias in the two scenarios (plus and minus one prediction error) to obtain a mean deviation of £171 million in inefficiency – which it interprets as a measure of the extent to which water companies' predicted efficiency level may be wrong if Ofwat's models were incorrect by one prediction error.

Table 3: Total inefficiencies for each water company under different prediction error scenarios and their deviations from the current level of inefficiency

Water company	*Total inefficiencies*	*Deviation from the current inefficiency level of £84m (£m)*
Plus one prediction error	259	176
Minus one prediction error	–83	–166
Mean deviation		**171**

Source: Ofwat's initial submission.

31. Fourth, it repeats steps 1 to 3 using prediction errors adjusted for a loss of generalised data points and it calculates the extent to which the mean deviation has expanded post-merger. According to this calculation, Ofwat

estimates the increase in the annual mean deviation as £6.3 million (from £171 million to £177 million).

Table 4: Increase in the mean deviation

Water company	*The current econometric totex estimate (£m)*
Mean deviation pre-merger	171
Mean deviation post-merger	177
Increase in the mean deviation	6.3

Source: Ofwat's initial submission.

32. Finally, it presents this in terms of an increase in the mean deviation in efficiency as a percentage of Ofwat's current total estimate of annual inefficiency across all water companies. The reduction in precision according to this measure is 7.5% of the current level of annual inefficiency (£6.3 million of £84 million).[18]7.5% is Ofwat's chosen measure for the merger related reduction in precision.

A loss in precision in the benchmark

33. In terms of estimating the reduction in precision in the benchmark, Ofwat stated:

> We consider that capturing the precision of the benchmark is inherently difficult because that would require estimating a range around the 93.47% UQ position that we calculated at PR14. Efficiency confidence intervals are not linear and there is not sufficient precedent of using them in regulation. We understand that what the CMA has tried to do here is to capture the precision of the UQ by adjusting the **bounds** around the average line by the upper quartiles produced by those new lines (11% and 2.5%). However, the result is a mixture of model precision and benchmark precision.
>
> If we wanted to measure solely the precision of the benchmark (keeping in mind that the choice of benchmark is itself based in part on confidence in the models discussed in the previous section) we could use the range of UQ benchmarks, based on the error band of the average cost line.

[18] It also calculated a 3.7% loss in precision after adjusting its totex estimate according the current totex to UQ benchmark adjustment but it placed less weight on this result.

The range of UQ estimates based on the pre-merger error band is 8.5%.[19] We essentially re-estimate the UQ for each bound.

Post-merger this increases to 8.9%.[20] The total increase in the range of UQ estimates is 0.4 percentage points, or 4.7% of the original band[21].

This can alternatively be estimated by calculating the inefficiencies to the average line after it is adjusted by the new upper quartiles. Instead of adjusting the central cost curve by 6.5%, we would adjust it by 11% and 2.5% for the pre-merger band as illustrated in the diagram below. For the post-merger, we adjust it by 11.2% and 2.3%. The interpretation is 'what is the range of inefficiencies implied by the uncertainty in the UQ benchmark'. Using the average cost line and applying different UQ challenges to it here is appropriate as we are measuring only the uncertainty of the UQ benchmark.

34. The results of Ofwat's analysis are presented in the table below.

Table 5: Ofwat's estimate for the mean deviation in the benchmark

Measure of inefficiencies	*Pre-merger*	*Post-merger*
Central estimate (£m)	153	
Based on UQ upper bound (£m)	318	326
Based on UQ lower bound (£m)	8	0
Mean deviation (£m)	155	163
Increase in mean deviation % (£m pa)	4.7% (7.4)	

Source: Ofwat's initial submission.

Our conclusions on Ofwat's interpretation of the General Approach

35. Although we agree that a general approach to assessing the reduction in precision can be a useful way of quantifying the potential impact of the merger, we have the following reservations regarding Ofwat's approach:

(a) First, in quantifying the reduction in precision in its overall econometric totex estimate, Ofwat used an unconventional ad hoc measure of precision: the mean deviation of inefficiency as a percentage of Ofwat's current level of inefficiency. It is unclear how changes in this measure equate to a statistical reduction in precision in Ofwat's overall econometric totex estimate.

[19] Upper bound UQ adjustment of 11% minus lower bound UQ adjustment of 2.5%.
[20] Upper bound UQ adjustment of 11.2% minus lower bound UQ adjustment of 2.3%.
[21] 0.4 divided by 8.5.

(b) Second, as mentioned by both Ofwat and Pennon, Ofwat's more advanced econometric modelling used in the last price review has introduced several complexities in applying the General Approach. Most notably, the increase in the error band estimated under the General Approach is likely to be affected by collinearity, which refers to the situation where there is a linear relationship between certain cost drivers. This can lead to artificially large calculated prediction errors, and may also affect the predicted change in prediction errors resulting from removing generalised data points.

(c) Third, the pre-merger level of precision under the General Approach does not account for the current variation in company efficiency, an econometric limitation in Ofwat's models mentioned in paragraph 17.

36. We also have further reservations regarding Ofwat's estimates of a reduction in precision in its benchmark. We agree with Ofwat that capturing the precision of the benchmark is inherently difficult. In particular, we note that it is unclear how changes in the adjustment from the overall econometric totex estimate to the UQ benchmark relate to a reduction in precision in Ofwat's benchmark. We therefore have found it unclear as to how to interpret Ofwat's results in relation to the reduction in precision of the upper quartile benchmark, and have placed limited weight on this result.

Pennon's interpretation

37. Pennon considered that the General Approach (in its exact form as used by the CC in past mergers which estimated the precision effect of cross-sectional models) was only applicable to Ofwat's unit cost models. It explained to us that:

> The main models used at PR14 impose a complex cost–cost driver relationship. For example, one has 27 variables, while others have 12 variables (including the constant). The functional form of the models complicates the implementation of this approach in this case due to the presence of cross-products and squared terms. Moreover, the models are characterised by very high standard errors, which would impose unrealistic shocks to model coefficients. Finally, in Ofwat's translog models, due to collinearity (apart from high standard errors), the model coefficients are not all positive, and not all coefficients have a direct interpretation. As such, a perturbation by increasing (decreasing) the coefficients by one standard error will not

necessarily increase (decrease) cost. The general approach, as applied in previous merger inquiries, cannot therefore be mechanically employed in the translog case. As such, it is questionable whether the 'general' approach is valid with respect to Ofwat's models[22]

38. Therefore Pennon only applied its interpretation of the General Approach to two specifications (out of 4) of two (out of three) unit cost models, the only models unaffected by the limitations noted above:[23,24]

    (a) The log and linear specifications of the supply-demand balance models (log SDB and linear SDB).

    (b) The log and linear specifications of the new development models (log new development and linear new development).

39. Table 6 summarises Pennon's results. It shows that on average, post-merger, the estimate of the error band around the UQ benchmark (the mean deviation) becomes wider in both the log and linear new development models (by 2.9% and 3.4% respectively), and in the log SDB model (by 8.4%). In the linear SDB specification Pennon's analysis suggests that the error band is narrower by 20% on average. Thus, overall, precision has reduced in three of the model specifications (log SDB, log new development and linear new development) but increased in one specification (linear SDB).

Table 6: Pennon's General Approach results (applied only to Ofwat's unit cost models)

Unit cost model specification	*% increase in the benchmark error band*
Log SDB	8.4
Linear SDB	–20.0
Log new development	2.9
Linear new development	3.4

Source: Pennon's initial submission.

Our conclusions on Pennon's interpretation of the General Approach

40. We believe that Pennon's interpretation of the General Approach is useful in interpreting the likely impact of a reduction in precision on the two specifications of the two unit cost models it considered. Yet there is a question over how much weight we can place on these results given that Pennon's

[22] Pennon's initial submission, p8.
[23] Bournemouth is not used in the lead unit cost model.
[24] Pennon did not explain why it only chose these two specifications.

analysis only covers a few models used in a small part of Ofwat's modelling approach.

Our overall conclusions on the General Approach

41. We have reservations about both Pennon's and Ofwat's general approaches. Pennon's estimate of the reduction in precision of Ofwat's overall econometric totex estimate only covers a small part of Ofwat's modelling approach. Ofwat uses an ad hoc measure which is unclear to interpret as a statistical measure of precision.

42. As an alternative to both these interpretations we have performed our own analysis that looks at how the prediction errors in Ofwat's models might expand post-merger under the General Approach. In doing so, we have followed Ofwat's methodology, but applied it to the predicted change in the error band around the central totex estimate rather than to the change in the error band around the predicted inefficiency scores. We considered that this was a relatively intuitive measure of loss of precision, which could be compared with the results obtained by Ofwat and Pennon.

43. To do this we first calculated the percentage difference between Ofwat's historical overall econometric totex estimates' predictions and the predictions when Ofwat's historical overall econometric totex estimate was out by plus or minus one prediction error (following step 1 in Ofwat's General Approach calculation outlined in paragraph 28).

44. Table 7 below shows that each water company's average annual predicted costs[25] is out by an average of 4.90%[26] when Ofwat's econometric totex estimate is out by plus or minus one prediction error.

[25] Note that these predicted costs are distinct from the model forecast costs used to calculate the basic cost threshold. These are based on the forecasts for each cost driver according to the current cost curve.
[26] Based on an overall average of the % difference between the current econometric totex estimate and the estimate in the plus or minus one prediction error scenarios.

Table 7: The pre-merger precision of each water company under different prediction error scenarios

Water company	*The current econometric totex estimate (£m)*	*The econometric totex estimate plus one prediction error (£m)*	*The econometric totex estimate minus one prediction error (£m)*	*Difference between current econometric totex estimate and plus one prediction error scenario (%)*	*Difference between current econometric totex estimate & minus one prediction error scenario (%)*
ANH	301.16	315.60	287.49	4.79	4.54
WSH	233.76	244.72	223.33	4.69	4.46
NES	266.68	276.52	257.28	3.69	3.53
SVT	481.00	502.02	461.01	4.37	4.16
SWW	145.45	152.46	138.76	4.82	4.60
SRN	147.74	155.05	140.83	4.95	4.68
TMS	680.32	723.38	640.29	6.33	5.88
NWT	415.50	432.91	398.88	4.19	4.00
WSX	102.52	108.32	97.07	5.66	5.32
YKY	280.32	290.62	270.46	3.68	3.52
AFW	193.72	201.80	185.96	4.17	4.01
BRL	68.21	71.25	65.29	4.46	4.27
DVW	16.03	17.16	14.96	7.10	6.64
PRT	27.62	29.31	26.03	6.12	5.77
BW	27.39	29.16	25.71	6.47	6.11
SEW	138.84	145.42	132.58	4.74	4.51
SSC	78.60	82.42	74.95	4.87	4.64
SEC	41.03	43.31	38.87	5.55	5.27
Overall average of both plus and minus scenarios				**4.90%**	

Source: CMA analysis of Ofwat's initial submission.
*This analysis is derived from Ofwat's calculated prediction errors which were used in Ofwat's initial submission.

45. We then repeat the same calculations for companies predicted costs with a new prediction error, adjusted for a loss of generalised data points[27] due to the merger. Our results in Table 8 show that each water company's predicted costs according to the prediction error is out by an average of 5.08% post-merger.

[27] Calculated by reducing the degrees of freedom in the prediction error.

Table 8: The post-merger precision of each water company under different prediction error scenarios

Water company	*The current econometric totex estimate (£m)*	*The econometric totex estimate plus one prediction error (£m)*	*The econometric totex estimate minus one prediction error (£m)*	*Difference between current econometric totex estimate & plus one prediction error scenario (%)*	*Difference between current econometric totex estimate & minus one prediction error scenario (%)*
ANH	301.16	316.14	287.01	4.97	4.70
WSH	233.76	245.13	222.96	4.87	4.62
NES	266.68	276.90	256.93	3.83	3.66
SVT	481.00	502.81	460.30	4.53	4.30
SWW	145.45	152.72	138.52	5.00	4.76
SRN	147.74	155.33	140.58	5.14	4.85
TMS	680.32	725.01	638.89	6.57	6.09
NWT	415.50	433.56	398.28	4.35	4.14
WSX	102.52	108.54	96.88	5.87	5.50
YKY	280.32	291.02	270.10	3.82	3.65
AFW	193.72	202.10	185.68	4.33	4.15
BRL	68.21	71.37	65.19	4.63	4.42
DVW	16.03	17.23	14.93	7.36	6.87
PRT	27.62	29.38	25.98	6.35	5.97
BW	27.39	29.22	25.65	6.72	6.33
SEW	138.84	145.67	132.35	4.92	4.67
SSC	78.60	82.57	74.82	5.05	4.81
SEC	41.03	43.39	38.79	5.76	5.46
Overall average of both plus and minus scenarios				**5.08%**	

Source: CMA analysis of Ofwat's initial submission.

46. Taken together the results in Tables 6 and 7 suggest that the reduction in precision in Ofwat's historical overall econometric totex estimate is around 4% (based on a 0.18 percentage point reduction in precision from 5.08% to 4.90%). This reduction in precision equates to all water companies costs being a combined £6.3 million less precise in total in any given year where the prediction of the average water company's costs is around £350,000 less precise.

47. However, we acknowledge that this estimate still has three main drawbacks:

    (a) It does not tell us how the merger might affect the reduction in precision in the UQ benchmark that Ofwat used at PR14.

    (b) There is no commonly agreed threshold under which the reduction in precision in Ofwat's overall econometric totex estimate can be judged.

    (c) Finally, it is likely to overestimate the impact on precision due to the limitation noted in paragraph 35(b).

The Specific Approach

48. The Specific Approach uses the re-estimation of Ofwat's models under a simulation of the merged entity to identify how a specific loss of a comparator changes the confidence interval widths in Ofwat's models.

Ofwat's interpretation

49. Ofwat's interpretation of the Specific Approach had two parts to it:

    (a) First, it looked at the specific characteristics of BW's data points to identify what characteristics it had that would be likely to have the greatest impact on coefficient estimates if BW were lost.

    (b) Second, it looked at the difference between the predicted values for each company based on a re-estimation of the historical econometric totex estimate with a simulated merged entity (replacing the merging parties' information) and a re-estimation after dropping BW's observations.

50. In the first part, Ofwat identified that BW had the highest usage per property in the industry, and through simulation predicted that the merged entity would only have average usage. It then tested how the removal of BW affected its coefficient estimates. It found that, aside from the usage elasticity in the full model, the removal of BW resulted in insignificant changes in the coefficient estimates, and that the predicted costs determined by the model effectively remained unchanged. This suggested that there was not a significant reduction in variation in drinking water usage per property in the industry.

51. In the second part, Ofwat tried to isolate the effect of efficiency loss (changes in the benchmark) and precision loss (confidence in the benchmark) by looking at the difference in two re-estimations of its model, the first including a proxy for the new merged entity, and the second excluding BW (but retaining SWW).

52. In doing so, it compared a firm's inefficiency (ie its distance from the UQ benchmark) for firms pre-merger with a firm's inefficiency under the two scenarios. It interpreted the difference between the estimates of inefficiency under the two scenarios as the 'specific' reduction in precision resulting from the merger.

53. According to Ofwat, under the Specific Approach, the merger resulted in a 0.21% decrease in precision. However, relative to other approaches it placed less weight on this precision estimate.

Our conclusions on Ofwat's interpretation

54. We have some reservations about Ofwat's analysis. We consider that Ofwat's approach in both parts, even when trying to compare the level of precision pre- and post-merger, risks conflating the benchmark effect with the precision effect. In essence, the benchmark effect measures how less challenging the benchmark becomes directly as a result of a loss of a comparator whereas

the precision effect measures how imprecise the estimation of the benchmark becomes from a loss of a comparator, potentially indirectly resulting in a less challenging benchmark. By comparing the inefficiency levels pre- and post-merger it is looking at how less challenging the benchmark would have become as a direct result of the merger – and not as a result of reduced imprecision.

Pennon's interpretation

55. Pennon estimated the change in precision due to the merger by looking at differences in the precision of the predictions for BW and SWW relative to the precision of the prediction for the merged entity.[28]

56. In doing so, it calculated prediction intervals, error bands around each predicted value of each of Ofwat's model, for the predicted values for each of the 18 water companies assessed at PR14 (including BW and SWW) and the merged entity. It then compared the average size of prediction intervals across all water companies in two scenarios: one using the 18 water companies assessed at PR14; and the other with 16 of the water companies and the merged entity, excluding BW and SWW.

57. Based on these estimated average prediction interval widths Pennon then constructed 'confidence intervals' around each econometric model. This confidence interval provided an error band for the average value predicted by the model and thus provided a measure of precision for the overall model. This allowed Pennon to consider "the impact of the merger on the standard error of the linear prediction of the companies keeping the technology or cost function fixed in the pre- and post-merger cases, as well the ratio of the confidence width (around the linear prediction) to the linear prediction of the companies".

58. Using the above approach, Pennon looked at "the ratio of the confidence width (around the predicted values for each company) to the predicted values for each company to normalise for the scale of the predicted values of each water company". Pennon's results show that on average there is a contraction in confidence interval widths in Ofwat's models, suggesting that there may be a post-merger improvement. In the full totex (OLS), the refined base totex (RE), the refined base totex (OLS), the log and linear SDB, and the linear new development model the confidence interval contracted post-merger.[29] Only in the refined totex (RE), the refined totex (OLS), and the log

[28] Comprising a weighted combination of both BW and SWW's characteristics.
[29] Where the confidence interval widths contracted from 3.5 to 3.3%, 3.7 to 3.7% and 6.5 to 6.4% respectively in Ofwat's full totex (OLS), refined totex (RE), and refined totex (OLS). In three specifications of two unit cost

new development model did the confidence interval width expand post-merger.[30,31]

Table 9: Pennon's confidence interval widths pre- and post-merger under the specific approach

Model	*Pre-merger (confidence interval width as a proportion of the average model predicted value) (%)*	*Post-merger (confidence interval width as a proportion of the average model predicted value) (%)*	*Confidence interval width increase/ decrease in the post-merger scenario*
Econometric models			
Full totex (OLS)	3.5	3.3	Decrease
Refined totex (RE)	3.5	3.6	Increase
Refined totex (OLS)	5.9	6.0	Increase
Refined base totex (RE)	3.7	3.7	Decrease
Refined base totex (OLS)	6.5	6.4	Decrease
Average for 5 econometric models	4.62	4.59	Decrease
Unit cost model specification			
Log SDB	41	31	Decrease
Linear SDB	134	128	Decrease
Log new development	27	28	Increase
Linear new development	251	158	Decrease
Average for 2 specifications of 2 unit cost models	113	86	Decrease

Source: Penon's initial submission.
Note: the average model predicted value refers to the average modelled prediction for each water company.

59. Pennon also looked at various statistical tests that measure how the 'goodness of fit' of Ofwat's econometric estimate changed according to its post-merger re-estimation.[32] It found that the main measures of goodness of fit were unchanged post-merger, and that there was some evidence in these goodness of fit tests that suggested that the precision in Ofwat's unit cost models would somewhat improve post-merger.

Our conclusion on Pennon's interpretation

60. We have some reservations about Pennon's interpretation of the Specific Approach because it does not account for any change in relative efficiency variation between water companies.

61. A characteristic of Ofwat's models is that efficiency is unobserved even though its effect on a water company's costs is one of the main water company characteristics estimated by the model, and instead measured according to the size of each company's residuals in Ofwat's models which

models confidence interval widths contracted from 41 to 31%, 134 to 128% and 251 to 158% respectively in the linear logged specifications of the supply-demand balance model.

[30] Increasing from 3.5 to 3.6%, 5.9 to 6.0%, 27 to 28 respectively in Ofwat's refined totex (RE), refined totex (OLS), and log new development models.

[31] Although the change in the average prediction interval width was wholly driven by the difference between the merged entity's prediction interval width and the prediction interval width of BW and of SWW.

[32] Pennon also considered performed other statistical tests that looked at the impact of the merger on a number of diagnostic tests, the intuition of the elasticities relating to specific cost drivers modelled costs and outlier tests. These also show that at worst the merger has a minimal impact on precision.

contain both efficiency and error. This means that in addition to including some level of random error, each of Ofwat's modelled company residuals – which Ofwat derives its efficiency scores from – also includes a measure of relative cost efficiency. Therefore there is no way of distinguishing between efficiency and error and there is no way of precisely measuring the relative efficiency between water companies as the residuals contain both efficiency and error.

62. Therefore, when Pennon estimates the contraction in confidence intervals (or any other goodness of fit measure) post-merger a problem arises because the size of the residuals in these models (and ultimately the confidence interval widths) are not assessed against the potential reduction in the variation in water companies' efficiency that accompanies the contraction. This problem is particularly relevant to the effective loss of BW as a comparator – as it is the most efficient firm according to Ofwat's efficiency ranking. (Although we do acknowledge that the equivalent of BW's efficiency rank in each of Ofwat's models does vary somewhat from model to model.)

63. Further, we note that the current variation and distribution of efficiency among water companies may not be reflective of the lost efficiency in future.

64. For these reasons, we have decided to place no weight on the results of Pennon's Specific Approach.

Pennon's response to our conclusions

65. In response to our conclusions in an earlier working paper shared with the parties, Pennon provided two arguments:

    (a) First, it argued that its approach avoided the problem of conflating efficiency and error.

    (b) Second, it argued that BW's efficiency position was not likely to affect the outcome of prediction interval width analysis materially.

Avoiding the conflation of efficiency and error

66. Pennon stated that in Ofwat's current modelling framework, inefficiency was not modelled directly and the residuals from the estimated cost function (or technology) captured both noise and inefficiency.

67. However, it argued that if the technology in the pre-merger econometric estimate was kept fixed the relative efficiency positions of the companies was unchanged post-merger. In this way it argued that looking at differences in the prediction intervals of the merging parties predicted values and that of the

merged entity under the current econometric models provided a representative estimate for the reduction in precision due to the merger that did not conflate inefficiency with error.

68. We disagree: we maintain that Pennon's estimate for reduction in precision may still be driven by a reduction in the variation in efficiency. In particular we believe that although keeping the econometric estimate fixed means that the prediction intervals for water companies outside the merging parties are unaffected by changes in the distribution of efficiency, the prediction intervals for the merging parties will still be affected.

BW's efficiency position

69. In relation to BW's efficiency position, Pennon looked at the historical efficiency ranking of BW in each of Ofwat's econometric models.

70. Table 10 shows its results. According to Pennon, BW's efficiency ranking is not substantially above or below the historical median (the ninth ranked firm). It argued that BW's historical rank position was predominantly between sixth and ninth, and that BW was only considered an outlier in the two unit cost models (the supply-demand balance and the new development models).

Table 10: BW's historical rank at PR14

Model	*Historical efficiency rank of BW by model*
Econometric models	
Full totex (OLS)	6
Refined totex (RE)	9
Refined totex (OLS)	9
Refined base totex (RE)	8
Refined base totex (OLS)	6
Unit cost model	
SDB	1
New development	16

Source: Pennon.

71. Further Pennon went on to say that BW was a statistical outlier in the supply-demand balance model and that 'dropping' BW from Ofwat's data set would result in a benefit in precision in Ofwat's econometric models.

72. We believe that although the historical efficiency ranking for BW is close to the median in three of Ofwat's econometric models (9 or 8 in the refined totex (RE), refined totex (OLS) in two of Ofwat's models (the full totex (OLS) and the refined base totex (OLS)) BW is ranked 6th, some distance away from the median, and in the two unit cost models which BW is used in BW is ranked 1st and 16th, a considerable distance from the median. Consequently, we cannot confirm that the reduction in relative efficiency variation due to the merger is small and still have concerns with Pennon's approach.

Our conclusions on the Specific Approach

73. Both Pennon's and Ofwat's interpretations of the Specific Approach have significant limitations. Pennon's interpretation does not account for the variation in efficiency lost due to the merger and Ofwat's interpretation conflates the benchmark effect with the precision effect. Taking these limitations into account we have decided to place no weight on either interpretation.

Bootstrapping

74. In both Pennon's and Ofwat's initial submissions, both parties undertook bootstrapping simulations to estimate the pre-merger and post-merger change in the bias of the estimation of the standard error.

75. These bootstrapping simulations tried to find an estimate of the standard error by estimating its models under different random simulations of the current data set. Specifically, the model estimates derived from different simulations provided a number of randomly distributed sensitivities to the current model coefficient estimates, and the variation in these sensitivities provided an estimate of the standard error.

