south east water

Cost Adjustment Claim

PR19 Supporting Appendix 19

3 September 2018

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What does this appendix do?

This document supports the submission of South East Water's business plan for 2020-2025 and provides:

- Justification of our required cost adjustment to correct for omitted explanatory factors in the proposed Ofwat econometric modelling
- Quantification of required cost adjustment (Annex A)

The evidence you will find in this appendix

The following evidence is included in this document:

- Need/justification for cost adjustment
- Management control
- Quantification of cost adjustment (Annex A)
- Ofwat proforma: Cost adjustment claim summary form – for both wholesale water resource and network plus (Annex B/C)

The decisions we have made based on this evidence

We have made the following decisions based on this evidence:

- Consideration of proposed Ofwat wholesale econometric models
- Independent assessment of historical base total expenditure (BOTEX) performance for wholesale water services
- Availability of cost assessment data

Other evidence and data that supports our decisions

You will find additional evidence in the following [document]:

- Oxera's independent report: "Impact of diseconomies in sources, treatment plants and abnormal groundwater complexity in Ofwat's models", provided in Annex A

Need further information?

Please email yourwateryoursay@southeastwater.co.uk if you require further information or wish to clarify anything in this document.

Contents

1. Introduction

In May 2018 we submitted an early adjustment claim to Ofwat. We outlined that geological factors leading to higher number of sources and corresponding treatment works in addition to treatment complexity are material drivers of costs for the industry. This was acknowledged by Ofwat and a number of companies in their models. Should these factors be suitably accounted for in Ofwat's final suite of models and triangulated appropriately then the need for associated cost adjustment from ourselves would not apply, which remains our preferred option.

We concluded that the number of assets, dictated by geological constraints, is a key explanatory factor of cost for the industry, as recognised in Ofwat's own econometric modelling consultation document (March 2018). When considering the number of assets we include both sources and treatment works as distinct characteristics to be