76. Then, by comparing the bootstrapped standard errors with the econometric totex estimated standard errors, both parties obtain a measure of bias in the latter. And, to look at the impact of the merger, both parties compare the current standard error bias in model estimates calculated using all 18 firms at PR14 with the standard error bias in model estimates where the merging parties are replaced with a simulated merged entity.

77. The rationale for of this approach is that there is evidence that the error in Ofwat's model is biased and is based on a small sample. By looking at how the errors become more or less biased after a merger simulation one supposedly obtains some measure for the reduction in precision due to the merger.

Pennon and Ofwat's interpretation of bootstrapping

78. Ofwat's results, summarised in the table below, suggest that a loss of a comparator will on average result in an increase in the bias in model estimated standard errors of around 11%, suggesting increased imprecision. However, Ofwat argued that this result was partly down to the very low level of bias in certain aspects of its models. This is relevant because a small increase in bias in aspects with a very low level of bias could represent a small actual decrease in precision that is estimated as a large percentage

decrease in precision. If we ignore the percentage decrease in precision in these aspects the average bias in Ofwat's models is substantially lower: 1% under the approach that normalises the bias by the standard error of the standard error and 3% when normalised by the original standard error.

Table 11: Ofwat's bootstrapping results

%

Econometric model	*Standard error bias as a proportion of the standard error of the standard error*	*Standard error bias as a proportion of the original standard error*
Full totex (OLS)	4	21
Refined totex (RE)	–4	8
Refined totex (OLS)	26	27
Refined base totex (RE)	–25	21
Refined base totex (OLS)	289 (15)	245 (–18)
Average	10 (1)	11 (3)

Source: Ofwat's initial submission.

79. According to Pennon's interpretation of its results, it believed that a loss of a comparator would result in a reduction in bias in standard errors. It looked at whether the merger resulted in standard error bias greater than 25% in each model. It found that on balance, bias in standard errors greater than 25% in each econometric model were less likely post-merger.

Table 12: Pennon's bootstrapping results

Model	*% of coefficient estimate standard errors in the model where the bias>25% pre-merger*	*% of coefficient estimate standard errors in the model where the bias>25% post-merger*	*Standard error bias increase/ decrease after the merger*
Econometric models			
Full totex (OLS)	88	92	Increase
Refined totex (RE)	64	36	Decrease
Refined totex (OLS)	82	64	Decrease
Refined base totex (RE)	64	45	Decrease
Refined base totex (OLS)	73	91	Increase
Average	74	66	Decrease
Unit cost model specifications			
Unweighted average SDB	100	100	-
Unweighted average new development	100	100	-
Linear SDB	0	0	-
Linear new development	100	0	Decrease
Log SDB	0	0	-

Source: Pennon's initial submission.

80. We place limited weight on both Pennon's and Ofwat's results for two reasons:

(a) It is unclear how to statistically interpret the results of these simulations. Even though past CC approaches (such as in *Mid Kent/South East Water*) have looked at whether there is significant bias in the current standard errors using the same method as both Ofwat and Pennon, it is unclear why looking at how the bias in standard errors changes post-merger

provides a statistical estimate of the degree to which there is a merger related loss in precision. Bias in standard errors is a measure of how reflective standard errors are as measure of precision and is not a measure of precision in itself.

(b) Both bootstrapping estimates did not preserve the panel data structure of the original sample in that they did not hold the different firms in each bootstrap sample fixed. This meant that the estimates derived from certain bootstrapping samples could have provided slightly erroneous results as these bootstrap samples would have had several different data points from the same firm.

Pennon's comments on our bootstrapping conclusions

81. Pennon made two arguments regarding our assessment of its bootstrapping approach:

(a) First, it considered that Ofwat's modelling approach ignores the panel nature of the dataset in three of the five econometric models. In particular, the observations are considered to be independent and identically distributed (and not from specific companies over time) in the pooled OLS models[33]. Hence its bootstrapping approach is consistent with Ofwat's model.

(b) Second, it argued that bootstrapping estimates might be useful to determine if the standard errors estimated from the models would be smaller (ie more precise with less data). In particular it argued that in principle its results suggested that the merger would lead to a small increase in precision.

82. We disagree with these arguments. We still maintain that taking account of the panel structure of Ofwat's data in bootstrapping procedures is appropriate as it allows for the possibility of the standard errors being correlated for each firm over time, and thus prevents bias in them.

83. Bootstrapping is a method used to simulate the data set upon which Ofwat derives its econometric estimate. If bootstrapping is performed in such a way that its results less accurately represent the data it wishes to simulate then it may create bias in any results of econometric estimates derived from simulated data. By not performing bootstrapping in such a way that it mimics the panel data structure of Ofwat's data, Pennon may have generated bias in

[33] Specifically the full totex (OLS) model, the refined totex (OLS) model and the refined base totex OLS model.

its results because its simulated samples are less representative of the panel data structure in Ofwat's data set.

84. As a result we still believe that bootstrapping estimates that take account of the panel data structure of Ofwat's data are a more representative simulation of Ofwat's current modelling approach. And, if after being corrected, Pennon's bootstrapping estimates were to identify a reduction in precision due to the merger we would still need to know to what extent precision is reduced by the merger.

Our Qualitative Approach

85. Due to the limitations inherent in the Specific, General and bootstrapping approaches, and the difficulty in obtaining a reliable estimate of a potential loss of precision, we have devised an alternative qualitative approach to look at the loss in precision related to this merger that builds upon the work of other approaches.

86. Because the new merged entity is likely to be dominated by SWW's characteristics, an estimate of the impact of the merger can be thought of as the loss of BW as a comparator. The Qualitative Approach focuses on how the loss of BW affects the major drivers of precision in Ofwat's models. These are: the variation in Ofwat's data; the relative importance of certain types of variation in Ofwat's data in determining Ofwat's benchmark estimate; and how the level of precision is inherently related to the number of data points upon which Ofwat's estimate is based.

87. In more detail, there are two main ways in which the merger may adversely impact on the precision of Ofwat's econometric modelling.

88. The first, as stated in paragraph 11, is that SWW and/or BW may have some characteristics which make them particularly good, or bad, comparators (in other words, one or both are especially representative or unrepresentative of other water companies in England and Wales). In controlling for water companies' heterogeneity, Ofwat's models estimate the extent to which relevant factors determine a water company's costs by exploiting differences in the relationship between the relative variation in these water companies' relevant factors and their cost expenditure. Therefore, if as opposed to the new merged firm, BW or SWW individually were to contain characteristics that provided more variation in certain relevant factors, the merger may result in poorer precision in Ofwat's models.

89. The second, as stated in paragraph 10, is the impact of having fewer independent data points for statistical analysis. In this case going from 18

companies to 17 which equates to a reduction in the number of independent observations over five years from 90 to 85 in Ofwat's econometric models. This results in an inherent loss in precision. If Ofwat has fewer data points to derive its models from then any error in one data point is likely to have a larger effect on its estimates than in cases where it has more data points.

90. Our Qualitative Approach focuses on the first impact looking at:

(a) the extent to which BW has certain characteristics in its data points which, when lost, would significantly reduce the variation in certain variables upon which Ofwat's main econometric models rely; and

(b) the extent to which the variation in Ofwat's data lost through the loss of BW as a comparator is important in Ofwat's econometric modelling.

91. Parts (a) and (b) collectively evaluate whether important variation in the data is lost due to the merger: (a) assesses to what extent variation is lost due to the merger and (b) assesses both to what extent Ofwat is reliant on the lost variation in calculating its model estimate and whether or not the lost variation is related to specific characteristics in BW.

To what extent does BW have certain characteristics in its data points which, when lost, would significant reduce the variation in data upon which Ofwat's models rely?

92. To examine how the loss of BW's observations could affect the variation in Ofwat's data, we looked at how much variation in Ofwat's data would be lost due to the loss of BW as a comparator by looking at the % reduction in the standard deviation of the 18 water companies' characteristics. In doing so, we were able to observe how the spread of data in each variable around its mean changed post-merger.

93. Table 13 shows our results, two of Ofwat's variables indicate % changes in the standard deviation greater than 10%: drinking water usage per property (26%) and the proportion of water usage by metered non-households (46%).

Table 13: Reduction in variation after the loss of BW*

Variable used in Ofwat's models	*Variable definition*	*% reduction in standard deviation (after the loss of BW)*
Length of mains	Total length of mains at year end	1
Density of mains	Number of connected properties divided by length of mains	–3
Drinking water usage per connected property	Potable water used per connected property	26
Wage	Average regional wage	–3
Population density	Population divided by number of properties connected	0
Water pressure	Properties below reference pressure level divided by total properties connected	0
Leakage	Leakage volume divided by water input distributed	4
Proportion of usage by metered properties	Water delivered to metered households divided by total water delivered	3
Proportion of water input from reservoirs	Proportion of water input from reservoirs	1
Proportion of water input from river abstractions	Proportion of water input from river abstractions	9
Proportion of new meters	(number of selectant + optant meters installed) divided by (metered households with external meters + metered households without external meters + metered billed non-households)	–2
Proportion of new mains	New mains divided by total length of mains at year end	0
Proportion of mains relined and renewed	(mains relined and renewed) divided by the total length of mains at year end	–2
Planned interruptions	Properties affected by planned interruptions > 3hrs	2
Unplanned interruptions	Properties affected by unplanned interruptions > 3hrs	2
Sources	Total number of sources divided by distribution input	1
Pumping head	Pumping head X distribution input	1
Proportion of usage by metered household properties	Water delivered to metered households divided by total potable water delivered	3
Proportion of usage by metered non-household properties	Water delivered to metered households divided by total potable water delivered	46
Totex	Total company expenditure	0
Expenditure in supply and demand balance model	Annual expenditure in 2012-2013 prices	0
Regional adjustment in supply and demand balance model	% regional adjustment for the specific region	–2
Volume in supply and demand balance model	Volume of water used	–3
Expenditure in new development model	Annual expenditure in new development model	–1
Regional adjustment in new development model	% regional adjustment for the specific region	–2
Volume in new development model	Volume of water used	1

Source: CMA analysis of Ofwat data.
*Note that BW is not used in the lead unit cost model so there is no loss in variation in this model.

Ofwat's view on our analysis

94. In response to an earlier working paper shared with the parties, Ofwat extended our analysis by looking at the change in variation in three additional measures:

    (a) The reduction in the standard deviation of the log of Ofwat's variable after the loss of BW, because this is closer to the form in which the variables are actually used in Ofwat's econometric models.

    (b) The reduction in the between-company variation in data after the loss of BW.

    (c) The reduction in the within-company variation in data after the loss of BW.

95. Of these three measures Ofwat argued that the reduction in between-company variation was the most significant as it most accurately captured the impact of the loss of BW, a loss in variation between companies.

96. Table 14 shows the results of Ofwat's analysis. Ofwat's calculation of the percentage reduction in between-company variation suggests that there is a greater than 10% reduction in variation in four of the variables it uses in its wholesale cost models: The proportion of usage by non-metered households (73%), the drinking water usage per property (47%), the proportion of water input from river abstractions (17%) and unplanned interruptions (13%).

Table 14: Ofwat's results for the level reduction in between-company variation due to the loss of BW

Variable used in Ofwat's models	*% level reduction in the between-company variation*
Length of mains	2
Density of mains	–6
Drinking water usage per connected property	47
Wage	–6
Population density	0
Water pressure	4
Leakage	7
Proportion of usage by metered properties	5
Proportion of water input from reservoirs	1
Proportion of water input from river abstractions	17
Proportion of new meters	–4
Proportion of new mains	0
Proportion of mains relined and renewed	–1
Planned interruptions	–3
Unplanned interruptions	13
Sources	2
Pumping head	1
Proportion of usage by metered household properties	–6
Proportion of usage by metered non-household properties	73
Totex	0

Source: Ofwat.
Note: In certain cases there is an increase in the between-company variation. This is because the between-company variation measures the average variation between companies so if no additional variation is added by the inclusion of BW the between-company variation may increase.

Pennon's view on Ofwat's comments and our analysis

97. Pennon believed that since both the within-company and between-company variations were taken into account in Ofwat's modelling approach it was unclear why more weight should be placed on between-company variation. And further Pennon considered that since the impact of this merger is already taken account of in other statistical analysis (such as Pennon's Specific Approach) it sees no reason to discuss this point separately.

Our conclusions on the loss in variation

98. We agree with Ofwat's extension to our analysis. We believe that looking at the loss in the between-company variation is representative of the true loss due to the merger: the loss of having one fewer company in Ofwat's data set. By contrast, the variation within each company is more determined by the number of years over which data is collected; this is less affected by the merger.

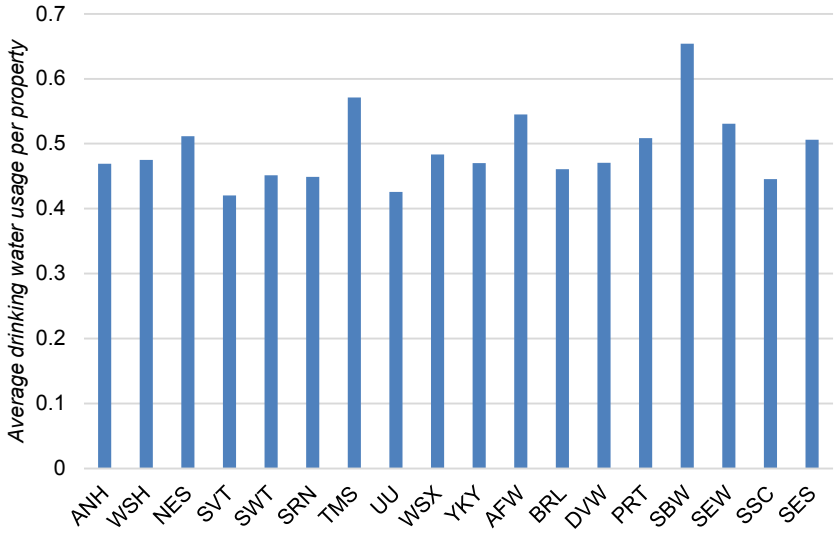
99. Taking this new analysis into account we believe that Ofwat identified reductions in variation due to the loss of BW in four of its variables: drinking water usage per connected property; the proportion of drinking water used by metered non-households; unplanned interruptions; and the proportion of water input from river abstraction.

To what extent is the variation in Ofwat's data lost through the loss of BW data points important in its PR14 econometric modelling?

100. To look at how important the loss in variation in the four variables mentioned by Ofwat (the drinking water usage per connected property, the proportion of drinking water used by metered non-households, unplanned interruptions, and the proportion of water input from river abstraction) is in its econometric modelling, we looked at to what extent BW's characteristics were peculiar in the areas in which Ofwat would lose data variation post-merger. The rationale for doing this was that, if BW's data was driven mainly by firm-specific factors, then the reduction in variation due to the merger would be less likely to affect the precision of Ofwat's models. This involved looking at whether or not BW's characteristics were significantly greater or less than other water companies' and identifying particular reasons for why this was the case.

101. Figure 1 shows that among all water companies BW has the highest level of drinking water usage per connected property. There appear to be few exceptional, company-specific factors which would explain this data, so we do not treat it as an outlier.

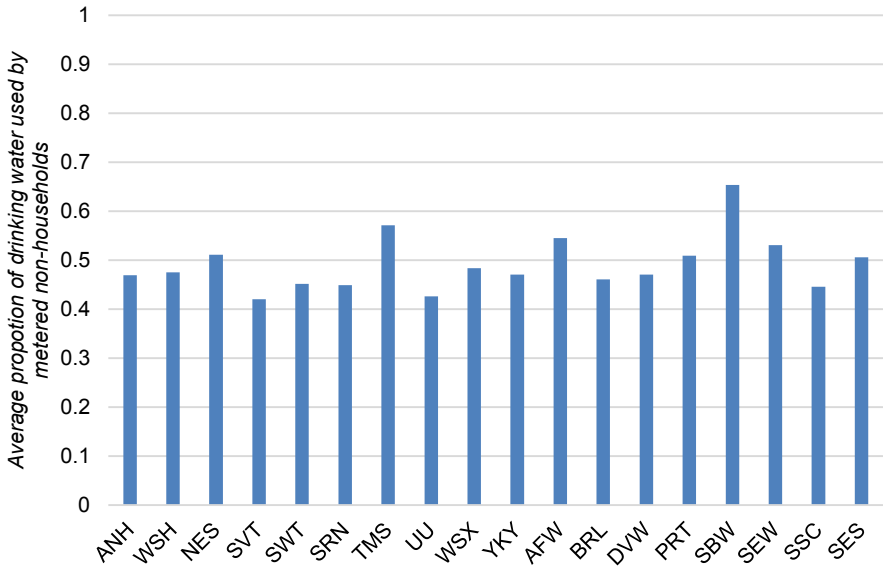
Figure 1: Average of drinking water usage per connected property among all water companies between 2009 and 2013



Source: CMA analysis of Ofwat data.
Note: SWT = SWW, SBW = BW.

102. Figure 2 shows that among all water companies BW has the highest proportion of drinking water delivered to metered non-households. This could be driven by the fact that BW has one very large industrial customer, namely the Esso refinery in Fawley, suggesting that BW may be an outlier in this variable.

Figure 2: Average proportion of total drinking water supplied used by metered non-households among all water companies between 2009 and 2013

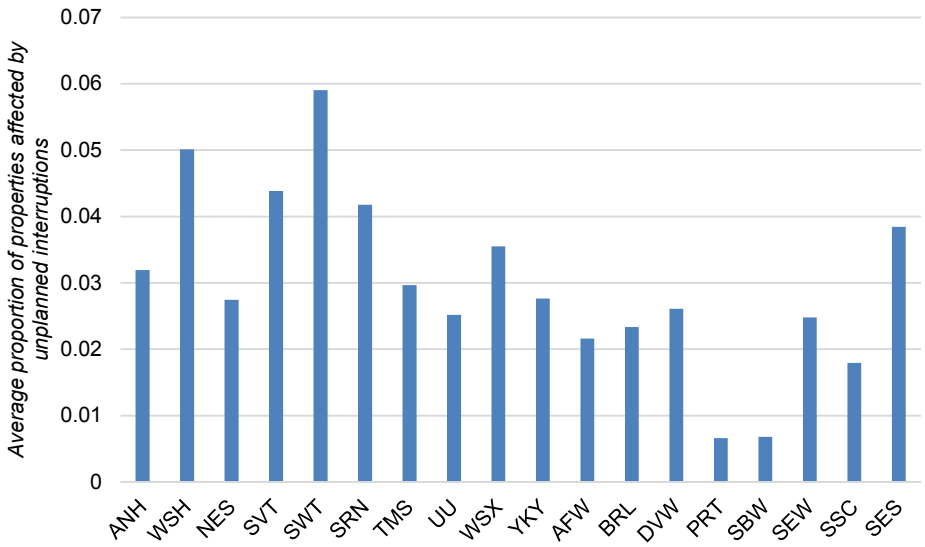


Source: CMA analysis of Ofwat data.
Note: SWT = SWW, SBW = BW.

103. Looking at Ofwat's variable that measures unplanned interruptions, Figure 3 shows that both BW and Portsmouth Water have a much lower number of

unplanned interruptions than any other water company. But, we have no theoretical reasons to think that these two companies are outliers in these characteristics.

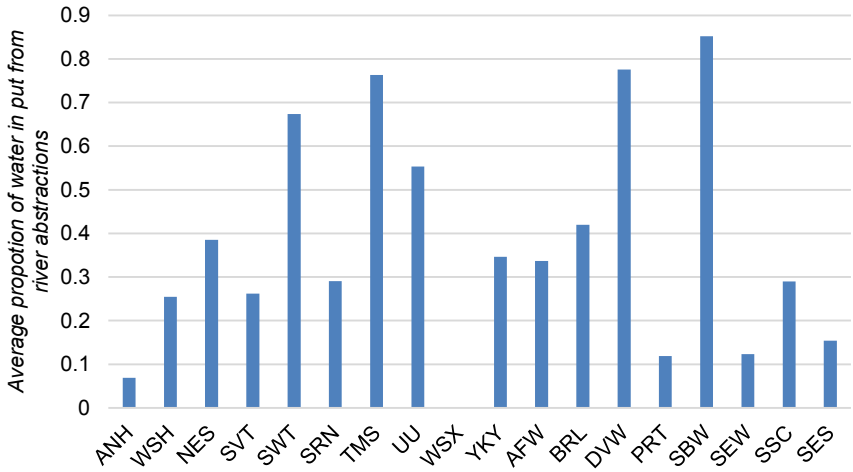
Figure 3: Average proportion of properties affected by unplanned interruptions greater than 3 hours among all water companies between 2009 and 2013



Source: CMA analysis of Ofwat data.
Note: SWT = SWW, SBW = BW.

104. Figure 4 shows the distribution of Ofwat's measure of the water input from river abstractions across all water companies. BW has the highest level of water input but this is not significantly above the water company with the second highest level, so we cannot conclude that BW is an outlier in this variable.

Figure 4: Average proportion of water input from river abstractions among all water companies between 2009 and 2013



Source: CMA analysis of Ofwat data.
Note: SWT = SWW, SBW = BW.

105. We also looked at Ofwat's own use of the four variables in its current PR14 econometric modelling. We find that three of the variables (unplanned interruptions, proportion of drinking water usage per property, and the proportion of drinking water used by metered non-households) are only used in one of Ofwat's five main econometric models for PR14, where according to the weighting it places on its different modelling strands[34] the results of this one econometric model only accounts for one-third of its overall econometric totex estimate. And in this one econometric model the output derived from the proportion of drinking water usage per property has a counterintuitive result.[35]

106. Finally, we considered the nature of each of the four variables when assessing how reflective the loss in the current level of variation would be going forward. The variation in three out of the four variables is likely to remain unchanged in the future as we would not expect the amount of drinking water used by each property, the level of drinking water used by metered non-households, or the proportion of river abstractions used by companies to change in the near future.[36] Unplanned interruptions on the other hand are likely to be considerably different in future as the management of each water company may become more or less adept at managing unplanned interruptions.

107. Taken together these points suggest that:

(a) there are reasons which suggest that BW may be an outlier in the proportion of drinking water delivered to non-households, the variable in which Ofwat is losing most of its between-company variation;

(b) there is some evidence to suggest that Ofwat's econometric modelling approach for wholesale costs may place limited weight on the same variables in future and that drinking water usage per property provides counterintuitive results; and

(c) the variation in one variable, unplanned interruptions, may change in future so the current level of between-company variation in this variable may not be reflective of the future between-company variation.

108. For these reasons we believe that although there is some loss in variation in Ofwat's data due to the loss of BW as a comparator, a lot of the lost variation may not be useful in estimating more precise econometric models.

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[34] As described in Appendix B.
[35] According to Ofwat (2014), *Cost assessment – advanced econometric models*, all else equal the proportion of drinking water usage per property has a negative impact on a water company's costs.
[36] However we acknowledge that future mergers may affect this result.

Simplified standard error formula

s.e[37] = $$\sqrt{\frac{1}{(nt-k)}\left(\frac{SSR}{SSX_j(1-R_j^2)}\right)}$$

Where:

(a) nt is the sample size;

(b) k is the number of coefficients being estimated;

(c) SSR is the sum of squared residuals (how far away each company's actual observed cost is from the modelled estimate);

(d) SSX_j is the sum of the square deviations in the independent variable from the mean (the variance in each cost driver); and

(e) 1 - R_j^2 is the proportion of the total variation in the independent variable that can be explained by other independent variables (to what extent is the variance in each cost driver explained by other cost drivers).

[37] Wooldridge, J M, *Introductory Econometrics: A Modern Approach*, 4th Edition, pp101 & 102.

Impact of the merger on Ofwat's wholesale benchmarks

Introduction

1. A summary of the analysis of the impact of the merger on the wholesale benchmark is set out in paragraphs 6.120 to 6.173 of the report. This appendix provides a more detailed descriptions of the analysis of the impact of the merger on Ofwat's ability to set wholesale efficiency benchmarks. Wholesale efficiency benchmarks are key to Ofwat's regulatory function and largely determine the overall expenditure allowed by the industry over a price control. In PR14, for the first time, Ofwat set the wholesale efficiency benchmark at the UQ for totex, rather than setting separate benchmarks for opex and capex. We focus our analysis on how the merger might have affected this benchmark in the past and how it may be expected to affect it in the future.

2. Ofwat and Pennon have each submitted models of the expected impact on the wholesale efficiency benchmark on a static and a forward-looking basis, following the approach used by the CC in previous water mergers.

3. We have also used these frameworks for our analysis, and focused on understanding the key assumptions driving the different results. We have then produced our own range of estimates of the likely impact of the merger and tested the impact of different assumptions.

4. The appendix is structured as follows:

   (a) First, we set out how the parties performed in the most recent price control, PR14, and how the merger might affect these benchmarks.

   (b) Second, we set out how we have modelled the expected performance of the merged firm relative to the pre-merger counterfactual.

   (c) Third, we set out our static analysis of the likely impact of the merger on the wholesale efficiency benchmarks – in effect, what might have been the impact on Ofwat's determination at PR14, had the regulator been considering a merged firm rather than SWW and BW separately.

   (d) Fourth, we describe our approach to estimating the forward-looking impact of the merger, based on the probability of changes in relative performance of the merger parties in future price control periods, and taking into account possible changes in the regulatory regime.

(e) Finally, we summarise our modelling results.

5. Throughout this appendix, we focus on the methodology used by Ofwat to determine relative efficiency in the most recent price review, and assume that this methodology is employed in future price reviews. There is a good deal of uncertainty related to how Ofwat will set price limits in the future as PR14 has only recently been finalised and as such we are not in a position to conduct our analysis against any possible future models. However, we consider that it is a reasonable assumption that Ofwat will continue to use some form of wholesale cost benchmarking for the foreseeable future, and we have considered some sensitivities to possible changes in which Ofwat sets its efficiency benchmarks.

Ofwat's wholesale efficiency benchmarks

6. Appendix C sets out the methodology that Ofwat used in PR14 to estimate each company's relative totex efficiency. A key part of this methodology is the setting of the efficiency benchmark at the UQ, which is based on a series of econometric models that try to identify how efficient each company is, so they can be ranked and a benchmark set. It is by comparison with the totex of this benchmark company that other companies' relative efficiencies are calculated. These relative efficiencies are then used in setting companies' totex allowances.

7. A merger may lead to an adverse impact on Ofwat's ability to regulate if, through the merger, Ofwat's econometric models are either less able to accurately predict industry efficiency or if the benchmark level of efficiency[1] from the model is different. Thus, through these effects, the merger may lead to a less challenging efficiency target for the industry. This appendix focuses on the second of these effects, with the first covered in Appendix D.

Efficiency ranking

8. The relative efficiency rank of each company in PR14 is shown in Table 1Table 1. The third column shows the historical out-turn totex of each company, with the fourth column showing the modelled totex requirement for the same time period. The models used by Ofwat at PR14 used panel data on opex from 2008/09 to 2012/13 and for capex from 2005/06 to 2012/13, to produce estimates of the impact of cost drivers on costs and to isolate the impact of management efficiency on costs. The modelled amount is the

[1] It should also be noted that in PR09 the firm at the efficiency frontier was used as a benchmark, as opposed to PR14 when the UQ firm was used as the benchmark, and as such any merger is now capable of having an impact on the benchmark by moving the point at which the UQ falls.

annual average modelled totex requirement, and the company amount is the annual average historical out-turn. Dividing the actual totex by the modelled totex gives the relative efficiency score for each company. The lower this number, the more efficient the company is estimated to be.[2] Table 1 shows that, in PR14, BW was estimated to be the most efficient company and SWW the second most efficient.

Table 1: Each company's overall totex efficiency rank for AMP6

Identifier	*Company*	*Company amount (annual average, £m)*	*Modelled amount (annual average, £m)*	*Efficiency ratio (%)*
BW	Bournemouth Water	115	137	84.3
SWW	South West Water	615	728	84.5
PRT	Portsmouth Water	126	138	91.5
SEW	South East Water	643	694	92.6
NES	Northumbrian Water	1,244	1,334	93.3
SSC	South Staffordshire Cambridge	370	393	94.1
TMS	Thames Water	3,210	3,403	94.3
SVT	Severn Trent Water	2,302	2,406	95.7
DVW	Dee Valley Water	77	80	95.9
YKY	Yorkshire Water	1,348	1,402	96.1
AFW	Affinity Water	942	969	97.2
ANH	Anglian Water	1,498	1,506	99.4
WSX	Wessex Water	516	513	100.6
SRN	Southern Water	751	739	101.7
NWT	United Utilities	2,139	2,078	102.9
SES	Sutton & East Surrey Water	212	205	103.5
WSH	Dwr Cymru (Welsh)	1,282	1,169	109.7
BRL	Bristol Water	418	341	122.4
IND	**Industry**	**17,808**	**18,236**	

Source: CMA analysis of Ofwat relative efficiency models for PR14.

9. Ofwat chose to set its efficiency benchmark and the UQ based on the efficiency rankings set out in Table 1, this is detailed further in Appendix C.

10. We note that in AMP6 there were 18 companies included in the totex modelling, with the UQ falling three-quarters of the way between the fifth and the sixth-ranked firm (ie it is the hypothetical 5.25th-ranked firm). This introduces an asymmetry into our analysis as if there is an equal probability of a benefit (ie the merger combines two poor-performing companies so the quartile moves to the fifth-ranked firm) or a detriment (ie the merger combines two UQ firms so the quartile moves to the sixth-ranked firm), the detriment will be three times the size of the benefit.[3] However, the choice of a UQ was made in the context of setting a price control and Ofwat has indicated that it is likely to continue to use this approach in future. Therefore, although it causes an asymmetric impact when considering a merger, it is still correct to assess the impact of the merger against the regulatory framework as it exists.

[2] Since a lower number means that a company's business plan envisages lower totex than Ofwat's model of efficient costs.
[3] We note that due to the way that a quartile is constructed, there will always be an asymmetry between the benefit and the detriment of a merger, no matter how many firms exist in the industry.

11. Further, we note that a merger may in and of itself cause Ofwat to alter where its benchmark falls in the future. For instance, if two UQ companies were to merge, Ofwat could use an upper quintile in the next price review to ensure that the benchmark efficiency is not less challenging.[4] However, Ofwat notes that although implementing a more stringent benchmark may mitigate the impact of two high-performing companies merging, the merger will reduce the precision of its economic models, giving Ofwat less confidence in its efficiency modelling. As such, it is unlikely that Ofwat would choose to implement a stricter benchmark as a result of a merger.

The impact of the merger on the benchmark in Ofwat's models

12. A merger may affect the outcome of the efficiency modelling by changing the benchmark and as such may lead to other firms in the industry receiving a less (or more) challenging determination, relative to the counterfactual case in which the firms do not merge. The effect of the merger on the wholesale efficiency benchmark will depend on the expected performance of the merged entity compared to the expected performance of the merging firms absent the merger. Absent efficiencies, we would expect that:

    (a) if the two merging parties are both more efficient than the UQ threshold in the counterfactual case, the merger will lead to a decrease in efficiency as one firm above the quartile is removed, so the quartile shifts down to the next firm;

    (b) if the two merging parties are both less efficient than the UQ threshold, the merger will lead to an increase in efficiency as one firm below the quartile is removed, so the quartile shifts up; and

    (c) if the merger parties lie either side of the UQ, the results of the merger will depend on which quartile the merged entity is expected to fall into. This will depend on the efficiency of the merged firm, relative to the best-performing of the two merger parties, which we will need to model.

13. In order to fully assess the impact of the merger we need to consider not only what the effect of the merger would have been based on the parties' positions in the most recent Ofwat price review, referred to as the **static** approach, but also what the effect may be in future, referred to as the **forward-looking** approach. The merger is more likely to have a negative impact on the level of the wholesale efficiency benchmark if there is a high probability that both of the merging parties would have been in the UQ in future time periods absent

[4] We note that the movement to a more challenging benchmark would be dependent upon the confidence Ofwat places in its modelling and that a merger will lead to a reduction in confidence compared to pre-merger levels.

the merger. Conversely, the lower the probability that they will both be in the UQ, the more likely the merger is to result in a benign or positive impact.[5]

Constructing the hypothetical merged entity

14. In order to model the impact of the merger we must make certain assumptions as to how the merged entity would have performed in the past and as to how it will perform in the future. By making such assumptions, SWW and BW can be substituted for the new merged firm, which will allow us to simulate whether the merger would have had an impact either on the most recent price review, or a future one.

15. Pennon and Ofwat have taken different approaches in combining the companies' historical data. Whilst Ofwat has principally taken the parties' historical performance as given and combined their data to give the hypothetical performance of the merged firm,[6] Pennon believes that the merger will result in a number of efficiencies and have included 25% of these efficiencies when constructing the merged firm.

16. The differences between Pennon and Ofwat's approaches suggest that there are two key components in constructing the hypothetical merged entity – first, how the costs and efficiency rankings of the two existing firms (SWW and BW) should be combined to form the new merged firm; and second, whether we should make any allowance for possible merger efficiencies.

Estimating costs and efficiency ranking of the merged firm

17. There are two possible methodologies for combining the performance of the SWW and BW to give a putative measure of the merged entity's performance.[7] These are:

    (a) Assuming that the smallest merging party is lost as a comparator and as such that the performance of the merged entity reflects that of the larger of the two merging parties pre-merger.

    (b) Assuming that the merged entity's performance is the sum or average of the performance levels of the merging parties.

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[5] As already noted, since little time has elapsed since PR14, we do not currently have a clear indication as to what changes, if any, will be made in the modelling approach for PR19, as such we have no choice but to simulate the future effect of the merger using the PR14 models.
[6] Note that we do not consider in this section how the merged firm could perform on qualitative aspects of performance.
[7] See Europe Economics (18 May 2015), *Valuing the Impact of Mergers and Identifying Undertakings in Lieu*, section 3.2.1.

18. In the context of the wholesale cost modelling, our view is that it is not clear why it would be appropriate to drop the observations for BW. In particular, we consider that there is unlikely to be a significant change to BW's wholesale costs post-merger as there is little scope to consolidate services.[8,9] Therefore, we believe that, excluding any merger synergies, the costs of the merged firm are likely to be similar to a weighted average of the two parties pre-merger. Since both parties are in the UQ historically, Ofwat has assumed that they will continue to be in the UQ and has used a weighted average of their performance in calculating the static approach.

19. In the forward-looking analysis, the ranking of the parties is not fixed, and as such it is possible to have a situation where one of the parties is in the UQ and the other is in the lower quartile in future periods.[10] Thus, Ofwat has set out a number of different scenarios for the merged entity's performance based on whether each of the merged parties are in the UQ in the year in question (see Table 2). Ofwat has then calculated the probability of each of the four scenarios in Table 2 where the parties rank in different quartiles and the two scenarios where the parties rank in the same quartile (either UQ or NUQ) occurring, combining this with the impact of losing an upper or a lower quartile company as appropriate and summing gives the overall impact of the merger. In the table below x is set by Ofwat at 90%,[11] Ofwat notes that the choice percentage is conservative and if this probability was lower the detriment would be higher.[12]

Table 2: Possible combinations of merged company performance, used in the forward-looking approach

Scenario	*SWW performance*	*BW performance*	*Merged entity performance*	*Merged entity probability*
1	UQ	NUQ	UQ	x
2	UQ	NUQ	NUQ	1-x
3	NUQ	UQ	UQ	1-x
4	NUQ	UQ	NUQ	x

Source: Ofwat.

20. We consider that although taking a weighted average by turnover may produce a reasonable estimate, it is not robust, as there will not be a linear

[8] There may be scope for some changes due to different management efficiencies, but given that SWW were ranked number 1 for efficiency in AMP6, it is unlikely that this will lead to a decline in performance.
[9] Note that when considering some of the qualitative parameters it may be appropriate to assume that BW is dropped, there is greater scope for the consolidation of services, which may lead to delivered services assuming the characteristics of one or other of the merging parties. Given the asymmetry in their size, it is more likely that BW's services will be subsumed into SWW than vice versa.
[10] This situation obviously exists for other mergers in the static case as well.
[11] Ofwat used 90% in its calculations and also tested whether its calculations were sensitive to different percentages, they were not. Ofwat has not stated why 90% was chosen, although we calculate that the ratio of turnover for the merging parties is roughly equal to 83%.
[12] Ofwat calculated that if x was 50% the merger would result in a detriment of £51.7 million in the forward-looking approach and if it were 10% the detriment would be £92.8 million.

relationship between each variable in the totex models and turnover. As such, we have taken a slightly different approach and combined the parties' totex cost data and then used this to model the efficiency score for the merged entity.

21. In doing so we have looked at the different merger impacts when one of the merging firms is above the UQ and the other is below the UQ under three different scenarios:

    (a) A scenario where the merged entity is ranked below the current sixth-ranked firm where the loss of a comparator results in a less challenging benchmark. We assume that this has the same impact as the benchmark moving from (1/4:3/4) between the fifth and sixth firm to the efficiency level of the current sixth firm.

    (b) A scenario where the merged entity is ranked above the current fifth-ranked firm where the loss of a comparator results in a more challenging benchmark. We assume that this has the same impact as the benchmark moving from (1/4:3/4) between the fifth and sixth firm to the efficiency of the current fifth firm.

    (c) A scenario where the merged entity is ranked between the current fifth- and sixth-ranked firm and becomes the new UQ where the loss of a comparator results in either a more challenging or less challenging benchmark depending on whether the merged entity is above the current benchmark. Since the size of the impact in these scenarios will depend on the exact efficiency score of the merged entity we have assumed that these scenarios result in no impact.

22. In response to our initial working paper, Ofwat commented that this approach did not account for the impacts in scenarios where the merged entity became the new UQ. In scenarios where the merged entity's efficiency score was between the fifth and the sixth company, but was above the UQ, we assumed no impact. As such, Ofwat believes that we may have overstated the probability of benefits. We acknowledge that our modelling approach does not take this into account. However, we note that:

    (a) Scenarios of 'no impact' have a relatively low probability in our modelling. Across all the baseline scenarios using both historical data and business plan data respectively we have calculated that the likelihood of such scenarios occurs on average in around 9% of instances.[13] Therefore any

[13] Ranging from between 8.6% and 13.8% using business plan data and between 7.3 and 11.7% using historical data.

error resulting from our simplifying assumption is likely to be small, particularly in the context of the significant wider uncertainties in predicting benchmark impacts.

(b) The extent to which the UQ shifts is likely to be somewhat dampened as the size of the impact depends on the difference between the old pre-merger UQ and the efficiency score of the new merged entity that determines the post-merger UQ.

Treatment of efficiencies

23. The second consideration in constructing the merged entity is whether to take account of any merger efficiencies. Ofwat has not made any allowance for efficiencies in their estimates of the merger impact. Pennon has claimed that efficiencies should be taken into account, and for modelling purposes has included 25% of its claimed total cost savings resulting from the merger.

24. We believe that there is a theoretical case for including merger efficiencies in estimating the impact of the merger on wholesale benchmarks provided they are timely, likely and merger-specific. In principle, efficiencies resulting from a merger could directly reduce the costs of the merged company. This in turn could increase the likelihood of the merged firm forming part of the UQ benchmark. However we would need to assess whether there exist any efficiencies that are likely to cause a permanent reduction in totex and as such an expected increase in efficiency relative to the rest of the industry.[14]

25. Pennon submitted that cost efficiencies totalling around £[✂] per year[15] would be realised as part of the merger, although we note that only a proportion of these efficiencies will relate to wholesale costs. In order to accept these efficiencies and include them in our modelling calculations, we would have to be content based on compelling evidence that the merger synergies were timely, likely to occur and could not be realised absent the merger.

26. We propose that a full assessment of efficiencies should occur only *after* a baseline assessment of whether the merger is likely to result in a prejudicial impact on Ofwat's ability to make comparisons without taking efficiencies into account, and only if we are of the view that the acceptance of efficiencies is likely to lead to a different finding. We have not found it necessary to conduct a full assessment of efficiencies in view of our provisional findings in this inquiry.

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[14] For example, some of the suggested savings such as the sale of surplus land will result in a one-off benefit for the company and even if reflected in a price determination would only affect efficiency in that price review.
[15] Excluding sales of land

Estimating impacts on the wholesale cost benchmark

27. The simplest way of analysing the impact of the merger on wholesale efficiency benchmarks is to simulate what would have happened in the most recent price control review if Ofwat had carried out its benchmarking based on a merged company rather than separate SWW and BW comparators. However, this static approach does not attempt to control for future changes in costs, efficiency rankings or regulatory approach. In general, we would expect to put less weight on the results of the static analysis compared with a forward-looking approach which attempts to control for the probabilities of future changes. However, we consider that it is useful to set out the static results first to provide a benchmark against which to consider more forward-looking modelling results.

When to assess the impact?

28. One important consideration is whether the static analysis should be estimating the merger impact on Ofwat's approach in PR14 or PR19 (and as a result whether the forward-looking analysis beings in PR19 or PR24). As the choice of the starting point for our analysis may affect the starting ranking of the merging parties.

29. Pennon argued that prices had already been set for the period 2015–2020, and as such the earliest point at which the merger is capable of having an impact is 2020, following the next price review which will be finalised in 2019. As such, Pennon argued that the static analysis should consider the impact of the merger at PR19, rather than in the most recent price review. To that end it submitted that it was most appropriate to use the company rankings based on costs included in its business plan, since these were forward-looking and could give a projection for company expenditure in 2019. In contrast, Ofwat's static modelling is based on re-running the analysis in PR14, based on historical data on firms' efficiencies.

30. While we accept that the merger will not impact on Ofwat's ability to set wholesale benchmarks until the next price control, we believe that the static approach is best interpreted as a hypothetical test of the impact of the merger on Ofwat's current regulatory framework. This is consistent with the approach taken in the two most recent water merger investigations by the CC in 2007 and 2012, both of which were conducted three years after the most recent price reviews by Ofwat (PR04 and PR09 respectively).[16] In South East Water/Mid Kent Water, the CC analysed whether the merger might have been

[16] We note that the current case is taking place only one year after the PR14 price control review.

expected to result in an impact on the benchmark on the basis of the existing rankings and bands (ie PR04), based on historical data, and separately went on to consider whether there would be an impact in the future. Similarly in South Staffordshire/Cambridge Water, the CC analysed whether the outcome of PR09 would have been different if the merger had taken place, prior to going on to see whether there would be an impact in the future.

31. Although the static approach adopted by the CC in South East Water and South Staffordshire Water was backward looking, it allowed the CC to assess whether the merger would have impacted the most recent price control. The static approach also allowed the CC to use historical data, rather than making predictions as to how the merged entity and other firms in the industry would perform going forward. The weakness in the static approach is that firms are unlikely to hold exactly the same ranking at the time of the next price review, and as such, looking at the results of the previous price review may not be a good approximation for the future.[17] As such, the CC used a forward-looking approach (discussed in more detail below) to make predictions as to how the merged entities would rank in future price reviews.

32. In this case we have adopted the same approach as in the previous CC inquiries, with the static approach modelling the impact of the merger as if it had taken place prior to PR14, and the forward-looking analysis modelling the impact from PR19 onwards.

Starting rankings of the merging parties

33. Ofwat and Pennon made alternative suggestions for the appropriate starting rank of the parties pre-merger for the purpose of the static (and forward-looking) analysis. Pennon proposed that the starting point for the static analysis of wholesale costs should be the rankings as determined by the revenue bids in the PR14 business plans.[18] If these are used, SWW ranks number 1 and BW ranks number 9 (as shown in Table 3). In contrast Ofwat proposed using a comparison of actual out-turn costs between 2009 and 2015 with the company specific cost efficiencies calculated for PR14. If the historical rankings are used, SWW ranks number 2 and BW ranks number 1. These alternative rankings are set out in Table 3.

[17] If there was no effect on the benchmark in the most recent price review it could be argued that Ofwat would have a tool, at least in principle, through which it could set prices that are unaffected by the merger and as such irrespective of changes in the rankings the merger would be unlikely to cause a prejudice to benchmarking.
[18] Note that Pennon also proposed using the business plan rankings as the starting point for its forward-looking analysis.

Table 3: Ranking of water companies based on historical performance and business plan projections

Identifier	*Company*	*Rank based on PR14 historical data*	*Rank based on PR14 business plan projections*
BW	Bournemouth Water	1	9
SWW	South West Water	2	1
PRT	Portsmouth Water	3	5
SEW	South East Water	4	12
NES	Northumbrian Water	5	6
SSC	South Staffordshire Cambridge	6	13
TMS	Thames Water	7	4
SVT	Severn Trent Water	8	14
DVW	Dee Valley Water	9	16
YKY	Yorkshire Water	10	2
AFW	Affinity Water	11	3
ANH	Anglian Water	12	11
WSX	Wessex Water	13	15
SRN	Southern Water	14	17
NWT	United Utilities	15	8
SES	Sutton & East Surrey Water	16	10
WSH	Dwr Cymru (Welsh)	17	7
BRL	Bristol Water	18	18

Source: Ofwat's and Pennon's initial submissions to the CMA.

34. Pennon and Ofwat provided detailed submissions outlining their views on the appropriate choice of starting point in both the static and the forward-looking analysis. The starting point in previous CC investigations was to use the companies' historical out-turn rankings for both the static and the forward-looking analysis. However, we have considered whether business plan rankings might be more appropriate in assessing the impact of the current merger.

35. We consider that the decision on whether to use historical out-turn rankings or business plan rankings (or any other approach) should depend on how well these can be expected to reflect past and future performance of the merging firms. We have considered:

    (a) First, whether there might be specific reasons why the historical out-turn rankings at PR14 for BW and SWW might not be a good reflection of the current and future performance of the parties.

    (b) Second, and linked to the first, whether we should base the PR19 ranking that is the starting point for the forward-looking analysis on historical data or business plan forecasts.

Are PR14 out-turn rankings a good reflection of performance?

36. There are two reasons why historical rankings may not give an accurate impression of the impact of a merger:

    (a) If one or both of the merging parties were historically either much more or much less efficient than they were in the last price review, and their

performance was driven by one-off factors. If we were to find that the merging parties' historical rankings were substantially different from their ranking in the most recent price reviews, we would need to understand what impact that would have on our analysis. If the impact were significant, we would want to understand what has led to the change in ranking and whether this is likely to persist in future, or whether it was a one off.

(b) If there are concerns that Ofwat's models over- or understate the efficiency of one of the merging parties, such that there is uncertainty over the true efficiency ranking of the parties.

Changes in historical efficiency ranking of the merging parties

37. In order to assess whether the merging parties' efficiency rankings at PR14 were similar to their rankings in the past, we compared the position at PR14 to the position in previous price reviews.

38. One of the challenges in carrying out this analysis is that Ofwat's panel data models in PR14 do not allow us to track annual changes in efficiency ranking. The models used by Ofwat at PR14 used panel data on opex from 2008/09 to 2012/13 and for capex from 2005/06 to 2012/13, and as such produced a single estimate of totex for the period, rather than separate annual estimates.[19] As such we do not have separate annual rankings, and it is difficult to formulate annual rankings as the models are designed to smooth capex over the period. In order to produce annual rankings we would need to know the level of capex each year which will be different from the average annual smoothed capex.

39. Looking back at previous price control reviews, in the AMP3, AMP4 and AMP5 price controls covering 1999 to 2009, Ofwat conducted separate analysis of spending on opex and capex, breaking capex into water infrastructure and water non-infrastructure. Table 4 below shows the ranking for each of these categories from 2000 to 2009.[20]

[19] When estimating a model based on panel data, all the data is used to produce a single estimate
[20] Note that due to mergers over the time period, the number of firm's changes, which can cause changes in the rankings.

Table 4: SWW and BW historical capex and opex rankings 2000/09

		00	01	02	03	04	05	06	07	08	09
Water infrastructure	SWW	1	1	1	1	1	1	1	1	1	15
	BW	15	15	15	15	14	14	14	14	14	16
Water non-infrastructure	SWW	4	4	4	4	5	5	5	5	5	6
	BW	18	18	18	18	12	12	12	12	12	15
Opex	SWW	12	15	9	16	16	18	16	16	17	16
	BW	8	12	14	7	7	5	7	6	5	12

Source: CMA calculations based on Ofwat data (these calculations take into account mergers that occurred in the past between some companies).

40. The change in methodology between PR09 and PR14 means that the historical rankings are not directly comparable to the PR14 totex rankings, as companies are now ranked on totex only, rather than on three different types of expenditure. However, the separate capex and opex rankings can be combined to produce a single estimate of overall totex efficiency for the time period. We have constructed this composite totex ranking by taking the average of the water infrastructure and water non-infrastructure expenditure and then adding this to the opex ranking, giving capex a 60% weight and opex a 40% weight.[21]

41. This composite totex ranking should be broadly comparable to the current totex ranking, although we acknowledge that there will be some differences due to the different methodologies used. Since we are using a ranking, rather than the efficiency score, we consider that these differences should be relatively minor since different treatments of expenditure affect all firms in a uniform way and as such should not alter the rankings between firms, although they are likely to change the individual efficiency scores. The composite totex ranking is shown Table 5.

Table 5: SWW and BW composite totex rankings 2000/09

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*Average*
SWW	6.3	7.5	5.1	7.9	8.2	9	8.2	8.2	8.6	12.7	8.17
BW	13.1	14.7	15.5	12.7	10.6	9.8	10.6	10.2	9.8	14.1	12.11

Source: CMA calculations based on Ofwat data (these calculations take into account mergers that occurred in the past between some companies).

42. Although SWW were the top ranked company for capital water infrastructure for the majority of the nine years, neither company was ranked in the top 2 for water non-infrastructure or opex. BW had an average composite totex ranking of 12, with neither company in the UQ based on average historical composite totex rankings.

[21] This approach follows that used by Ofwat in its initial submission to the CMA, p43.

43. Pennon argued that BW had not had a change programme that could explain this improvement in historical ranking since PR09. It also argued that there were further reasons to suggest that BW did not consider itself a top-ranking performer on costs over the current price control period, including that:

(a) BW's choice of 101.2 on the totex menu indicates it will underperform compared to Ofwat's determination;

(b) Pennon argued that [✂]; and

(c) Pennon stated that recent out-turn data for 2013/14 and 2014/15 suggested that BW's historical PR14 efficiency rank position had deteriorated.

44. Conversely, Ofwat told us that:

(a) there were factors that might explain an improvement in BW's performance between PR09 and PR14, including the change in ownership from Cascal to Sembcorp in July 2010; and

(b) the changes in ranking also reflected significant changes in the modelling at PR14 compared with PR09, with Ofwat moving to a totex approach. Ofwat commented that it was not surprising that results were different under the new modelling approach, and that the changes had been made in part to avoid the potential for gaming of the opex and capex rankings under the previous approach.

45. Overall, the CMA agrees with Ofwat that the change to a totex modelling approach could have been expected to lead to movement in the rankings between companies. At the same time, the fact that BW does not appear to have been a UQ comparator in previous price control periods raises questions over whether the PR14 efficiency rankings provides an accurate representation of the historical performance of the merging parties, as it performed particularly well in PR14, compared to its previous performance.

Sensitivity of PR14 efficiency rankings to Ofwat's modelling approach

46. We have also considered the robustness of the parties' rankings in PR14 to sensitivities in Ofwat's modelling approach, reflecting that there is uncertainty over how Ofwat might model wholesale costs in future reviews.

47. In particular, Pennon submitted that the totex efficiency ranking from PR14 overstated BW's actual efficiency as the result was driven by the outcome of the supply-demand balance model. The supply-demand balance model is a unit cost enhancement model, which models any additional expenditure

companies need to make to be able to balance supply and demand. For instance, if a company has significant seasonal fluctuations in demand, driven by an influx of tourists, it may have to spend more money to be able to meet this demand than another company with a more stable demand profile. Pennon submitted that the supply-demand balance model predicted £[✂] of expenditure over the historical period, which compared to its actual spend of around £[✂] over the same period. It submitted that the EA had now classified BW as not water stressed. As such, BW had **no** forecast activity in this area. Thus, if Ofwat's cost assessment exercise was repeated for PR19, BW would not be allocated any expenditure.

48. Pennon used two alternative methodologies to assess the impact of the supply-demand model on BW's efficiency ranking. First, it replaced BW's predicted historical spend in the supply-demand balance model with its actual costs and triangulated the results using Ofwat's PR14 approach. Pennon submitted that this shifted BW down from its frontier position to rank 8. Second, it triangulated the results from Ofwat's full and refined totex models alone (ie not including any of the enhancement models of which the supply-demand balance model is one) – this shifted BW down from its frontier position to rank 6. Using either adjustment, BW's historical frontier position was shifted below the UQ of the efficiency levels (ie became NUQ).

49. Ofwat indicated that although it disputed the basis for the recalculation, it agreed with the result if it was accepted as relevant. In particular, Ofwat submitted that the econometric models should be interpreted as a suite of models and companies should not 'cherry pick' single models that they under- or overperform in.

50. We note that during the course of PR14 companies would have had the incentive to challenge models that predicted low levels of expenditure, but not those that predicted high levels of expenditure. Since BW is a small company with an average annual totex requirement of £115 million[22], there is greater scope for a single model to skew its efficiency ranking. In this case Pennon and Ofwat agree that the supply and demand balance model predicted expenditure 10 times in excess of historical spending.[23] Further Pennon submitted that future spending in this area would be zero, as BW was no longer classified as water stressed. Therefore, in this case we believe it is appropriate to take account of the effect of the supply and demand balance

[22] £115 million is BW's totex over the entire historical period, it is not a per annum figure
[23] Ofwat noted that this was a feature of the supply-demand balance model, which included a variety of solutions companies employed across the industry, some of them being cheaper than others.

model on BW's efficiency ranking, as such we have conducted two sensitivities, based on different scenarios;

(a) a sensitivity which excludes the results of supply and demand model when calculating the totex requirement for BW; and

(b) a sensitivity which using historical supply demand balance expenditure rather than predicted expenditure.

Starting point for forward-looking analysis in PR19

51. In order to conduct our forward-looking assessment we need to predict the likely ranking of the parties at the start of PR19. This can be done in two principal ways; using PR14 out-turns and forecasting forward, or using business plan rankings for PR19. The choice of business plan rankings or historical rankings is linked to the previous discussion on whether the PR14 out-turn was reflective of the historical performance of the merging parties.

52. Pennon argued that Ofwat's approach in PR14 placed greater reliance on business plans, and was intended to incentivise companies to reveal their true costs. Ofwat used a fast track approach for those companies where it judged their business plans to be particularly high quality.[24] The fast track approach resulted in a shorter, less resource intensive review for the companies, as well as 'enhanced menu' with a higher cost sharing rate, and, in addition, a financial reward that uplifted its revenue,[25] this was designed to incentivise companies to reveal their true costs in their business plans. In addition, enhanced companies benefited under a 'do no harm' principle, as a result of which they retained a higher cost of capital after the WACC was reduced for standard companies at final determination and were not subject to the 5% cap. This is in contrast to the process at AMP5 where companies submitted business plans which could be viewed as bids for opex and capex, and then Ofwat used comparative analysis and the review process in an attempt to find their true costs. Additionally, Pennon submitted that in contrast to previous price controls Ofwat had used forecast data for the cost drivers in PR14 to calculate the basic cost threshold (BCT), and as such they should be more accurate than previously, although Ofwat noted that it was historical data and not forecast data that was used to calibrate the models.[26]

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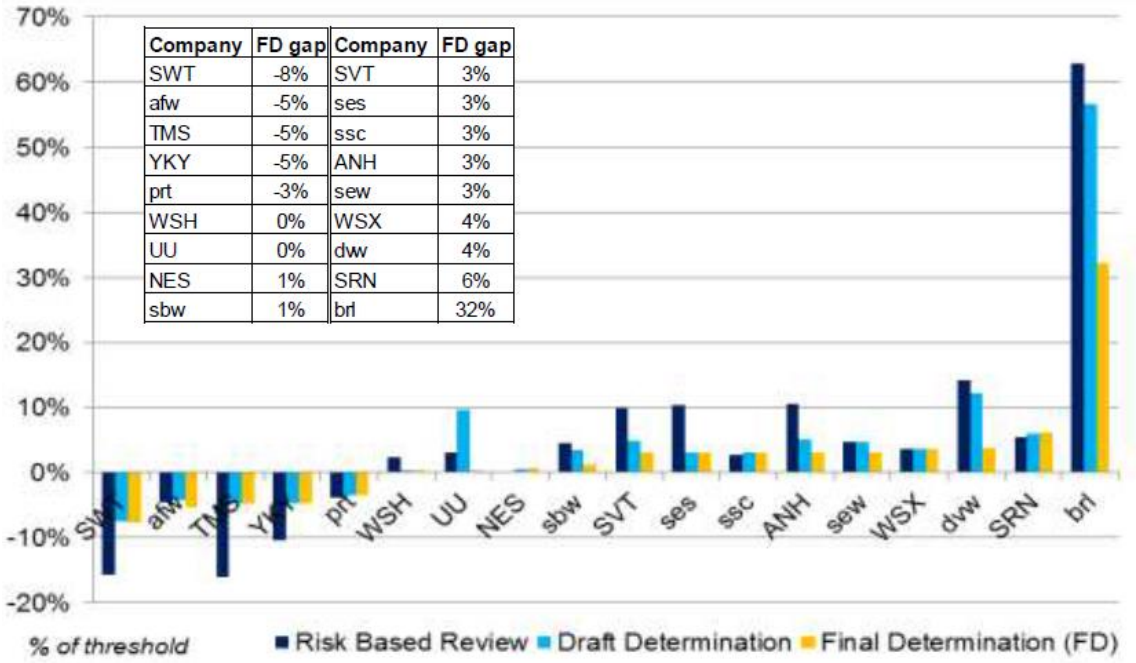
[24] Two out of 18 companies in AMP6, where the fast track companies still had to accept a number of conditions in order to achieve enhanced status.
[25] Note that this is distinct from the BCT allowance, where an enhanced company can benefit from an 'enhanced menu' (of the type mentioned in the Annex) with a higher cost sharing rate and in addition from a financial reward that uplifted its cost of capital.
[26] Specifically Ofwat used forecasts for certain cost drivers in the calculation to obtain the forecast cost allowance that firms should receive under the BCT allowance in PR14.

53. The majority of the final business plans, with the exception of Bristol Water, were within 5 to 10% of Ofwat's totex forecast, as shown in Figure 1. This suggests that the business plans may be a reasonable reflection of costs. However, Ofwat submitted that this would have at least been partly driven by the modelled totex forecast giving the companies a target to aim for with their final business plans, and as such it should not be surprising that final business plans were similar to modelled totex.

Figure 1: Final determination against modelled totex



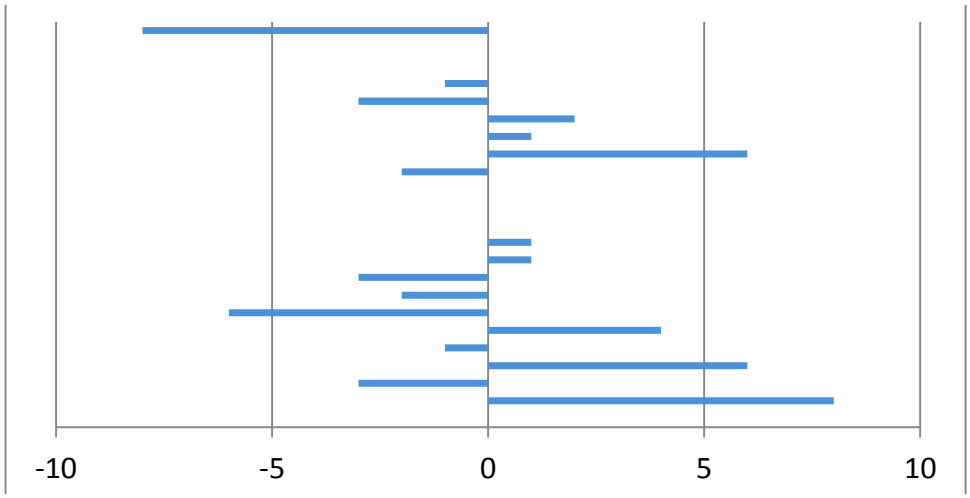
Company	FD gap	Company	FD gap
SWT	-8%	SVT	3%
afw	-5%	ses	3%
TMS	-5%	ssc	3%
YKY	-5%	ANH	3%
prt	-3%	sew	3%
WSH	0%	WSX	4%
UU	0%	dvw	4%
NES	1%	SRN	6%
sbw	1%	brl	32%

Source: CMA analysis of Ofwat data.

54. Ofwat also submitted that out-turn costs often differed from companies' forecasts, which led to movements in efficiencies and ranks. Figure 2 (below) illustrates the movements in company ranks from the business plan (PR09 final determination capex and opex) to actuals.[27] The negative numbers indicate that the company has improved in rank, while the positives show a deterioration in rank. There are few companies with no change and a substantial number of large jumps (eg including some companies jumping eight ranks).

[27] Actuals comprise actual company expenditure in the financial years 2010/11 to 2013/14 and company projections for 2014/15 that were used for price setting purposes. 2014/15 actuals will be available only when the regulatory accounts for 2014/15 have been submitted.

Figure 2: Change in company rankings between business plans and out-turn costs for AMP5 (2010/15)



Source: Ofwat.

55. Ofwat considers that the differences between the business plan forecasts and the actual out-turns for AMP5, show that business plans are not a reliable indicator of actual delivered efficiencies and that this is not surprising as the regime is designed to incentivise companies to outperform their business plans. It further noted that business plan rankings are not the same as efficiency forecasts for PR09 and PR14 and that business plans included some disallowed items, such as the Cheddar 2 reservoir for Bristol Water at PR14. In addition, while the business plan process was changed at PR14 to encourage companies to reveal their best estimate of costs, in practice only two companies out of 18 were given enhanced status.

56. Finally Ofwat argued that using business plan projections as the basis for judging parties' relative efficiency could create a perverse incentive for parties intending on merging in the future. In particular, parties might have an incentive to submit higher costs in their business plans, suggesting that they were less efficient, in order that this might then affect the assessment of whether the merger could lead to the loss of a good comparator.

57. We note that any prediction of efficiency rankings for PR19 will contain some degree of error, and as such we must consider what methodology or methodologies are capable of providing a reasonable starting point for our forward-looking analysis. In particularly, we are assessing whether applying a changes matrix to the PR14 out-turn data is likely to give a better or worse prediction of future ranking than using the business plan ranking for PR19 (we later discuss how a confidence interval can be placed around these estimates to reflect uncertainty). It is important to note that although there may be differences between the business plan forecast and out-turn for the AMP5 control period, there are good reasons to think that these may be greater than

will occur for AMP6. Furthermore, we note that the business plan ranking for BW is directionally the same as historical ranking if the effect of the supply-demand balance model is excluded, with BW being outside the UQ in both cases, and as such using business plan rankings has a similar effect to using historical rankings, but controlling for the supply-demand balance model.

Conclusions on starting rank of the parties

58. We consider that it is appropriate to use the historical PR14 ranks as the central basis for the static analysis, which is conducted at PR14. However, given the historical performance of BW on cost efficiency, and the sensitivity of the efficiency rankings to the results of the supply-demand balance model, we believe that it is appropriate to conduct a sensitivity which adjusts these historical rankings to account for the high level of predicted spend in the supply-demand balance model.

59. Overall when considering which rankings are appropriate for PR19 (and as such the basis for the forward-looking analysis) we think that both the business plan approach and the historical out-turn approach can provide useful information on possible future impacts. The fact that there are differences between them underlines the degree of uncertainty and difficulty in forecasting future merger effects. We agree with Ofwat that there are risks in using business plan forecasts. At the same time, given the historical performance of BW on cost efficiency, and the sensitivity of the efficiency rankings to the results of the supply-demand balance model, we do not believe that we can have confidence that BW is likely to be a UQ comparator in future. We note that, as argued by Pennon, the efficiency rankings when the supply-demand balance model is excluded are similar to the rankings based on the company business plans.

Static analysis – results

60. As discussed above, the static approach is backward looking and as such is concerned with the historical performance at PR14, rather than a forecast of future performance. Therefore, we consider that the historical efficiency rankings are the appropriate starting point for the static analysis.

61. Based on the assumption that BW and SWW are ranked 1 and 2 respectively, we would expect that the merger would lead to the loss of a high-performing comparator under the static approach, and would shift the benchmark downwards, as illustrated in Table 6.

Table 6: Static approach movement in rankings

Rank	Identifier	Efficiency ratio (%)		Rank	Identifier	Efficiency ratio (%)
1	BW	84.3		1	SWW/BW	84.4
2	SWW	84.5				
3	PRT	91.5	UQ	2	PRT	91.5
4	SEW	92.6		3	SEW	92.6
5	NES	93.3		4	NES	93.3
6	SSC	94.1		5	SSC	94.1
7	TMS	94.3		6	TMS	94.3
8	SVT	95.7		7	SVT	95.7
9	DVW	95.9		8	DVW	95.9
10	YKY	96.1		9	YKY	96.1
11	AFW	97.2		10	AFW	97.2
12	ANH	99.4		11	ANH	99.4
13	WSX	100.6		12	WSX	100.6
14	SRN	101.7		13	SRN	101.7
15	UU	102.9		14	UU	102.9
16	SES	103.5		15	SES	103.5
17	WSH	109.7		16	WSH	109.7
18	BRL	122.4		17	BRL	122.4
UQ threshold		93.5		UQ threshold		94.1

Source: Ofwat.

62. Therefore, the merger results in a 0.6% decrease in the industry efficiency target, relative to the pre-merger level. In order to monetise the decrease in the efficiency target, we multiply it by industry totex over the PR14 period, which is £17,393 million. Therefore, on this basis, the estimated magnitude of the adverse impact is estimated at £112 million over the five years of the PR14 period.[28]

Testing the sensitivity of the results of the static analysis

63. In assessing how much weight to attach to these results, we considered that it was important to assess not only how the parties' rankings might change in future (forward-looking approach, see below), but also whether the one period snapshot provided by the static approach was a good starting point for our assessment. As discussed above, we believe that there may be good arguments as to why the efficiency ranking, particularly of BW may be overstated in PR14, and note that the historical ranking of the merging parties has been lower than it was at PR14.

Historical rankings

64. Rerunning the static approach based on the previous composite totex efficiency rankings (with SWW ranked ninth and BW ranked 15th) would suggest a benefit to Ofwat's efficiency benchmark, because it would remove a below UQ comparator and increase the UQ efficiency threshold. We estimate

[28] This impact estimate (as with other estimates given in this appendix) is based on the predicted change in the BCT. We have not attempted to apply any caps or menu weightings to reflect the way in which Ofwat might determine cost allowances for individual firms. This assumption is discussed in more detail in Annex 1.

that the benefit in this case would be around £37 million in present value terms over five years. We acknowledge that this is a purely hypothetical estimate, and that the increase in the parties' rankings in the period to 2014 might reflect genuine efficiency gains relative to other firms. However, the historical movements in ranking suggest that we need to be cautious about the weight we place on the core static model results.

PR14 adjusted for the supply-demand balance model

65. Rerunning the static approach based on the PR14 totex efficiency rankings controlling for the supply-demand balance model (with SWW ranked first and BW ranked sixth or eighth) would suggest a benefit to Ofwat's efficiency benchmark, because it would remove a below UQ comparator and increase the UQ efficiency threshold. We estimate that the benefit in this case would be around £37 million in present value terms over five years.

Forward-looking approach

66. Although the static approach is capable of giving an indication as to whether the merger may prejudice Ofwat's ability to make comparisons between water companies, it takes no account of possible future changes in the relative efficiency rankings of water undertakings. As such, and as is the case in this merger, if two merging parties were to perform well in the most recent price review, irrespective of their historical or potential future performance, the merger would be shown to result in an impact on benchmarking under the static approach. In general, we would expect to put less weight on results of the static analysis compared with a forward-looking approach which attempts to control for the probabilities of future changes.

67. The methodologies discussed below were developed by the CC when analysing the South East Water/Mid Kent Water merger in 2007. In order to produce an estimate of the probability that a firm will change its ranking we began by looking at the extent of movement in companies' efficiency ranks in the past, and use this information to estimate the probabilities associated with movements in companies' efficiency rankings of different magnitudes in the future.

The starting point for the forward-looking analysis

68. As with the static approach, a key driver of results under the forward-looking approach is the starting ranking of the merging parties. As noted in the discussion in paragraphs 36 to 59 59, we believe the arguments over which approach is preferable are finely balanced, and we have estimated the

impacts using both PR14 historical rankings forecast through to PR19 and PR19 business plan rankings.

69. One significant point for the forward-looking analysis is whether it is appropriate to use the business plan rankings as a forecast of the efficiency position at PR19, or whether we should treat them as an alternative indicator of rankings during the PR14 period, which may then change by PR19. We shared initial modelling results with Ofwat and Pennon which assumed that the business plan rankings would be the true prediction of the rankings at PR19 and then considered the probability of changes in firms' rankings in future periods beyond PR19 (described in more detail below).

70. In response, Ofwat argued that this was not a realistic assumption, and we should not expect the business plan rankings to remain unchanged. Instead Ofwat argued that we should consider the probability of changes in firms' rankings between the business plan forecasts for PR14 and the next review period in PR19. Ofwat also noted that Pennon's initial modelling was carried out on this basis, applying a probability matrix to the business plan rankings in order to forecast the possible position in PR19.

71. Pennon argued that applying the business plan forecasts as a direct prediction of the ranking at PR19 had the benefit of reflecting the stickiness of rankings. It argued that the changes approach (described below) over-estimated the likelihood of firms changing their ranking position over time, so assuming that the business plan rankings were the actual rankings in PR19 corrected for this bias.

72. We acknowledge that business plans are making a prediction of the future based on information available at the current time. As with any prediction, these forecasts are not certain, and as such there is a certain probability that the rankings based on business plans will be realised, which is less than 100%. In order to account for this, Ofwat suggested three approaches, one of which was to apply a probability matrix to the business plan figures in order to project the impact at PR19 (and in future periods).[29] In doing this, Ofwat suggested that we should take the PR14 business plan rankings, which are forecasts of spending over the period between PR14 and PR19, as if they were the efficiency rankings in PR14 and then use the changes matrix to forecast the likely outcomes in PR19.

73. We note that both Ofwat and Pennon used a change matrix to provide the probability distribution around the PR19 business plan forecast. In this case

[29] Ofwat suggested an alternative approach which would combine business plan and historical rankings to give an estimate of the ranking at PR19.

we have chosen to follow their approach as we do not have sufficient information to estimate the true probability distribution. However, we note that the changes matrix may under- or overestimate the true probability distribution around the totex forecasts. We note that if information on the true probability distribution were available, it would be preferable to using a changes matrix as we are concerned with the error in the business plan forecast, which is different from observed historical movements in ranking given a starting ranking.

The probability of different companies reaching the upper quartile in Ofwat's rankings

74. Under the previous Ofwat regulatory framework we were concerned primarily with the likelihood of a firm becoming the frontier firm and as such being the efficiency benchmark. The greater the extent to which companies' ranks move over time, the more likely companies currently towards the bottom of Ofwat's efficiency rankings are to reach the top and be chosen by Ofwat as a benchmark in the future. The more stable companies' ranks are over time, the more likely it is that those companies already at the top of Ofwat's rankings will stay there.

75. Due to the change in methodology in PR14, the effect of a merger will differ depending on which quartile each of the merging parties is in. Thus, although we are still concerned with the degree to which companies' ranks are stable (or not) over time, we are now primarily concerned with whether a firm is in the UQ or not, since the effect of a merger differs depending on which quartile each of the merger parties are in.

76. The methodologies for predicting possible future changes in rankings are all based on data from 2000 to 2009 (see Table 7), as the efficiency rankings from PR14 are not directly comparable due to the change in methodology. There does appear to be some persistence in companies' ranks across years, although occasional substantial movements in rank are also observed, such as between 2001 and 2003 when South Staffordshire's ranking improved from 12th to second.

Table 7: Each company's opex efficiency rank, 2000 to 2009

Company	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Anglian Water	5	10	7	10	8	9	8	4	3	4
Dwr Cymru (Welsh)	16	18	18	17	14	17	15	15	16	18
Northumbrian Water		7	5	13	11	14	10	9	9	15
Severn Trent Water	9	9	6	4	6	10	12	11	8	13
South West Water	12	15	9	16	16	18	16	16	17	16
Southern Water	3	1	2	9	4	4	1	7	6	1
Thames Water	4	5	11	18	18	15	18	18	15	14
United Utilities	7	6	8	6	10	16	9	10	12	8
Wessex Water	1	4	4	3	3	6	3	2	4	9
Yorkshire Water		2	1	5	5	7	2	3	2	3
Bristol Water	15	16	17	15	17	11	14	13	14	11
Dee Valley Water	6	11	15	8	9	3	5	14	13	10
Portsmouth Water	2	3	3	1	1	1	4	1	1	2
Bournemouth Water	8	12	14	7	7	5	7	6	5	12
South East Water	13	14	13	11	13	12	11	8	11	7
South Staffordshire Cambridge Water	10	13	12	2	2	2	6	5	7	6
Sutton & East Surrey Water	11	8	10	12	12	8	13	12	10	5
Veolia	14	17	16	14	15	13	17	17	18	17

Source: CMA analysis of Ofwat relative efficiency models for PR14 (the analysis takes into account mergers occurred in the past between some companies).

77. We note that the underlying models used by Ofwat have changed within this period. Specifically, in 2006, the cost driver used in Ofwat's resources and treatment model changed from the proportion of supplies derived from river sources to the proportion of supplies derived from boreholes. In 2008 the cost driver used in Ofwat's distribution model changed from the length of main greater than 320 mm in diameter divided by total mains length to the natural log of the length of main divided by the number of connected properties at year end. These changes to the models may have driven some of the changes in rank observed in the period.

78. Following the CC's approach in the merger between South Staffordshire Water and Cambridge Water and the analysis in the merging parties' initial submission, we can combine this information on companies' current positions in Ofwat's models with historical data on movements between ranks to estimate the probability that companies will achieve different rankings in future years. As already noted, these approaches were originally designed to assess the probability of a firm reaching the efficiency frontier.

79. We have begun by considering the two models proposed by Ofwat and Pennon, which partly correspond to the three different approaches used in the previous CC inquiry into the merger of Cambridge Water and South Staffordshire Water. Ofwat and Pennon both used the changes approach, whilst Pennon also used a hybrid of the permutation and the transitions approach. These three methodologies all use the frequency of movements of different magnitudes in ranking in the period 2000 to 2009 to predict the likelihood of companies with different starting ranks moving either up or down a specified number of places in Ofwat's rankings. We use this information to predict the probability of movements of different magnitudes in ranking over

a five-year period – allowing us to assess for each company, given their position in Ofwat's models in 2014, what their likely position in 2019 and beyond will be.

80. The changes approach uses data on changes in ranking over five-year periods to produce an estimate of the probability that a firm will move up or down the rankings by a certain number of places. The permutations approach is motivated by a desire to increase the number of data points used to estimate the changes approach, and uses a combination of three and two year changes in rankings to estimate the probability of a change in rankings. Neither the changes nor the permutation approach account for any dependency in the data – ie the probability of moving up or down for a company may depend on previous movements in that companies ranking – and do not allow the probability of a specified change in rankings to vary depending on the starting rank of the firm – ie the probability of a firm in second place remaining second is the same as the probability of a firm in tenth place remaining tenth. This motivates the third methodology: the transitions approach, which attempts to condition the probabilities of a change on starting ranking by grouping firms above and below a certain ranking. This allows the probability of a specified change in ranking to differ depending on starting ranking.

81. The methodologies do not take any specific features of a company into account – for example the investment planned by a company, the size of a company, or the features of a company's management team – and the estimate of each company's probability of moving up or down Ofwat's ranks is determined entirely by the extent to which companies have historically moved between ranks. In addition, we are unable to fully account for the possibility of dependence in our data, either across time (the idea that the extent to which a company's rank changes in one period may depend on the extent to which its rank changed in the previous period) or across companies (the idea that the extent to which one company's rank changes over time may, in part, depend on the extent to which another company's rank changes). Nevertheless, despite these limitations, these measures provide some guide to how likely different companies are to reach different rankings in future price controls. This allows us to construct a probabilistic forecast of the likely impact of the merger on Ofwat's future wholesale cost benchmark.

82. In what follows, we begin by describing the methodology underlying the three different approaches to calculating probabilities. We then set out the results of using the changes approach and the Pennon hybrid of the permutation and the transition approach to estimate the probabilities of different movements in rank for the small water companies, and discuss the interpretation of these results. We also consider whether the change to PR14 and the move to UQ

rather than frontier regulation might allow us to take a different approach based on looking directly at movements in quartile ranking.

Changes approach

83. The changes approach uses historical data to calculate the probability of a company moving either up or down, based on its ranking at the beginning of the time period. For example, if we are considering a company that is ranked fifth in PR14, the changes matrix will give the probability of it either remaining fifth in PR19 or achieving any rank other than fifth. Since the changes matrix does not account for a company's starting ranking the probability of a company remaining fifth in the next time period is the same as the probability of a company remaining 12th.

84. Due to the change in methodology between PR09 and PR14, Ofwat does not believe that it is appropriate to include PR14 data when estimating the changes matrix, as efficiencies are not directly comparable between the different methodologies.[30,31] Since separate capex and opex models were used in PR99, PR04 and PR09, whilst a single totex model was used in PR14, it is necessary to combine the capex and the opex changes matrices, so they can be applied to the PR14 rankings. Ofwat proposes calculating separate changes matrices for opex and capex and then applying a notional 60% capex weight in order to produce a single 'totex' matrix. It should be noted that Ofwat used this methodology when performing a benefit calculation for the company-specific uplift on the cost of capital in PR14.

85. Under the changes approach, we consider movements in water companies' ranks across each overlapping five-year period from 2000 to 2009. That is to say, we compare each water company's rank in each year from 2000 to 2004 to its rank five years later and then calculate the frequency of different magnitudes of changes in ranking. We then use these frequencies in order to estimate the probability associated with movements of different magnitudes.

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[30] Principally this is because opex and capex efficiencies were calculated separately and on an annual basis up to 2009, whereas the totex ranking used panel data so produced a single estimate at PR14. Therefore, Ofwat has constructed a composite totex ranking for the period up to 2009, which may not be directly comparable with the PR14 totex ranking. Additionally opex rankings were produced on an annual basis, allowing for the calculation of annual changes in ranking, up to 2009, whilst there was only a single ranking produced for PR14, which drew upon all the data so can be viewed as a ranking over the period of the input data which was form 2008/09 to 2012/13 for opex and from 2005/06 to 2012/13 for capex. As such there would be an overlap between the annual rankings and the PR14 ranking.

[31] As discussed in the latter section reviewing historical performance, if a change in methodology renders past performance a poor predictor of future performance, it is not clear that any methodology based on historical data will be able to predict future performance under a different methodology with any degree of accuracy. In such circumstances any of the methodologies based on historical data will only be able to predict future performance to the extent that the methodology is the same.

86. In this case Ofwat submitted that capex efficiency was more appropriately observed for an entire price control rather than for separate years, because of the potential for expenditure to move between years, it had not published annual efficiency rankings for capex, and it did not consider it useful to retrospectively develop annual capex or totex rankings now. Instead, it proposed that we should use the capex efficiency rankings from PR99, PR04 and PR09. Thus Ofwat proposed using separate overlapping five-year periods as shown in the example below for calculating opex efficiency, but only using the data at PR99, PR04 and PR09 to calculate capex efficiency.

87. Ofwat then applied a normal distribution to smooth the raw changes matrix and ensured that all possible changes were populated. For instance, in principle the raw changes matrix could have a non-zero probability that a firm would increase ranking by ten places, but a zero probability that it would increase by seven, eight or nine places, due to a lack of observations. Applying a normal distribution smooths the results so that there is always a non-zero probability of a change in ranking occurring. In order to test whether the use of a normal distribution is having a large impact, we have estimated the impact based on the raw changes matrix, and found no material difference.[32]

88. In calculating the changes matrix we have adjusted the historical rankings to account for changes in rankings brought about by mergers, as we are only interested in ranking changes driven by changes in performance. For instance, if the first- and second-ranked firm in an industry were to merge every other firm would move up one rank by default, with no change in their performance. As such, if we were not to adjust the changes matrix for changes in industry structure, we would overestimate the number of times firms have improved their ranking. We have adjusted historical rankings by merging the opex/capex rankings of previously merged firms.

89. Ofwat submitted that it was not appropriate to merge historical opex and capex rankings and that the correct way to weight merging company performance was to weight their actual efficiency scores and then derive rankings, as efficiency was assessed separately for opex and capex in previous reviews rather than for opex and capex combined (totex). Ofwat noted that weighted rankings might be misrepresentative of the actual ranking that would have occurred had efficiency scores been weighted, then ranked. However, Ofwat acknowledged that efficiency scores were not available and as such it was not possible for us to construct the changes matrix as it

[32] The 25-year present value is –£74 million using historical rankings and the normalised changes matrix and –£63 million using historical rankings and the raw changes matrix.

suggested. We believe that our approach to adjusting the changes matrix results is preferable to using an unadjusted matrix, and as such have used this adjusted matrix.

90. When we use these distributions to estimate the probability attached to future changes we use data on each company's rank in Ofwat's models of opex efficiency for each year from 2000 to 2009. Within this dataset there are 21 to 22 companies, and five different five-year periods (ie 2000–2005, 2001–2006, 2002–2007, 2003–2008 and 2004–2009). This implies that the changes approach is based on 107 observations.

Pennon transitions approach

91. Estimates derived using the changes approach may be affected by dependence in the data, as this methodology assumes that water companies' movements in rank are unaffected by their starting position. For the period 2001 to 2008, Table 8 sets out the movements in water companies' ranks conditional on their starting rank. It shows that the position of water companies towards the top of Ofwat's rankings were more likely to worsen in the next year, rather than improve, while the position of water companies towards the bottom of Ofwat's rankings were more likely to improve than to worsen. This suggests that starting position may play a role in determining the probability of different movements of rank in subsequent years.

Table 8: Proportion (and number) of water companies whose quartile increased, remained the same, or decreased, depending on their initial quartile

	Change in quartile next year		
	Quartile worsens	*Quartile remains the same*	*Quartile improves*
Q1	23% 11	77% 36	
Q2	34% 12	49% 17	17% 6
Q3	24% 9	50% 19	26% 10
Q4		69% 29	31% 13
Overall	20% 32	62% 101	18% 29

Source: CMA analysis based on composite totex efficiency 2000 to 2009.

92. In order to control for this feature of the data we would ideally calculate the probability associated with movements in rank of different sizes for water companies at each position in Ofwat's rankings. However, given the limited

amount of data available to us, this approach is not feasible.[33] Instead in the South East Water/Mid Kent Water merger investigation,[34] the CC partially accounted for companies' starting positions by grouping together all companies below a given position in Ofwat's rankings. Doing so allows the estimation of the probability of a company reaching the top of Ofwat's rankings given its starting position.

93. Specifically, under the transitions approach, we assess movements in rank over a five-year period using a similar methodology to the changes approach. However, we restrict our assessment to those companies below a given position in Ofwat's rankings in order to account for the fact that companies at different positions in the rankings may have different probabilities of moving up or down Ofwat's efficiency ranks.

94. Ofwat argued that the transitions approach was problematic as it reduced the number of observations on which to estimate changes in rank compared with the changes approach, and as such reduced the significance of the results. Ofwat noted that in the South Staffordshire/Cambridge inquiry, the CC had considered that this approach essentially considered the overall probability for a company of a given starting position and all companies positioned lower in the rankings of reaching the top of Ofwat's rankings, which was likely to cause it to yield an underestimate of the true probability for a company with that starting rank.[35] Ofwat stated that this approach appeared to give implausible results in the South Staffordshire/Cambridge inquiry, with the probability of a high-performing company remaining top of the rankings being less than a random chance.

95. One way of increasing the number of observations available to estimate companies' changes in rank is to reduce the length of the periods across which we are looking at changes in rank. This provides the motivation for an alternative methodology – the permutations approach. In order to increase the amount of data available and as such produce more reliable estimates using the transition approach, Pennon first used the permutations approach, before then using the transition approach.

96. Under the permutations approach, we would consider the extent to which companies' ranks have historically changed across every two- and three-year period from 2000 to 2009.[36] That is to say, we follow the changes approach

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[33] Over the ten years of data there would only be five observations for each ranking, using the five-year change methodology.
[34] CC, South East Water Ltd/MidKent Water Ltd merger inquiry, final report.
[35] CC, South Staffordshire/Cambridge merger inquiry, final report, Appendix F, paragraph 57.
[36] There are other possible ways of using permutations of probabilities to calculate and predict the likelihood of companies moving a given number of places in Ofwat's rankings over a five-year period. For example, permutations of five sets of one-year probabilities could be used, or permutations of four- and one-year changes.

set out above and compare each company's rank in each year from 2000 to 2007 to its rank two years later, and each company's rank in each year from 2001 to 2006 to its rank three years later, and then calculate the frequency of changes in rank of different sizes. Pennon used this type of frequency when calculating the transitions approach.

97. Ofwat does not believe that the permutations approach is capable of giving a robust estimate of the probability of a change in ranking as it assumes that changes in ranking in different periods are independent of the starting rank. Given that there is some evidence of persistence in rankings over time, with continued strong and weak performance across some water companies, this assumption appears to be unrealistic and is likely to lead to an overestimate of the chance of a large change in ranking over a five-year period. Therefore, Ofwat did not use the permutations approach when assessing the small company uplift.

98. We agree with Ofwat that there are difficulties with Pennon's use of the permutations approach to try to boost the sample size to conduct the transitions approach. In particular, in using the permutations approach to try to boost the sample size one must assume that the change in ranking within a firm over two and three years are independent of one another. However, the transitions approach is only used as we believe that there may be persistence in ranking over time and as such that a firm's performance one year will affect its performance another year – ie changes in ranking are not independent of one another. Therefore, we believe that there is an inconsistency in this approach and as such it is not valid.

Observed historical movements between quartiles

99. As an alternative to the changes and transitions approaches, we have considered whether we might look more directly at companies' historical movements into and out of the UQ. The changes matrix was developed by the CC when analysing the South East Water/Mid Kent Water merger in 2007. At the time Ofwat modelled capex and opex separately and set the efficiency benchmark at the frontier, subject to the frontier firm being representative of the industry. Therefore, a merger could have an impact on the outcome of the wholesale cost modelling only if one of the merging parties was likely to be selected as a frontier firm in future. As a result the changes matrix was designed to model the probability that a firm would achieve a specified ranking in the next period. For instance the matrix is capable of telling us the probability that a firm currently ranked fifth will be ranked first in the next price review, this is explained further below.

100. In PR14 any firm is able to affect the industry benchmark as any merger affects where the UQ falls. As such, the individual movements of a firm do not matter to the extent that the firm remains in the same portion of the distribution – indeed it only matters if the firm moves from the UQ to the lower three quartiles and vice versa. Although it is possible to use Ofwat's changes approach to calculate the probability of a firm attaining a certain ranking and then using this to calculate the probability that it will be in the UQ, the changes matrix does not take account of the starting position of a firm and as such may not accurately estimate the probability of moving from the UQ to the lower quartiles.

101. The following table shows the quartile into which each firm fell in for opex from 2000 to 2009.

Table 9: Firms' opex efficiency ranking by quartile

Company	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Anglian Water	2	3	2	3	2	2	2	1	1	1
Dwr Cymru (Welsh)	4	4	4	4	4	4	4	4	4	4
Northumbrian Water		2	1	3	3	4	3	2	2	4
Severn Trent Water	3	2	2	1	2	3	3	3	2	3
South West Water	3	4	2	4	4	4	4	4	4	4
Southern Water	1	1	1	2	1	1	1	2	2	1
Thames Water	1	1	3	4	4	4	4	4	4	4
United Utilities	2	2	2	2	3	4	2	3	3	2
Wessex Water	1	1	1	1	1	2	1	1	1	2
Yorkshire Water		1	1	1	1	2	1	1	1	1
Bristol Water	4	4	4	4	4	3	4	3	4	3
Dee Valley Water	2	3	4	2	2	1	1	4	3	3
Portsmouth Water	1	1	1	1	1	1	1	1	1	1
Bournemouth Water	2	3	4	2	2	1	2	2	1	3
South East Water	4	4	3	3	3	3	3	2	3	2
South Staffordshire										
Cambridge Water	3	3	3	1	1	1	2	1	2	2
Sutton & East Surrey Water	3	2	3	3	3	2	3	3	3	1
Veolia	4	4	4	4	4	3	4	4	4	4

Source: CMA analysis based on Ofwat data.

102. Based on the table above, it is possible to calculate the number of times a firm has moved from being in the UQ to the lower quartiles and vice versa on both an annual basis and comparing the current ranking to five years previously – as in the changes matrix. This is shown in Table 10 below.

Table 10: Movements into and out of the UQ for opex efficiency

	Annual basis		*5-year basis*	
	Count	*%*	*Count*	*%*
Firm moved into UQ	15	23	10	26
Firm moved out of UQ	14	21	11	28
Firm remained UQ	37	56	18	46
Total	**66**		**39**	

Source: CMA calculations.

103. Table 10 suggests that if a firm is in the UQ in one period, the most likely outcome is that it will be in the UQ in the next period, with 18 out of 29

occurrences of a firm in the UQ five years ago remaining in the UQ five years later (62.1%).[37] Conversely for a firm not in the UQ five years ago, the probability that it will be in the UQ five years later is 12.3%.[38]

104. Similarly, it is possible to perform the same calculation for capex, although there are fewer data points as capex is only recorded every five years. Table 11 below shows which quartile each company fell into in the capex rankings.

Table 11: Capex efficiency rankings by quartile

Company	*PR99*	*PR04*	*PR09*
Water infrastructure			
Anglian Water	Q2	Q4	Q1
Dwr Cymru (Welsh)	Q3	Q1	Q3
Northumbrian Water	Q2	Q4	Q4
Severn Trent Water	Q3	Q4	Q1
South West Water	Q1	Q1	Q4
Southern Water	Q4	Q3	Q2
Thames Water	Q1	Q4	Q3
United Utilities	Q2	Q1	Q1
Wessex Water	Q1	Q1	Q1
Yorkshire Water	Q1	Q1	Q2
Bournemouth and West Hampshire	Q4	Q4	Q4
Bristol Water	Q4	Q4	Q4
Cambridge Water	Q3	Q4	Q3
Dee Valley Water	Q4	Q4	Q2
Folkestone and Dover Water	Q4	Q4	Q1
Portsmouth Water	Q3	Q4	Q4
South East Water	Q4	Q4	Q4
South Staffordshire Water	Q4	Q3	Q4
Sutton & East Surrey Water	Q1	Q3	Q3
Tendring Hundred Water	Q4	Q4	Q4
Three Valleys Water	Q2	Q4	Q4
Water non-infrastructure			
Anglian Water	Q4	Q4	Q3
Dwr Cymru (Welsh)	Q3	Q1	Q2
Northumbrian Water	Q3	Q4	Q1
Severn Trent Water	Q3	Q1	Q4
South West Water	Q1	Q4	Q4
Southern Water	Q2	Q4	Q3
Thames Water	Q4	Q2	Q4
United Utilities	Q1	Q4	Q1
Wessex Water	Q1	Q1	Q1
Yorkshire Water	Q1	Q1	Q1
Bournemouth and West Hampshire	Q4	Q4	Q4
Bristol Water	Q1	Q4	Q2
Cambridge Water	Q4	Q4	Q3
Dee Valley Water	Q2	Q4	Q2
Folkestone and Dover Water	Q2	Q1	Q4
Portsmouth Water	Q4	Q3	Q4
South East Water	Q2	Q2	Q1
South Staffordshire Water	Q4	Q3	Q2
Sutton & East Surrey Water	Q4	Q4	Q3
Tendring Hundred Water	Q4	Q4	Q4
Three Valleys Water	Q3	Q4	Q4

Source: Ofwat.

105. Based on the table above, it is possible to calculate the number of times a firm has moved from being in the UQ to the lower quartile and vice versa on both

[37] Note that there were 29 occurrences of a firm in the UQ five years previously as there were ten occurrences of firms moving into the UQ that were not there previously.
[38] There were 81 occurrences where a firm was in the lower quartile five years ago, with only ten of these moving to the UQ five years later.

an annual basis and comparing the current ranking to five years previously, as in the changes matrix. This is shown in Table 12 below.

Table 12: Movements into and out of the UQ capex rankings

	Frequency	*%*
Water infrastructure		
Firm moved into UQ	5	33
Firm moved out of UQ	5	33
Firm remained in UQ	5	33
Water non-infrastructure		
Firm moved into UQ	6	38
Firm moved out of UQ	6	38
Firm remained in UQ	4	25

Source: CMA analysis.

106. This suggests that if a firm is in the UQ in one period, it is more likely than not that the firm will not be in the UQ in the next period. For water infrastructure, five out of ten firms that were in the UQ five years ago, were in the UQ five years later (ie 50%), conversely for a firm not in the UQ five years ago, the probability that it will be in the UQ five years later is 15.6%.[39] For water non-infrastructure, four out of ten firms that were in the UQ five years ago were in the UQ five years later (ie 40%), conversely for a firm not in the UQ five years ago, the probability that it will be in the UQ five years later is 18.8%.[40]

107. If we combine the capex probabilities, then the probability of a firm in the UQ remaining in the UQ five years later is 45%, conversely for a firm not in the UQ five years ago, the probability that it will be in the UQ five years later is 17.1%.[41] In order to give a composite totex ranking, we have combined the capex and the opex with a 60% weighting on capex. This gives a 51.8% probability of a firm remaining in the UQ and a 15.1% probability of a firm moving into the UQ.

108. Table 13 compares the annual joint probability of a firm remaining in the UQ based on this approach with the joint probability derived from the changes approach. As can be seen, the quartile based approach gives a higher probability of a firm remaining in the UQ in 2019 than the changes approach, but a lower probability from 2029 onwards. Therefore, we consider that the changes approach is supported by the quartile analysis.

[39] There were 32 instances where a firm was in the lower quartile five years ago, with only five of these moving to the UQ five years later.
[40] There were 32 instances where a firm was in the lower quartile five years ago, with only five of these moving to the UQ five years later.
[41] There were 32 instances where a firm was in the lower quartile five years ago, with only five of these moving to the UQ five years later.

Table 13: Comparing joint probability that parties were in UQ to changes approach

						%
	2014 ranking	*2019*	*2024*	*2029*	*2034*	*2039*
SWW	In UQ	51.8	34.1	27.6	25.2	24.4
	Out of UQ	48.2	65.9	72.4	74.8	75.6
BW	In UQ	51.8	34.1	27.6	25.2	24.4
	Out of UQ	48.2	65.9	72.4	74.8	75.6
	Joint probability that merged entity is in UQ	26.8	11.6	7.6	6.4	5.9
	Changes approach joint probability that merged entity is in UQ	24.3	11.4	8.1	8.1	6.6

Source: CMA analysis.

Third party submissions

109. The changes, permutation, and transition approaches are based on data up to and including PR09. One third party (Wessex Water) has argued that there have been significant changes in companies' efficiency rankings between PR09 and PR14, which indicates that there can be rapid changes in companies' efficiency rankings, particularly when Ofwat makes changes to its modelling approach. Wessex Water submitted the table shown below, which shows which quartile each of the WaSCs fell in in PR09 for both opex and capex and their corresponding totex quartile in PR14. As can be seen seven out of ten companies were in a different totex quartile in PR14 to either their opex or capex quartile in PR09.

Table 14: Comparison of efficiency performance in PR09 and PR14

Water service efficiency assessment	*PR09 opex*	*PR09 capex*	*PR14 totex*
Anglian	1st quartile	1st quartile	2nd quartile
Dwr Cymru	4th quartile	3rd quartile	4th quartile
Northumbrian	2nd quartile	1st quartile	2nd quartile
Severn Trent	2nd quartile	2nd quartile	1st quartile
South West	4th quartile	3rd quartile	1st quartile
Southern	1st quartile	2nd quartile	4th quartile
Thames	2nd quartile	3rd quartile	3rd quartile
UU	2nd quartile	1st quartile	4th quartile
Wessex	2nd quartile	1st quartile	3rd quartile
Yorkshire	1st quartile	1st quartile	2nd quartile

Source: Wessex Water based on Ofwat data.

110. The information submitted by Wessex Water suggests that any changes approach based on historical data will only be capable of predicting changes in ranking whilst the model remains stable. At any point where there is a significant change in the modelling methodology there may be significant changes in ranking which cannot be predicted. As such, to the extent that we believe further significant changes in methodology are likely, we will be less able to accurately predict the probability of a change in rankings.

Conclusion on key assumptions for the forward-looking approach

111. We believe that it is most appropriate to use the business plan projections at PR14 as the starting point for our analysis, with historical PR14 rankings based on out-turn data used as an alternative approach. As discussed above we have reservations over using the combined transition/permutation approach due to a lack of data points, although we do see the benefit in principle of an approach that allows for conditionality. We have conducted our core analysis using the changes approach.

Results of modelling based on the forward-looking approach

112. As shown in Table 15, the merger is expected to result in a positive impact if business plan rankings are treated as the true predictor of rankings, and a small negative impact when a changes matrix is applied to the rankings to forecast the position at PR19. The difference between these two results occurs because under the second approach there is a higher probability that both BW and SWW would both be UQ comparators in future, and hence that the merger would lead to the loss of a good comparator. Using the historical rankings as the starting point suggests a larger negative impact on the benchmark:

Table 15: Forward-looking impact based on starting point

Starting point	*NPV impact over the next 25 years (£m)*
Business plan rankings applied directly in PR19	61
Business plan rankings with change matrix applied to PR19	–9.4
Historical rankings	–63

Source: CMA calculations.
Note: NPV is based on a discount rate of 3.5%.

113. For the reasons set out above we believe that the business plan rankings are likely to provide a more accurate picture of the future state of the world than historical rankings, and that in the core scenario we should apply a change matrix to the business plan rankings in PR19. As such, and based on the results in Table 15, we believe the merger could result in a more or less stringent benchmark, depending on the different assumptions used. Under the central case using business plan ranks and applying a changes matrix in PR19, the merger is projected to lead to a slightly less challenging benchmark (estimated at around £9 million over 25 years on an NPV basis).

114. We note that these results do not assume any overall convergence in efficiency scores. Pennon argued that we might expect convergence over time, with companies catching up to the efficiency frontier. It is difficult to quantify the scale of any convergence, particularly given the move to a new

totex approach at PR09. However, we note that any convergence in scores would reduce the overall impact of the merger (either positive or negative) on the wholesale efficiency benchmark.

115. In Table 16 we have tested how sensitive these impacts are to possible changes in the point at which the benchmark is set. We have chosen to conduct two sensitivities, one based on an upper third and one on a median benchmark, these are based on benchmarks that have previously been used by other UK regulators. The results show that under historical rankings the detrimental impact on the benchmark is lower under both the median and the two-thirds benchmarks than under the UQ. Similarly, if business plan rankings are the correct starting point, a move to upper third or median regulation would result in a greater benefit than UQ.

Table 16: Merger impacts and different choices of benchmark under the Dynamic approach

Starting point	*Impact over the next 25 years (£m)*
Business plan UQ	61
Business plan median	87
Business plan two-thirds	125
Business plan applying changes matrix: UQ	–9.4
Business plan applying changes matrix: median	–1.4
Business plan applying changes matrix: two-thirds	40
Historical scores UQ	–63
Historical scores median	–20
Historical scores two-thirds	–17

Source: CMA calculations.

Applying capping and menu weights

1. Pennon and Ofwat took a different approach to which costs to use when calculating both the static and the forward-looking approaches. Pennon used the BCT after the application of menu weights and the totex cap, whilst Ofwat used the BCT. This has led to Pennon and Ofwat having different industry BCTs (£17 billion for Ofwat and £19 billion for Pennon), which leads to a difference in the outcome of their analysis.

2. We believe that it is not appropriate to apply the totex cap and menu weightings to the BCT for the purposes of our analysis. In particular, we note that the totex cap was applied discretionally by Ofwat in PR14, did not apply to enhanced companies and was set with reference to the enhanced companies at PR14. Thus, it is not possible to determine at what level the cap will be set in PR19 (if a cap is imposed). Nor is it possible to determine how many companies a cap would apply to, as it will be affected by the number of firms given enhanced status, which is not fixed (for instance if Thames Water had been considered to be an enhanced company at PR14, the cap would not have applied to any firms).

3. Furthermore, we note that the menu weights are chosen by companies and will be based on their expectations of their future performance and their degree of risk aversion. As such the choice of menu weights is outside of the efficiency model and as noted above the results of the efficiency modelling are actually an input into the menu weights. Therefore, we believe it most appropriate to model the impact of the merger on the BCT, which is the direct output of the efficiency model.

Setting household retail prices

Introduction

1. Household retail price regulation, Pennon's and Ofwat's views, and our analysis of possible impacts of the merger on Ofwat's ability to set retail prices are described in paragraphs 3.16 to 3.17 and 6.174 to 6.205 of the report. In this appendix: we detail how a merger might affect Ofwat's ability to set the retail benchmark if a UQ approach is used in future; we report the main assumptions behind our analytical approach and we detail the ones that are not described in the main body of the report; and finally, we describe in detail our forward looking approach.

How might a merger cause detriment to Ofwat's ability to set the retail benchmark if an upper quartile is used?

2. If a UQ is used, a merger may affect the future retail price control by changing the benchmark and as such may lead to other firms in the industry receiving a more or less challenging determination, relative to the counterfactual case in which the firms do not merge. The effect of the merger on the retail benchmark will depend on the expected performance of the merged entity compared to the expected performance of the merging firms absent the merger. Absent any improvements in performance, we would expect that:

   (a) if the two merging parties are both more efficient than the UQ threshold in the counterfactual case, the merger will lead to a decrease in the efficiency benchmark as one firm above the quartile is removed, so the quartile shifts down to the next firm;

   (b) if the two merging parties are both less efficient than the UQ threshold, the merger will lead to an increase in the efficiency benchmark as one firm below the quartile is removed, so the quartile shifts up; and

   (c) if the merger parties lie either side of the UQ, the results of the merger will depend on which quartile the merged entity is expected to fall into. This will depend on the retail costs and size of each party pre-merger.

3. Due to the changes in Ofwat's regulatory approach, and in particular its stated intention to move to a UQ or frontier benchmark in PR19, coupled with Ofwat's and Pennon's submission setting out a high level of convergence, we do not consider that it is useful to model the static approach and as such have only conducted a forward-looking analysis for retail.

Assumptions underlying the assessment of impact

Performance of the merged entity

4. In order to model the impact of the merger we must make certain assumptions as to how the merged entity would have performed in the past and as to how it will perform in the future. By making such assumptions, SWW and BW can be substituted for the new merged entity, which will allow us to simulate whether the merger would have had an impact either on the most recent price review, or a future one.

5. Both Ofwat and Pennon have taken the weighted average[1] of the two parties' historical retail CTS as the combined entity's CTS. We agree with this approach.

Convergence assumptions

6. On the issue of convergence of CTS across water companies, Ofwat believed that PR14 provided both Ofwat and water companies with better information and knowledge of the differences between water companies as a result of better accounting separation data. Further, it believed that having a separate retail control would allow the management of each company to focus on outperforming the PR14 retail price controls. Ofwat has assumed that water companies whose CTS is higher than the UQ would converge to the UQ by 2025. Pennon, on the other hand, has assumed that convergence would take place at a slower rate – ie 75% of the gap between the frontier company and the rest of the industry was closed within 20 years.

7. We note that the magnitude of the results of the forward-looking approach are likely to be sensitive to the assumed level of industry convergence, and that the assumed level of convergence is also likely to affect the time horizon over which the impact of the merger is assessed. For instance, the faster we expect water companies to converge to the same CTS, the shorter the time period over which the merger could have an effect.[2] Moreover, Ofwat considered that it was likely to be able to use non-water-based comparisons beyond 2025. This would mean that future regulation would be at least not exclusively based on efficiency comparisons between water companies, and thus that no impact of the merger should be assessed after 2025. However, the key result, whether the merger results in an adverse impact, is not sensitive to convergence assumptions.

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[1] Weighted by number of customers.
[2] Since once companies all have the same CTS, there can be no change in the benchmark due to a merger.

8. Given this range of plausible views on possible rates of convergence and that there is no clear evidence on the topic,[3], we have modelled three scenarios:

   (a) Convergence starts in 2020/21 and companies whose cost to serve is higher than the UQ converge to the UQ by 2025.

   (b) Convergence starts in 2020/21 and 75% of the gap between the frontier company and the rest of the industry is closed within 20 years.

   (c) Convergence starts in 2015/16 and 75% of the gap between the frontier company and the rest of the industry is closed by 2034/35.

Time horizon for forward-looking approach

9. Ofwat has set a clear expectation that it would determine retail costs by reference to an efficient cost to serve in PR19,[4] for example using a UQ or a frontier cost to serve approach. Thus, any impact arising from the merger has to be assessed at least until 2025.

10. There is much more uncertainty about whether the impact of the merger should be calculated also beyond 2025. We note that Ofwat currently thinks that the impact does not have to be calculated beyond 2025, as its approach at PR24 is still uncertain, as the approach it adopts could allow a focus towards the frontier or benchmarks that are external to the sector. Conversely, we also note that Pennon calculates the impact of the merger until 2040.

11. To some extent the choice of time period for the forward-looking approach is linked to the assumption around convergence. In particular, since our convergence assumptions (described in paragraph 8) all terminate at a set point in time, we do not have any basis on which to model beyond this point in time, given that it would require a further assumption around convergence.

12. Given the uncertainty around the time horizon to be considered and the link between this and the convergence assumptions, we have modelled each of our convergence assumptions over the period associated with that assumption. That is:

   (a) for the convergence assumption in paragraph 8*(a),* we have terminated our modelling at 2025;

[3] As Ofwat set separate price controls for household and non-household retail customers, set efficiency targets for the retail household sector and directly incentivised performance for the first time in PR14.
[4] Ofwat's initial submission.

(b) for the convergence assumption in paragraph 8*(b)*, we have terminated our modelling at 2040, assuming that the 20-year convergence period starts at 2019/20; and

(c) for the convergence assumption in paragraph 8*(c)*, we have terminated our modelling at 2025.[5]

Efficiencies and reductions in bad debt adjustments

13. Pennon submitted that reductions in bad debt adjustments and benefits from retail efficiencies arising from the merger should be explicitly recognised and included in the analysis. Pennon also calculated that the benefits from the reduction in bad debt adjustments could amount to £16 million[6] over PR19.[7] Conversely, Pennon did not submitted an explicit figure for the merger retail efficiencies.

14. Ofwat submitted[8] that to the extent that it might use alternative approaches in the future, such as external comparators, or the use of UQ benchmarks, comparative techniques for assessing bad debt claims may not be appropriate. Ofwat observed for example that none of the companies subject to bad debt adjustments at PR14 were in the UQ and so future changes will remove any direct impact due to a lost comparator. As such, Ofwat submitted that it is not appropriate to make any adjustments for bad debt in the forward looking approach. As for synergy savings, Ofwat considered that these could be included only if they were demonstrably a result of the merger.[9]

15. We recognise that a reduction in bad debt adjustments could increase the benefits arising from the merger and that it is at least possible that synergy savings would arise from the merger. However, we also note that there is some uncertainty regarding the extent to which the benefits from bad debt adjustments would occur, also related to the uncertainty regarding Ofwat's future approaches to benchmarking. Furthermore, we consider that the efficiencies benefits should be included only if there is compelling evidence that these synergies were timely and likely to occur and could not arise absent the merger.

16. Following our approach in Appendix E, we propose that a full assessment of efficiencies should occur only after a baseline assessment of whether the

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[5] Assumption *(c)* actually terminates convergence at 2035. However, since this assumption has been proposed by Ofwat, we have followed Ofwat's approach calculating the impact until 2025.
[6] In 2010/11 prices
[7] Pennon's initial submission.
[8] Ofwat's initial submission.
[9] ibid.

merger is likely to result in a prejudicial impact on Ofwat's ability to make comparisons without taking efficiencies into account, and only if we are of the view that the acceptance of efficiencies is likely to lead to a different finding. As a result, we have not included efficiencies and reduction in bad debt adjustments in our analysis.

Forward-looking analysis

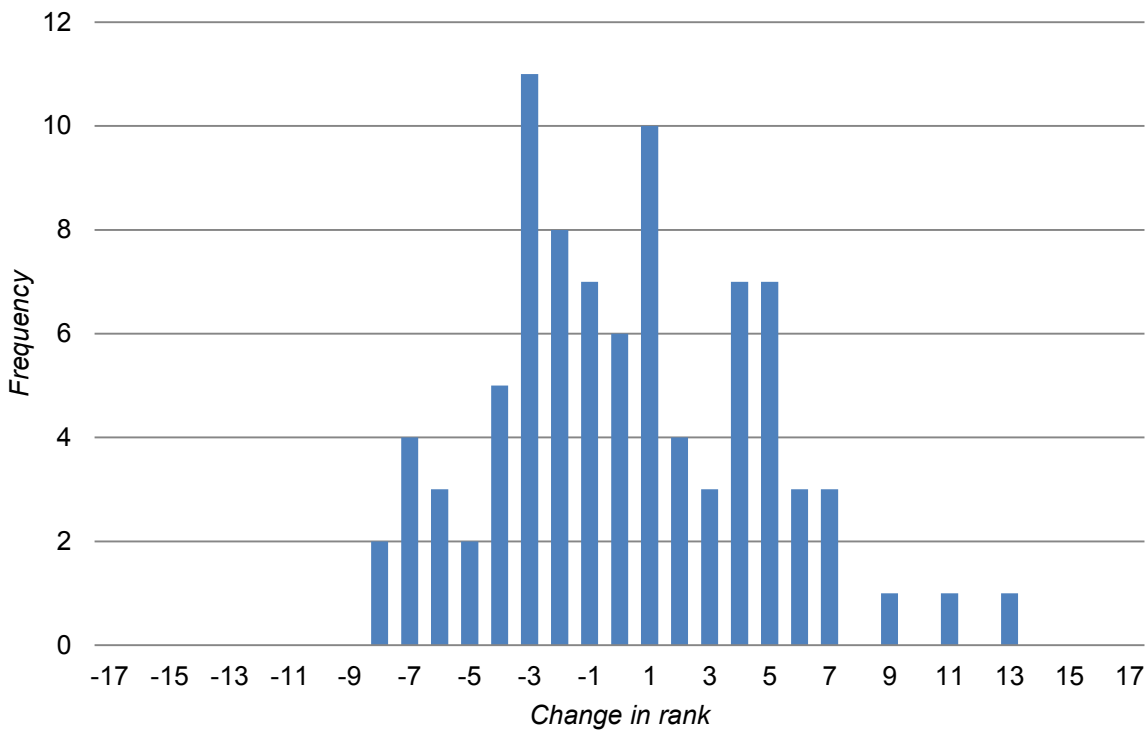
17. In estimating the forward-looking impact of the merger, we first apply the convergence scenarios set out in paragraph 8. However, if we just apply convergence assumptions, we risk over- or understating the impact of the merger as we will not take account of future possible changes in relative rankings.

18. In Appendix E, we set out the three approaches previously used by the CC to estimate the probability of a change in a firm's rank. Although we note that none of these methodologies is without limitations, we use the changes approach to forecast future wholesale cost rankings and use the same approach to forecast retail rankings.

19. The changes approach uses historical data to calculate the probability of a company moving either up or down, based on its ranking at the beginning of the time period. So if we are considering a company that is ranked fifth in PR14, the changes matrix will give the probability of it either remaining fifth in PR19 or achieving any rank other than fifth. Since the changes matrix does not account for a company's starting ranking the probability of a company remaining fifth in the next time period is the same as the probability of a company remaining 12th.

20. We have calculated a changes matrix (based on five-year changes in ranking over a ten-year period) to estimate the probability of a company achieving a particular rank. As the split between retail and wholesale prices has only been recently introduced there is insufficient historical data to produce an estimate of the probability of a firm changing retail rank. However, Ofwat submitted that retail rank moves could be proxied by opex rank moves as retail costs mostly consisted of opex. We have followed Ofwat's approach, but adjusted the changes matrix submitted by it to account for mergers between firms, so that a merger does not change the rank of other firms (see Appendix E, paragraph 88). The distribution of the change in rankings is shown in Figure 1.

Figure 1: Frequency of changes in five-year opex rank, 2000 to 2009



Source: CMA analysis based on data submitted by Ofwat.
*A negative change indicates an improvement in ranking.

21. In the forward-looking approach we have first calculated the expected retail expenditure using Ofwat data, based on the convergence assumptions for each scenario. We then apply the changes matrix to estimate the probability that each of the parties will be in the UQ at each price review in the period of analysis (these differ for the different scenarios as set out in paragraph 8). In order to work out the probability that the merged entity is in the upper or lower quartile when BW and SWW are in different quartiles, we apply the methodology set out in Table 1.

Table 1: Possible combinations of merged company performance, used in the forward-looking approach

Scenario	*SWW performance*	*BW performance*	*Merged entity performance*	*Merged entity probability*
1	UQ	NUQ	UQ	x
2	UQ	NUQ	NUQ	1-x
3	NUQ	UQ	UQ	1-x
4	NUQ	UQ	NUQ	x

Source: Ofwat's initial submission.

22. We have based the value of x on the relative size (in terms of number of customers) of the parties, which differs for metered and for unmetered customers. As such, the merged entity will have a higher probability of being in the UQ if the larger of the parties pre-merger has a higher probability of being in the UQ. Since BW has a much higher number of metered customers

than SWW, the value of x for unmetered customers is 83%[10] and for metered customers is 18.6%.[11]

23. Based on this methodology, Table 2 sets out our calculation of the expected impact of the merger on the retail benchmark. It should be noted that the time period over which the effect is monetised is different for the three scenarios, so the net present value (NPV) is over five years for convergence to the UQ in 2025 and for the convergence to the frontier in 2035, and 20 years for convergence to the frontier in 2040.

Table 2: Forward-looking impact of the merger

Convergence assumption	*Starting from 2020, to UQ in 2025*	*Starting in 2020, 75% convergence in 2040*	*Starting in 2015, 75% convergence in 2035*
Impact period	2020–2025	2020–2025	2020–2040
Expected impact	–£10.86	–£45.28	–£4.05
NPV	–£8.39*	–£27.03†	–£2.42*

Source: CMA analysis based on Ofwat data.
*NPV calculated over five years from 2020 to 2025.
†NPV calculated over 20 years from 2020 to 2040.

24. Therefore, we find that the merger will result in a reduction in the price control for the industry (ie a more stringent price control that will benefit customers) in the forward-looking approach of between £2 million and £27 million. We note that the £27 million figure is likely to be an upper bound of the impact since it is based on the assumption that the impact can be calculated beyond 2025, which is subject to what approach Ofwat will follow in PR24. Similarly, we consider the £2 million figure to be a lower bound as it is based on a fast convergence assumption, starting in 2015 and closing 75% of the gap between the frontier company and the rest of the industry in 2035.

25. We note that although the analysis suggests that there would be a benefit to customers, this should not be interpreted as a benefit to Ofwat's ability to regulate, as Ofwat has the option of removing companies that it views as bad comparators from its analysis absent a merger. Therefore, we find that there is no adverse impact on Ofwat's ability to set the wholesale price.

[10] This is calculated as 911,094 / (911,094+185,911).
[11] This is calculated as 27,384 / (27,384 + 119,232).

Outcome delivery incentives

Introduction

1. This appendix sets out the CMA's analysis of the effect of the merger on Ofwat's ability to set the ODI benchmark. The appendix does not consider the arguments as to why quantification might not be appropriate that are covered in the report. It should be noted that we find that separate reporting will mitigate any impact of the merger on ODIs. The estimates calculated in this appendix do not take account of this mitigation and as such overestimate the impact of the merger.

2. The ODI framework encourages companies to research and discuss the specific priorities of customers and interested stakeholders with CCGs as they develop their business plans. Following a review of the June 2014 revised business plans, Ofwat identified a considerable variation in the ambition of the ODI commitments proposed by companies. CCWater, some CCGs and companies raised concerns about some companies being rewarded for poor performance relative to other companies. Ofwat concluded that there were some areas where common ODI targets were required. It identified[1] five specific aspects of service delivery where there was sufficient commonality of ODIs across companies that it was possible to compare performance levels. These were:

   (a) duration of supply interruptions;

   (b) number of contacts from customers regarding water quality;

   (c) compliance with DWI water quality standards (mean zonal compliance);

   (d) number of sewerage pollution incidents; and

   (e) number of properties impacted by internal sewer flooding.

3. The first three apply to the provision of water services only and are collectively referred to as 'common ODIs'; the last two to the provision of sewerage services only (therefore not applicable to BW).

4. In addition to the industry-wide intervention by Ofwat to ensure that comparable ODIs are subject to a UQ assessment, Ofwat also intervened on

[1] Ofwat (2014), *Setting price controls for 2015-20. Final price control determination notice: policy chapter A2 – outcomes,* section A.2.3.1.

some company-specific ODIs to make sure they were both challenging (based on current trends in performance) and supported by customer engagement (including values of willingness to pay).

5. How might a merger cause detriment to Ofwat's ability to set ODIs? A merger will bring two firms that previously had separate management, under common management. At some point this will commonly lead to two firms that previously reported each of their ODIs separately, reporting the same ODIs on a combined basis, which could have a direct impact on the benchmarks chosen by Ofwat. To the extent that firms choose to continue to report separately on their ODIs, the effect of a merger is less clear as it depends on how performance is affected by the move to common management.

6. Ofwat has chosen to set UQ benchmarks for 2014–2019 in the common ODIs where the parties overlap (duration of supply interruptions, number of contacts from customers regarding water quality, and compliance with DWI water quality standards). Similarly to the wholesale cost benchmark, a merger is capable of having an effect on these ODI UQ benchmarks.

7. A merger may affect the outcome of the ODI benchmarking by changing the benchmarks, and as such may lead to firms in the industry receiving a less challenging determination, relative to the counterfactual case in which the firms do not merge. The effect of the merger on the ODI benchmarks will depend on the expected performance of the merged entity compared to the expected performance of the merging firms absent the merger. Absent any improvements in performance, we would expect that:

   (a) if the two merging parties are both more efficient than the UQ threshold in the counterfactual case, the merger will lead to a decrease in the efficiency benchmark as one firm above the quartile is removed, so the quartile shifts down to the next firm;

   (b) if the two merging parties are both less efficient than the UQ threshold, the merger will lead to an increase in the efficiency benchmark as one firm below the quartile is removed, so the quartile shifts up; and

   (c) if the merger parties lie either side of the UQ, the results of the merger will depend on which quartile the merged entity is expected to fall into. This will depend on the ODI performance and size of each party pre-merger.

8. In order to fully assess the impact of the merger on the benchmark we need to consider not only what the effect of the merger would have been based on the parties' positions in the most recent Ofwat price review, referred to as the **static** approach, but also what the effect may be in future, referred to as the **forward-looking** approach. The merger is more likely to have a negative

impact on the level of the ODI benchmarks if there is a high probability that both of the merging parties would have been in the UQ in future time periods absent the merger. Conversely, the lower the probability that they will both be in the UQ, the more likely the merger is to result in a benign or positive impact.[2]

Assumptions underlying the assessment of impact

Performance of the merged entity

9. In order to model the impact of the merger we must make certain assumptions as to how the merged entity would have performed in the past and how it will perform in the future. By making such assumptions, the separate observations of SWW and BW can be substituted for that of the new merged firm, which will allow us to simulate whether the merger would have had an impact either on the most recent price review, or a future one.

10. There are two principal methodologies highlighted by Europe Economics[3] for combining the performance of SWW and BW to give a putative measure of the merged entity's performance. These are:

    (a) to assume that the smallest merging party is lost as a comparator, so that the performance of the merged entity reflects that of the larger of the two merging parties pre-merger; or

    (b) to assume that the merged entity's performance is the sum/average of the performance levels of the merging parties.

11. Ofwat took the weighted average of the two parties' actual performance in its static analysis, and used this to forecast 2019 scores for the forward-looking approach. In contrast, Pennon submitted that no quantification of ODIs was possible/meaningful and as such did not undertake a quantitative analysis. (This argument is discussed further below after we set out the static and forward-looking analysis.)

12. We note that if we were to assume that the smaller merging party is lost as a comparator, we are implicitly assuming that the performance of the merging parties converges to that of the larger party. In this case that would result in a decline in performance in the BW area. We do not believe that it is

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[2] As already noted, since little time has elapsed since PR14, we do not currently have a clear indication as to what, if any, changes will be made in the modelling approach for PR19, as such we have simulated the future effect of the merger using the PR14 models.

[3] See Europe Economics (18 May 2015), *Valuing the Impact of Mergers and Identifying Undertakings in Lieu*, section 3.2.1.

appropriate to assume that performance declines as our baseline scenario, as the performance could remain the same or indeed the performance in the SWW area could improve to that in the BW area.

13. Therefore, our baseline scenario for both the static and the forward-looking approaches is a weighted average of the two parties' ODI scores.

Quantifying the impact of a change in the upper quartile benchmark

14. The following sections set out projections of the possible change in ODI benchmarks under static and forward-looking approaches. In carrying out this analysis, we need to make assumptions about how a change in ODI benchmarks might translate into a financial impact.

15. ODIs include a range of financial and non-financial incentives to encourage firms to deliver improved performance. In the case of financial incentives, since different customers can place a different valuation on services, depending both on their own preferences and existing service levels, the rewards and penalties were developed locally in collaboration with the CCGs. As such the penalty and reward rates differ between companies.

16. Ofwat used the company-specific penalty rate to measure the detriment to customers of changes in the UQ. The penalty rates are informed by cost information and/or willingness to pay data in most cases. However, we note that there is often a difference between the company-specific reward rate and the same company's penalty rate. The standard formula for a penalty rate[4] is a combination of cost and willingness to pay information and the standard formula for a reward rate[5] involves only customers' willingness to pay. Penalty rates are intentionally higher than reward rates in most cases. Where this was not the case Ofwat asked companies to justify why reward rates were higher than penalty rates during PR14.

17. Ofwat indicated that it chose to use the penalty rate as this merger led to a reduction in the benchmark, which was directionally the same effect as a decrease in performance that would trigger a penalty. We note Ofwat's argument, however such an approach would risk introducing an asymmetry into the analysis, as if a merger led to an increase in performance, the same argument could be used to justify the use of the reward rate. Further we note that we are not primarily concerned with the change in the rewards or penalties that Ofwat levies, but rather the value of any change in service performance, which is best measured by looking at the value placed on that

[4] $ODI_{penalty}$ = Incremental WTP – (incremental cost x customer share of expenditure).
[5] ODI_{reward} = Incremental WTP*(1– customer share of expenditure).

service by consumers. As such, we are primarily concerned with consumers' willingness to pay as we can use this figure to put a monetary value on any change in performance, be it positive or negative. The formula for calculating the penalty rate includes a measure of incremental cost, and as such it does not provide a pure measure of customers' willingness to pay.

18. Due to our reservations about using the penalty rate alone, we have used both the reward and the penalty rates when quantifying impacts, as the true value is likely to lie somewhere between them. These assumptions are discussed further below in relation to the static and forward-looking analysis.

Static analysis

19. As shown in Table 1, BW performed strongly and SWW performed poorly in two of the three ODIs where they were benchmarked at PR14. (Note that with 18 companies, the UQ lies between the fifth and the sixth ranked firm.)

Table 1: Rank of the merging parties on the three benchmarked water ODIs, average 2011/12 to 2013/14

	Drinking water contacts		*Mean zonal compliance*		*Hours lost due to supply interruptions*	
	Score	*Rank*	*Score*	*Rank*	*Score*	*Rank*
BW	1.13	4	99.98%	4	2.76	1
SWW	6.17	18	99.98%	1	22.8	15

Source: CMA analysis based on data submitted by Ofwat.

20. Although both firms were in the UQ in mean zonal compliance at PR14, all companies achieved very similar average scores between 2011/12 and 2013/14.[6] As a result the merger is unlikely to lead to any effect on the mean zonal compliance benchmark[7] and so it is not analysed further.

Drinking water contacts

21. Drinking water contacts are the number of contacts from customers regarding water quality; this is measured as the number of contacts concerning water quality per 1,000 population. BW was one of the top performing companies, ranked fourth, with an average of 1.13 contacts per 1,000 population between 2011/12 and 2013/14. (Note that the top-ranked company had 0.51 contacts). In contrast SWW was the poorest performing company on this measure, with 6.17 contacts per 1,000 population.

[6] The best performing company scored 99.980%, the worst performing company 99.931%.
[7] There will only be an effect if the performance of the merged entity was worse than that of both of the merging parties pre-merger.

22. Table 2 shows the performance of each of the merging parties in the previous three years before PR14, and combines them by taking a weighted average (by population) to give the performance of the merged party, which would be ranked 16th.

Table 2: Drinking water contacts, 2011 to 2013

	Number			*Rate per 1,000 population*				
Company	*2011*	*2012*	*2013*	*2011*	*2012*	*2013*	*Average contacts*	*Rank*
BW	477	533	4,39	1.120	1.250	1.020	1.13	4th
SWW	11,653	9,377	9,909	6.870	5.610	6.030	6.17	18th
Combined	12,130	9,910	10,348	5.716	4.724	4.990	5.14	16th

Source: CMA analysis based on data submitted by Ofwat.

23. Under this scenario, the merger leads to the loss of a UQ company, which results in the UQ benchmark worsening from 1.23 contacts per 1,000 population pre-merger to 1.53 contacts per 1,000 population post-merger.

24. In order to ascribe a monetary value to the change in the UQ benchmark, we have used the company-specific penalty rate for those companies where Ofwat intervened to set a UQ challenge, combined with the difference in the challenge that company would have been set as a result of the merger. For instance, if a company was previously set a challenge of attaining the UQ benchmark, post-merger its benchmark would be less challenging by 0.3 contacts per 1,000 population (ie 1.53 rather than 1.23). This difference is multiplied by the company-specific penalty rate per 1,000 population, which in this illustrative example is £1 million. Therefore, in this example the change in quartile leads to an adverse impact of £300,000. The impact is calculated for each company and then summed for the industry.

25. Table 3 shows the annual and net present value (NPV) impact of the merger over the PR14 price control. The NPV is measured over the three years for which UQ challenges were set (post glide path).[8]

Table 3: Static estimates of the impact of the merger on ODI benchmarks for drinking water contacts at the current price control

		£m
	Annual impact	*NPV impact*
Estimate applying company-specific penalty rates	13.4	35
Estimate using company-specific reward rates	10.13	26.5

Source: CMA analysis based on data submitted by Ofwat.

[8] Companies were given a two-year period in which to improve their performance before they could be subject to a penalty. This is referred to as a glide path.

26. We note that the above figures would be substantially different if the median or average willingness to pay was used instead of company-specific rates. Since each company's customers place a different valuation on penalties or rewards, with the range of penalties from £160,000 to £99.5 million per 1,000 population and the range of rewards from £25,000 to £47.6 million per 1,000 population, we do not consider that it is appropriate to use average figures when company-specific ones for the time period in question are available. Nevertheless, Table 4 shows the impact of using these average penalty rate figures to illustrate the difference between using the mean or median and company-specific rates reported in Table 3.

Table 4: Static estimates of the impact of the merger on ODI benchmarks for drinking water contacts at the current price control, sensitivity

		£m
	Annual impact	*NPV impact*
Estimate using median penalty rates	3.28	8.5
Estimate applying average penalty rates	24.6	64.3

Source: CMA analysis based on data submitted by Ofwat.

Number of hours lost due to water supply interruptions for three hours or longer, per property served

27. The other ODI which Ofwat benchmarked between water companies was a measure of number of hours lost due to water supply interruptions. BW was the best performing company on this measure at PR14, with an average of 2.76 hours lost per property served. In contrast SWW was one of poorest performing companies, ranking 15th, with 22.8 hours lost per property served.

28. Table 5 shows the performance of each of the merging parties in the previous three years, and combines them to give the performance of the merged party (weighted by the number of properties served), which would be ranked 11th.

Table 5: Number of hours due to water supply interruptions for three hours or longer, 2011 to 2013

	Number of hours lost				
Company	*2011*	*2012*	*2013*	*Average contacts*	*Rank*
BW	2.280	4.200	1.800	2.76	1st
SWW	37.200	16.200	15.000	22.80	15th
Combined	29.927	13.696	12.266	18.63	11th
	Properties served				
BW	182.47	184.59	185		
SWW	693.676	700.091	708.3		

Source: CMA analysis based on data submitted by Ofwat.

29. Therefore, absent any change in performance over time stemming from the merger, we would expect the merger to lead to the loss of a UQ company.

Rerunning the benchmarking exercise from PR14 and including the merged firm would result in the UQ benchmark worsening from 12.3 hours pre-merger to 12.6 hours post-merger.

30. In order to ascribe a monetary value to such a change in the UQ benchmark, we have used the company-specific penalty rate for those companies where Ofwat intervened to set a UQ challenge, combined with the difference in the challenge which that company would have been set as a result of the merger. The impact is calculated for each company and then summed for the industry.

31. Table 6 shows the annual and NPV impact of the merger over the PR14 price control. The NPV is measured over the three years for which UQ challenges were set (post glide path).[9]

Table 6: Static estimates of the impact of the merger on ODI benchmarks for water supply interruptions at the current price control

		£m
	Annual impact	*NPV impact*
Estimate applying company-specific penalty rates	6.03	15.78
Estimate using company-specific reward rates	3.03	7.92

Source: CMA analysis based on data submitted by Ofwat.

32. We note again that the above figures would be substantially different if the median or average willingness to pay were used instead of company-specific rates. Since each company's customers place a different valuation on penalties or rewards, with the range of penalties from £3,000 to £9 million and the range of rewards from £7,000 to £2.8 million, we do not consider that it is appropriate to use average figures when company-specific ones are available for the relevant time period. Nevertheless, Table 7 shows the impact of using these average penalty rate figures to illustrate the difference between using the median or mean and company-specific rates in the static approach.

Table 7: Static estimates of the impact of the merger on ODI benchmarks for water supply interruptions at the current price control, sensitivity

		£m
	Annual impact	*NPV impact*
Estimate using median reward rates	1	2.5
Estimate applying average penalty rates	4.1	10.9

Source: CMA analysis based on data submitted by Ofwat.

[9] Companies were given a two-year period in which to improve their performance before they could be subject to a penalty. This is referred to as a glide path.

Summary of static effect

33. Based on the figures above, the merger would have led to a negative impact on the two ODIs where the merging parties were benchmarked, as set out in Table 8, if it had occurred prior to PR14.[10] However, this is a hypothetical estimate based on the impact on the current price control. In practice the benchmarks for this price control have already been set and as such the merger cannot impact them, and the parties must continue to report separately against their performance during PR14. Therefore we have also considered how the merger might affect future benchmarks using a forward-looking approach.

Table 8: Overall static estimates of the impact of the merger on ODI benchmarks at the current price control

		£m
	Annual impact	*NPV impact*
Estimate applying company-specific penalty rates	19.4	50.78
Estimate using company-specific reward rates		3
	13.1	34.42

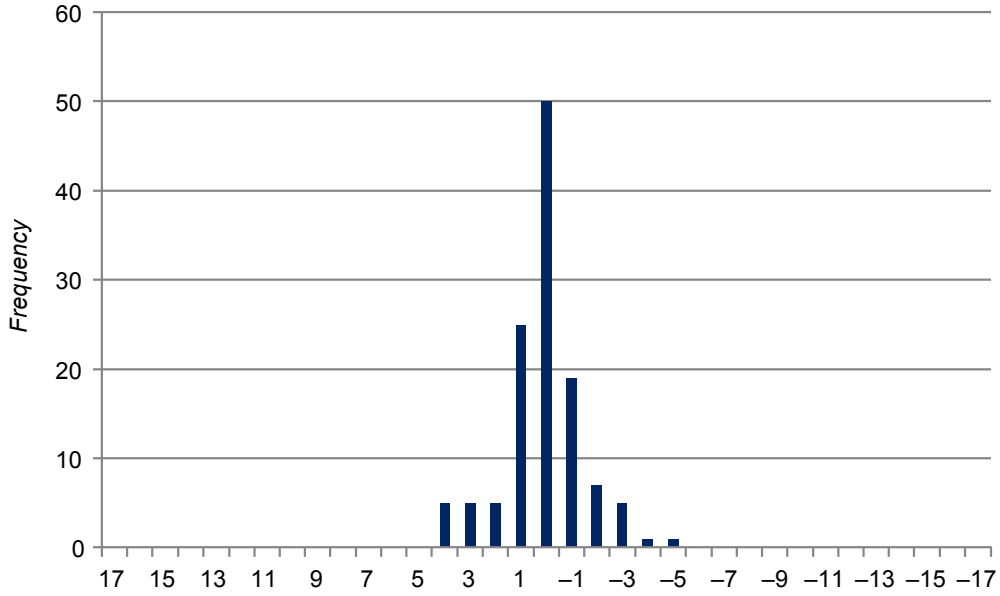
Source: CMA analysis based on data submitted by Ofwat.

Forward-looking approach

34. Although data on historical performance is available for a number of ODIs, they have not previously been subject to financial rewards or penalties. As such, companies have previously only had a reputational incentive to perform well against them. This has led to relatively few changes in companies' performance rankings over the past 17 years, as demonstrated for water quality contacts in the Figure 1.

[10] Note that for this impact to occur the merger would have had to occur prior to PR14 and data not to have been available on a separate basis for Ofwat to set the PR14 control.

Figure 1: Frequency of changes in rank over seven years for water quality contacts



Source: Ofwat's initial submission.

35. Ofwat submitted that it expected to see much stronger convergence between companies now there was a financial incentive in place, which meant that the historical data was likely to be of little use when making a forecast. As a result, Ofwat submitted that it was necessary to make assumptions about the degree of convergence between firms and it was not possible to predict how their rankings would change. Ofwat suggested using catch-up rates, which were calculated by drawing parallels with the convergence observed in the SIM. These shrunk the gap between the best and the worst performing firm, whilst each firm maintained the same ranking as at the start of the period. Ofwat's suggested catch-up rates are shown in Table 9.

Table 9: Ofwat's assumed convergence rates for performance against ODI measures

		%
	Supply interruptions	*Water quality contacts*
UQ gap made up by 2020 (worst company)	35	50
UQ gap made up by 2025 (worst company)	63	80

Source: Ofwat's initial submission.

36. We note that the choice of catch-up rates is not underpinned by any direct historical evidence.

37. Pennon submitted that the rate of convergence was likely to be much faster than suggested by Ofwat. In particular it noted that most companies had performance commitments that were set at the UQ, which would incentivise them to reach the current UQ level by the end of the PR14 period. Pennon

noted that recent evidence supported much faster convergence, as did historical evidence. In particularly Pennon cited:

(a) Recently published water quality performance data from the DWI for 2014 which indicated continuing convergence. If this rate continues convergence to PR14 UQ would be completed in advance of AMP7.

(b) Past convergence in overall performance assessment (between PR99 and PR04, all companies had improved performance such that they were above the PR99 UQ – in fact, the lowest company at PR04 was at 107% of the PR99 UQ).

38. Pennon undertook an analysis of convergence for water quality contacts, based on data from DWI and for water supply interruptions based on provisional data on performance indicators which was voluntarily shared across the industry. Pennon found that convergence from the worst-performing company to the UQ was already close to surpassing (or had surpassed) Ofwat's assumed convergence for the whole PR14 period. For water quality contacts, the poorest performing company had closed 44% of the gap to the UQ. For water supply interruptions, if Bristol Water was treated as an outlier[11] the poorest performing company had closed 50% of the gap to the UQ.[12]

39. We have analysed Pennon's results and have found:

(a) For water quality contacts it is true that the worst performing company at PR14 has closed 42% of its gap from the UQ. However, other companies' performance has declined over the same period, so there is now a different company at the bottom of the rankings. There are a number of different ways to calculate how the gap between the worst performer and the UQ has closed (for instance, including or excluding the worst performer, or taking just the last year or the last years' averages). We find that the gap has closed by between 10 and 24%. If these rates were to continue it would suggest convergence to 2020 of around 50 to 120%.

(b) For supply interruptions if Bristol Water is excluded the poorest performing company has closed 53% of the gap to the UQ. However, the next poorest performing company was Welsh Water, which has seen significant variability in its supply interruptions in recent years driven by heavy winter rains. For instance, in 2014/15 supply interruptions were half

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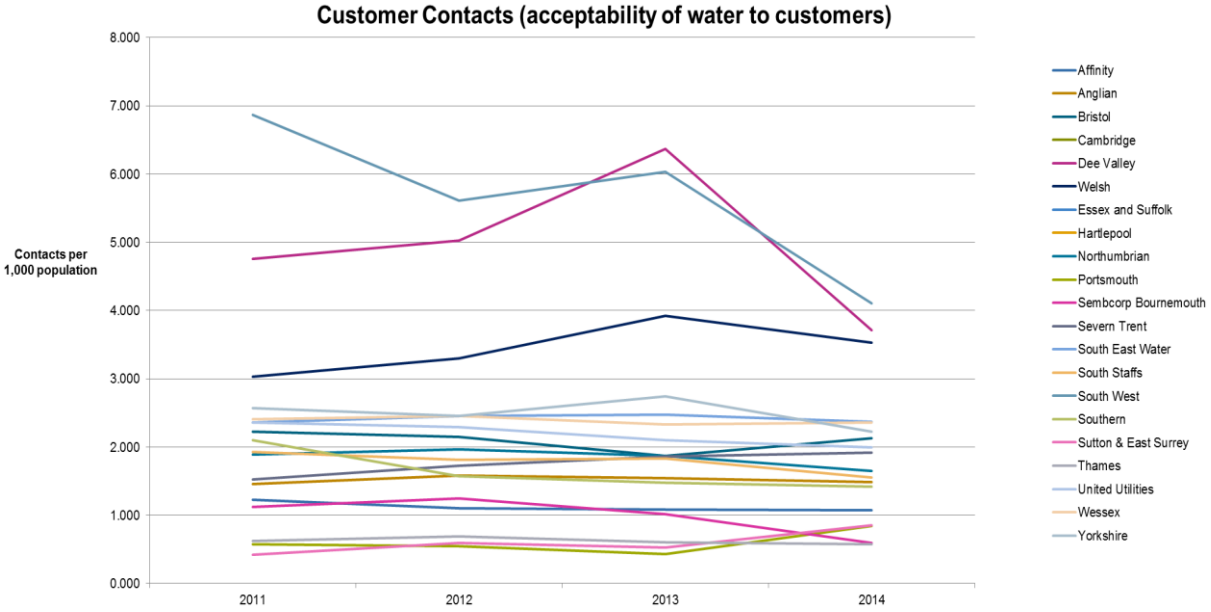
[11] Pennon submitted that Bristol Water experienced two incidents which led to significant supply interruptions. These were the largest scale supply interruptions in Bristol Water's history and Bristol Water described them as exceptional. Pennon noted that Bristol Water has historically been an average performer.

[12] Pennon noted that if Bristol Water were not treated as an outlier then convergence would be much lower.

of the level they were in 2013/14. If Welsh Water is also treated as an outlier, the poorest performing company has only closed 4% of the gap to the UQ. If this rate were to continue it would suggest convergence to 2020 of around 20%.

40. Ofwat submitted that although there had been rapid convergence by the poorest performers in terms of water quality contacts, there were still a number of middle-ranked firms that had not converged to the UQ of 1.23 contacts, as shown in Figure 2. Thus Ofwat believed that it was not appropriate to assume that all companies would converge to the PR14 UQ by 2019.

Figure 2: Water quality contacts against penalty rates, 2011 to 2013



Source: Ofwat.

41. Pennon noted that in assessing the benefits of an uplift on the cost of capital Ofwat assumed that 'by the middle of the 2015-20 period we expect all companies to reach current UQ performance'.[13] Ofwat responded that it was reasonable to expect companies to achieve UQ performance by 2015–2020 and to set performance commitments on that basis. However, Ofwat did not expect that all companies would necessarily achieve that level in practice. The concept of underperforming against performance commitments is central to the ODI framework with financial penalties linked to performance shortfalls, and as such Ofwat believed it was reasonable to use lower convergence rates in the context of merger analysis.

[13] Ofwat (2014), *Final price control determination notice: annex 3 – benefits assessment of an uplift on the cost of capital*, p44.

42. We find that the available evidence on current convergence rates for DWI and for supply interruptions supports the assumptions made by Ofwat in its analysis. As such, we will use the convergence rates set out in Table 9.

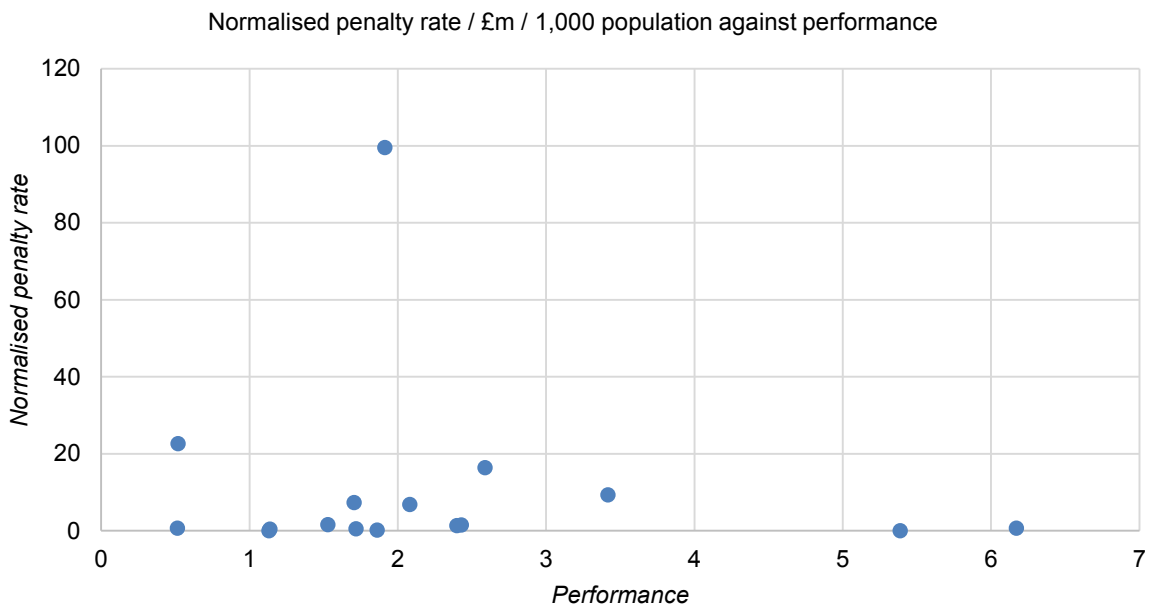
43. Ofwat has not assumed a frontier shift over time,[14] so that the upper bound is defined throughout by the current performance of the frontier company. As such, over time companies are expected to become more and more densely bunched – ie the ODI performance scores of the companies become closer and closer to each other – and the distance between the UQ with 18 firms and the one with 17 firms shrinks. This results in a decrease in the impact of any merger with every year that passes, as any change in the point where the UQ benchmark falls has less of an effect.

44. In order to monetise the change in the UQ, Ofwat proposed using the company-specific penalty rate, as was used in the static approach. As noted when considering the static analysis, in PR14 there was a large difference between the penalty rates for different companies, for both water quality contacts and supply interruptions. However, we would posit that where service levels are low, there is likely to be a high demand for improvements, which will lead to a higher willingness to pay. Conversely, where service levels are already high, customers may be less likely to be willing to pay for further improvements in service, since they are more likely to already be at or near the customers' desired level. As such, it is possible that there are diminishing returns to a customer's willingness to pay for improvements.

45. In order to test this, we have assessed whether customers' willingness to pay for improvements in service is correlated with current service levels. If there was a strong correlation between performance and penalty rates we would expect company-specific penalty rates to change as performance changes. Figures 2 and 3 show average performance from 2011 to 2013 against the penalty rate for water quality contacts and service interruptions respectively. In both figures, a lower performance number equates to a higher level of performance (ie fewer water quality contacts is better than more).

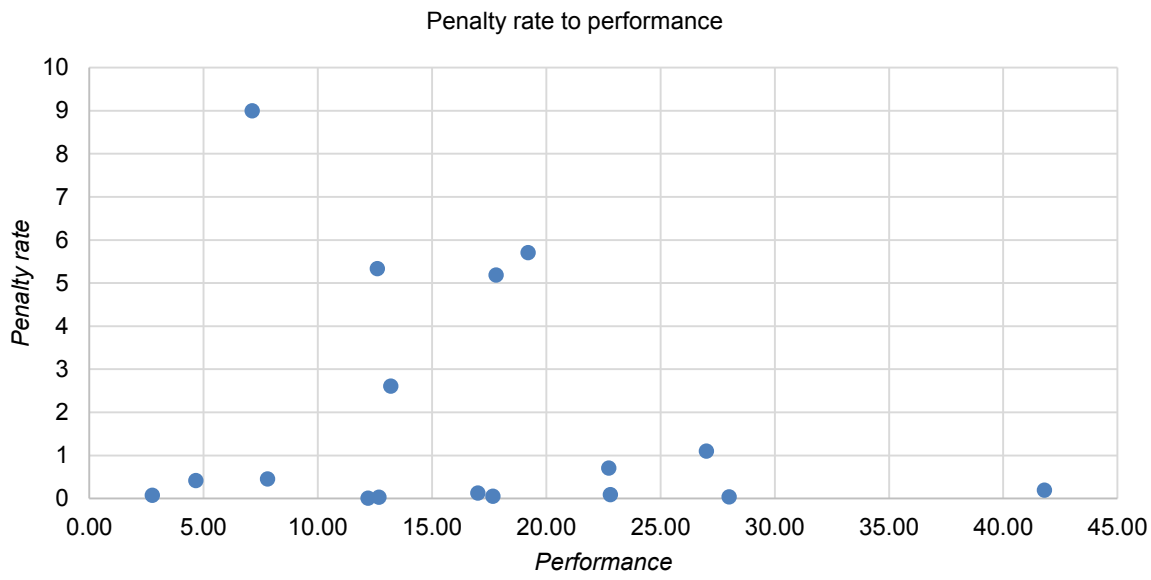
[14] We note that this is a modelling assumption, although Pennon submitted that this was supported by the recent supply interruptions data.

Figure 3: Water quality contacts against penalty rates, 2011 to 2013



Source: CMA analysis based on data submitted by Ofwat.

Figure 4: Supply interruptions of more than 3 hours against penalty rates



Source: CMA analysis based on data submitted by Ofwat.

46. As can be seen there is little if any correlation between performance and penalty rate for water quality contacts, and there may even be some very weak negative correlation (ie lower penalties associated with longer interruptions) for water supply interruptions.

47. We recognise that the relationship between penalties and performance may not be straightforward – for instance, it is possible that customers would set a high penalty rate for a high performing company, not because they want to

improve the service, but because they want to maintain it. We have conducted the same analysis for reward rates (not shown in this appendix), but have not found any correlation between them and performance levels. Therefore, it would seem that customers' willingness to pay is not strongly related to existing performance levels, at least when assessed across companies.

48. We do not have sufficient information to assess how within-company willingness to pay changes as performance changes. It is possible, for the reasons outlined in paragraph 424 that within-company performance is correlated with willingness to pay, in which case using company-specific rates from PR14 would risk overstating the impact of the loss of a comparator. Therefore, as a sensitivity we have used the median[15] penalty and reward rates from PR14, in addition to the company-specific rates.

49. Based on the convergence rates discussed in paragraphs 33 to 40 we estimate that the merger will have a negative impact on the two ODIs (ie it may make the benchmark less challenging in future), as set out in Table 10. The forward-looking NPV is calculated over the five years of the next price control.

Table 10: Overall forward-looking estimates of the impact of the merger on ODI benchmarks

	Water quality contacts (50% catch-up rate at 2020)		*Supply interruptions (35% catch-up rate at 2020)*	
	Annual impact	*NPV*	*Annual impact*	*NPV*
Estimate based on company specific penalty rate (£m)	9.37	35.60	4.4	16.8
Estimate based on company specific reward rate (£m)	6.80	26.10	2.2	8.47
Sensitivities on catch-up rate (%)	75	100	10	60
NPV based on penalty rate (£m)	22.00	8.75	21.21	12.54
Estimate based on median penalty rate (£m)	2.19	8.34	0.89	3.4
Estimate based on median reward rate (£m)	2.19	8.34	0.8	3.2
Sensitivities on catch up rate (%)	75	100	10	60
NPV based on median penalty rate (£m)	5.20	2.03	4.27	2.53

Source: CMA analysis based on data submitted by Ofwat.

50. We note that the figures in the above table are subject to a large degree of uncertainty, as they largely depend on assumptions around customers' future willingness to pay and, as already noted, catch-up rates. For instance, if company-specific penalty rates were used, the NPV impact of the merger would be £51 million, whereas if median penalty rates were used the NPV would be £12 million.

[15] The mean penalty and reward rates are skewed upwards by a small number of very large penalty and reward rates. Since we are concerned that company-specific rates may overstate the effect, we have not used the mean penalty or reward rate as these lead to a greater effect under the static approach than the company-specific rate.

51. We also note that for any given measure of willingness to pay the methodology we have used will overstate the impact of the merger, as it assumes that there is no change in any firm's rank in future. Given that BW was in the UQ in PR14 for both of the benchmarked ODI measures (water quality contacts and supply interruptions) and based on the relative size of the firms, this assumption means that the merger will always have a negative impact, whereas in reality there is at least some probability that BW will not be a UQ company at any given point in the future.

52. We have not incorporated a changes matrix into our analysis as we have insufficient data to construct a robust matrix for all ODIs. However, Ofwat produced an estimate of the likely changes based on the available data for water quality contacts. Although when more data is available the changes may be different, it allows us to test how our estimates of the impact of the merger are likely to be affected by changes in ranking. Table 11 shows the impact on Ofwat's base case scenario which is based on company-specific penalty rates and utilises ours and Ofwat's central assumptions of convergence.

Table 11: Impact on NPV of using a changes matrix

	NPV, £m	
	Initial submission	*With changes matrix*
Water quality contacts	36	13
Supply interruptions	17	10

Source: Ofwat.

Monitoring and incentivising service quality: service incentive mechanism

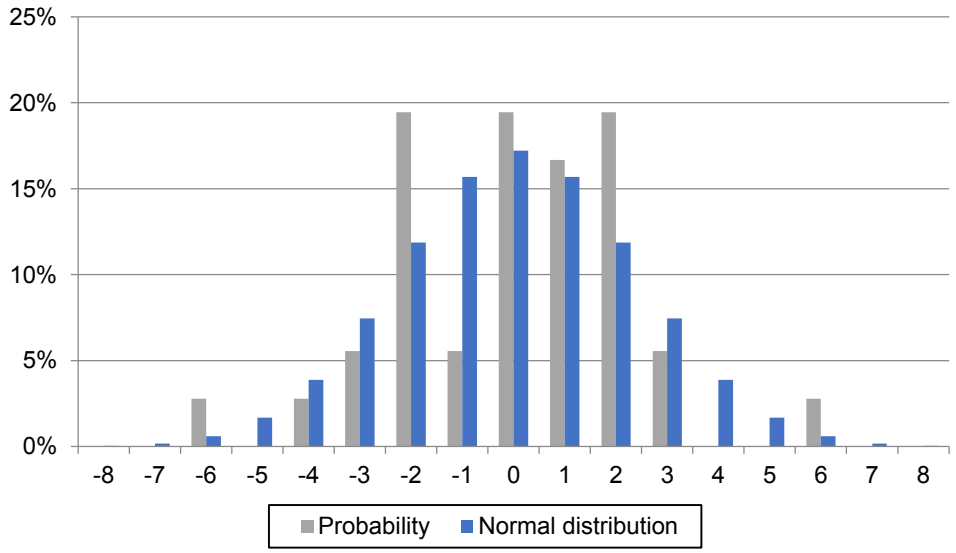
Introduction

1. SIM is described in paragraphs 3.22 to 3.24 and 6.269 to 6.298 of the report. This appendix details the approach followed in the forward-looking analysis and reports our sensitivities results.

Forward-looking analysis

2. We calculated a changes matrix for SIM rankings. This was based on ten years of data using a rolling five-year average which examined changes in rankings for each year within those five years. From this data we could estimate the probability of a company achieving a particular rank from one five-year period to the next. This matrix shows the probabilities of different one-year changes in ranking, which is shown in Figure 1.

Figure 1: SIM changes matrix – probability distribution of one year changes in ranking



Source: CMA analysis based on Ofwat data.

3. The changes approach uses historical data to calculate the probability of a company moving either up or down, based on its ranking at the beginning of the time period. So, if we are considering a company that is ranked fifth in PR14, the changes matrix will give the probability of it either remaining fifth in PR19 or achieving any rank other than fifth. Since the changes matrix does not account for a company's starting ranking the probability of a company remaining fifth in the next time period is the same as the probability of a

company remaining 12th. Given that there is a matrix of probabilities, this approach does not predict a single future ranking for water companies; but rather a range of rankings under different probabilities. We use those rankings to calculate an expected ranking which we can then use as the forecast ranking. The expected rankings for each of the merger parties under our baseline scenario are shown in Table 1.

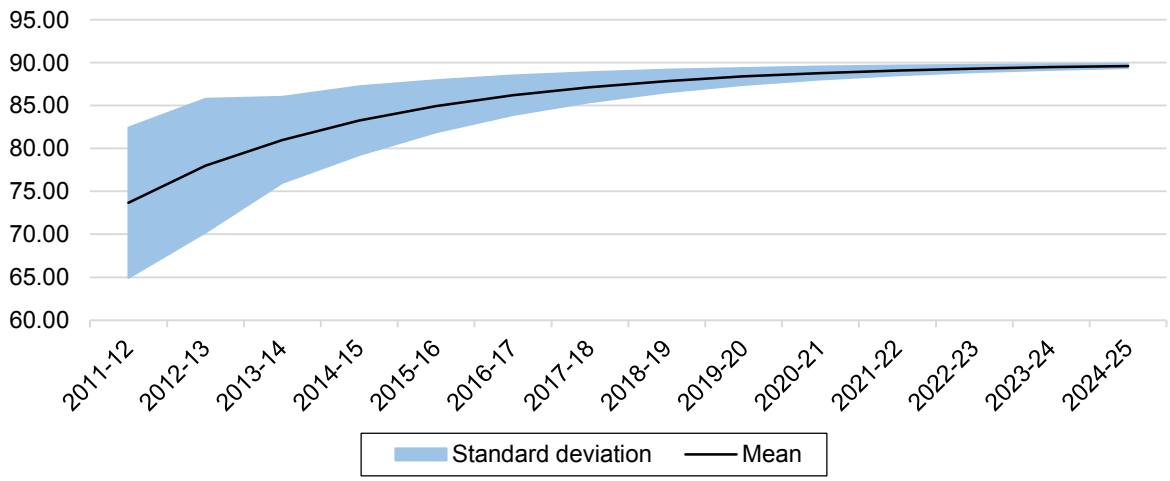
Table 1: Forecast average rankings from SWW and BW

	2014/15	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
SWW	16	15	14	14	13	13
BW	4	4	5	5	6	6

Source: CMA analysis based on Ofwat data.

4. Ofwat submitted that there had been convergence in companies' SIM scores over the AMP5 period and it expected this to continue over AMP6. In order to control for likely convergence, we have modelled the degree of previous convergence and used this to forecast the future mean and standard deviation of SIM scores. These forecasts are shown in Figure 2.

Figure 2: Forecast convergence in mean and standard deviation of SIM



Source: CMA analysis based on Ofwat data.

5. Since the SIM rewards (or penalises) performance based on how far a company's performance lies from the industry mean, we need to relate the ranking of each firm to a SIM score. As the SIM score is converging with an increasing mean and decreasing standard deviation, we calculate how many standard deviations from the mean each rank's SIM score is for 2013/14 (our base year). We then use this to project forward for each ranking, to give a new SIM score based on the expected standard deviation and mean for that year. The five years to 2019 are shown for firms ranked 1 to 5 under our baseline scenario in Table 2.

Table 2: Projected SIM score for rankings 1 to 5, 2014/15 to 2019/20

		Projected mean	83.25	84.94	86.20	87.15	87.86	88.40
		Projected standard deviation	4.02	3.04	2.30	1.75	1.32	1.00
Rank	*2013/14*	*Standard deviation of rank from mean in 2013/14*	*2014/15*	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
1	87.33	1.26	88.31	88.77	89.11	89.35	89.53	89.66
2	86.45	1.08	87.60	88.23	88.70	89.04	89.30	89.48
3	86.16	1.03	87.37	88.06	88.57	88.94	89.22	89.42
4	85.93	0.98	87.19	87.92	88.46	88.86	89.16	89.38
5	84.78	0.75	86.27	87.22	87.93	88.46	88.86	89.15

Source: CMA analysis based on Ofwat data.

6. We are now able to equate each ranking in the forecast period to a SIM score. By taking a weighted average of BW's and SWW's SIM score, we can construct the new merged entity's SIM score. We then replace the merging parties' separate SIM scores with that of the merged entity, to estimate the net annual reward or penalty for the industry. By comparing this with the non-merger case where the merging parties remain separate we are able to estimate the impact of the merger.

7. As stated in paragraphs 6.285 to 6.289 of the report, we acknowledge that our baseline scenario (mid-2017/18 integration date, impact until 2020 and performance of the merged entity equal to the weighted average of the merging companies) may not be wholly reflective of the true adverse impact on SIM. As a result, we have also performed a number of sensitivities based on assumptions around the performance of the merged entity, the integration date of the merger, the future convergence in SIM and a separate reporting period for the merging parties. The results for the baseline scenario and the different sensitivities are shown in Table 3 below.

Table 3: Forward-looking impact on SIM penalties

	Discounted annual change in penalties (£m)									
Sensitivity	*2016/17*	*2017/18*	*2018/19*	*2019/20*	*2020/21*	*2021/22*	*2022/23*	*2023/24*	*2024/25*	*NPV*
Baseline scenario	0	–0.40	–0.70	–0.76	0	0	0	0	0	–1.86
2016/17 integration date	–0.56	–0.80	–0.70	–0.76	0	0	0	0	0	–2.82
Impact beyond 2020	0	–0.40	–0.70	–0.76	–0.59	0.18	–0.20	–0.19	–0.16	–2.84
Improved post-merger performance*	0	0	0.10	0.26	0.12	0	0	0	0	0.48
Separate reporting, baseline impact	0	0	0	0	0	0	0	0	0	0
Separate reporting, impact beyond 2020	0	0	0	0	–0.59	0.18	–0.20	–0.19	–0.16	–0.98
Impact from 2016 to 2025	–0.56	–0.80	–0.70	–0.76	–0.59	0.18	–0.20	–0.19	–0.16	–3.79

Source: CMA analysis based on Ofwat data.
*The merged company has the same performance as the best out of the two merging companies.

Glossary

Act	The Enterprise Act 2002.
ACTS	Average cost to serve. The average cost per customer for the household retail activities. The ACTS was used as part of the calculation of **Ofwat**'s household retail price controls.
Adjustment factor	See **K factor**.
AFW	A term occasionally used by **Ofwat** to refer to Affinity Water.
AIC	Average incremental cost. AIC is based upon the financial net present value of a scheme.
AMP	Asset Management Plan: a plan submitted by a **water company** to **Ofwat** for a five-year period.
AMP period	A five-year period in relation to which an **AMP** is submitted by **water companies** to **Ofwat**. Also known as a price control period. AMP6 – the AMP period April 2015 – March 2020 (the **PR14** price control period).
ANH	A term occasionally used by **Ofwat** to refer to Anglian Water.
Appointment	The instrument by which the Secretary of State or **Ofwat** (with a general authorisation given by the Secretary of State) appoints a body under the **WIA** to be the **water undertaker** for the area described in that instrument. The word '**licence**' is used interchangeably with 'appointment'.
Basic cost threshold	For its **PR14** cost assessment, **Ofwat** produced a basic cost threshold for each **water company**. This represented an estimate of the company's efficient **totex** requirements for the period 1 April 2015 to 31 March 2020 (in 2012/13 prices and before **RPI** indexation) that was based on the output of **Ofwat**'s benchmarking modelling and analysis. The basic cost threshold did not include allowances for policy items or adjustments for **special cost factors**.
Benchmarking analysis	Comparisons and comparative analysis across companies (or other entities) on aspects of their performance (eg costs or quality of service) so as to assess the relative performance of different companies and/or to estimate what a good

	or efficient level of performance would be. **Econometric analysis** is one possible method to use for benchmarking analysis.
Botex	Base totex. **Opex** + capital maintenance expenditure (**capex** required to maintain existing assets) but excluding **capex** attributed to enhancement projects.
BRL	A term occasionally used by **Ofwat** to refer to Bristol Water.
Business Plan	**Ofwat** requires each appointed **water company** to submit a business plan at each **price review**.
BW	Bournemouth Water Limited.
BWIL	Bournemouth Water Investments Limited, **BW**'s parent company.
Capex	Capital expenditure. Expenditure and costs for new, replacement or refurbished capital assets, such as construction and buying machinery.
Capital maintenance	Appointed **water companies**' planned activity to replace and renovate water and sewerage assets to provide continuing services to consumers.
CC	Competition Commission. (As from April 2014, the functions of the CC have been taken over by the **CMA**.)
CCG	Customer challenge group.
CCWater	The Consumer Council for Water. The statutory consumer organisation that represents water and sewerage consumers in England and Wales, operating at both national and regional levels.
CEPA	Cambridge Economic Policy Associates. Consultants used by **Ofwat**.
CIS	Capital Expenditure Incentive Scheme. A system of incentives used at **PR09** that explicitly recognises that appointed **water companies** have access to better information about their future **capex** needs than **Ofwat** does. It was used with the aim of providing incentives to encourage regulated **water companies** to produce realistic and credible **capex** forecasts before price limits were set.

	After price limits have been set each company retained incentives to outperform **Ofwat**'s determinations, with the reward being higher for those companies that have made more challenging expenditure assumptions.
CMA	Competition and Markets Authority.
Cost of capital	The cost of financing a company. See **WACC**.
Cost-sharing incentive	For **PR14**, **Ofwat** developed and applied a system of incentives in relation to companies' **totex**. The cost-sharing incentive (scheme) meant that there was sharing, between a company and consumers, of the financial risk that the company's out-turn expenditure is higher or lower than the wholesale expenditure allowance which was used to set its wholesale revenue control. The cost-sharing incentive applied equally to **capex** and **opex**.
CTS	Cost to serve. The average cost for each **water company** to serve its customers. The CTS for each water company was used by **Ofwat** to calculate the industry **ACTS**.
Determination	In the context of the **periodic review**, the setting by **Ofwat** or the **CMA** of the price control conditions under Condition B of the **licence** of a **water undertaker**.
Draft determination	Produced by **Ofwat** during each periodic review, serving as the basis for consultation on the price controls for each company for the relevant price review period. The **PR14** Draft Determinations were published on 30 April 2014 for the enhanced companies, 30 May 2014 for the early Draft Determination companies and 29 August 2014 for all other companies.
DVW	A term occasionally used by **Ofwat** to refer to Dee Valley Water.
DWI	Drinking Water Inspectorate.
Econometric(s)	Econometrics is concerned with the analysis of economic data using, for example, statistical methods.
Econometric model	A model or equation used for econometric analysis.
Enhanced company	A company selected for enhanced status, due to the high quality of its **business plan**. The benefits of being awarded

enhanced status at **PR14** included a higher **totex** allowance and an increased cost of capital, acceptance of the **business plan** 'in the round' and an earlier publication date for the **draft determination**. Also known as a fast-tracked company.

Final determination Produced by **Ofwat** at the end of each **periodic review**, setting out the **K factor**s for each **water company**. To indicate which one is being referred to, a year indication is added, for example the most recent final determination for the period 1 April 2010 to 31 March 2015 is referred to as 'FD14'. The **PR14** final determinations were published on 12 December 2014.

Frontier company Company assessed by **Ofwat** to be the most efficient in **opex** for the provision of water services. The **frontier company** may or may not be chosen as the **benchmark company** for the relevant function.

Gray Review In 2010, the Department for Environment, Food and Rural Affairs commissioned David Gray to conduct a review of **Ofwat**. The Gray Review was published in 2011.

K The amount by which the weighted average charges for the supply of water services are allowed to increase relative to the **RPI** as determined by or under Condition B of the **appointment**. K can be positive, zero or negative.

KPI Key performance indicator.

Leakage Water lost between the treatment works and the customer's home or business.

Licence An instrument appointing a **water undertaker** (or water and sewerage undertaker) under Part II of the **WIA**.

See **appointment**. The word 'licence' is used interchangeably with the word '**appointment**'.

NES A term occasionally used by **Ofwat** to refer to Northumbrian Water.

NPV Net present value, ie the value of the cash flows arising in the future or past, discounted or increased to reflect its present value.

ODI	Outcome delivery incentives. These were introduced during **PR14** as part of **Ofwat**'s outcomes-based approach to focus companies on delivering a result or action that customers and society value.
Ofwat	The Water Services Regulation Authority. The economic regulator of water and sewerage companies in England and Wales.
Opex	Operating expenditure. Companies' day-to-day spending on running services. Expenditure that is not treated as **capex**.
Overall performance assessment	A series of measures previously used by **Ofwat** to assess the overall quality of service an appointee provides to customers. The key areas within the assessment were water supply, sewerage service, customer service and environmental impact.
Oxera	Oxford Economic Research Associates Ltd. The consultants used by **SWW** in this inquiry.
PCs	Performance commitments. Measure the direct and tangible services needed to achieve outcomes.
Pennon	Pennon Group Plc, the parent company of **SWW**.
Periodic review	See **price review**. The term 'periodic review' is used interchangeably with the term '**price review**'.
PR09	**Ofwat** 2009 price review.
PR14	**Ofwat** 2014 price review.
PR19	**Ofwat** 2019 price review.
Price control	A form of economic regulation that acts to constrain the prices or tariffs that a regulated company may charge (the price control may also regulate other aspects of the company's activities, such as service quality and performance). The price control may take the form of a restriction on the company's revenues, rather than limiting specific tariffs directly.

Price control review	The process undertaken every five years by **Ofwat** to determine **water company price control**s for the next five years.
PRT	A term occasionally used by **Ofwat** to refer to Portsmouth Water.
PUROS	Phased Utilisation of Remote Operating Systems. A technology that allows **SWW** to remotely monitor and operate its water assets.
RCV	Regulatory capital value. The capital base used in setting **price control**s. The value of the regulated business which earns a return on investment. It represents the initial market value (200-day average), including debt, at privatisation, plus subsequent net new **capex** including new obligations imposed since 1989 less disposed assets. The capital value is calculated using **Ofwat**'s methodology. Also known as regulatory asset base and regulatory asset value.
Regulated business	Those water activities of a company or group of companies which are the subject of an **appointment** by **Ofwat**.
Regulatory accounts	Accounts submitted by appointees to **Ofwat** in respect of their **regulated business**es. They are presented on both a historical cost and a current cost basis but only cover the **regulated business** and are prepared according to guidelines issued by **Ofwat** which differ in some respects from the generally accepted accounting standards which are applied in the statutory accounts. They are separate from the normal statutory accounts which are based on historical costs only, cover the entire business of the entities concerned (regulated and unregulated) and are prepared according to generally accepted accounting standards.
Relative efficiency	The term used to compare efficiency of one appointed business against others.
RPI	Retail prices index, a general purpose domestic measure of inflation in the UK.
SCP	Small company premium.
Serviceability	**Ofwat** makes an assessment of the capability of a system of assets to deliver an expected level of service to consumers

	and to the environment. This is done to ensure that companies are not underinvesting in their assets, and is completed by considering the trend in performance of a number of different indicators such as bursts and long duration interruptions to supply.
SES	A term occasionally used by **Ofwat** to refer to Sutton and East Surrey Water.
SEW	A term occasionally used by **Ofwat** to refer to South East Water.
SIM	Service incentive mechanism. A scheme introduced by **Ofwat** in 2010/11 for measuring and incentivising the delivery of customer service.
Special cost factor	The purpose of special cost factors is to take account of specific characteristics or circumstances of a company that affect its costs and which may not be adequately captured by **benchmarking analysis**.
SRN	A term occasionally used by **Ofwat** to refer to Southern Water.
SSC	A term occasionally used by **Ofwat** to refer to South Staffordshire Water.
Supply-demand balance	The balance between the amount of a **water company**'s available water resources and the demand for water by customers. Any imbalance between supply and demand can be met via resource enhancement or demand management strategies (eg selective metering and leakage control).
SVT	A term occasionally used by **Ofwat** to refer to Severn Trent Water.
SWT	A term occasionally used by **Ofwat** to refer to South West Water.
SWW	South West Water Limited, a wholly owned subsidiary of **Pennon**.
TMS	A term occasionally used by **Ofwat** to refer to Thames Water.

Totex	A company's total expenditure, ie covering both its **opex** and **capex**.
UQ	Upper quartile.
UU	A term occasionally used by **Ofwat** to refer to United Utilities Water.
WaSC	Water and sewerage company. A company which is a **water undertaker** and a sewerage undertaker.
Water Act	Water Act 2014.
Water company	See **water undertaker**. The term 'water company' is used interchangeably with the term '**water undertaker**'.
Water undertaker	A **water company** appointed under the Water Act 1989 or **WIA** to provide water services in a specified part of England and/or Wales. '**Water company**' is used interchangeably with water undertaker.
WIA	Water Industry Act 1991.
WICS	Water Industry Commission for Scotland.
WoC	Water-only company. A company which is a **water undertaker** but not a sewerage undertaker.
WSH	A term occasionally used by **Ofwat** to refer to Dŵr Cymru Welsh Water.
WSX	A term occasionally used by **Ofwat** to refer to Wessex Water.
YKY	A term occasionally used by **Ofwat** to refer to Yorkshire Water.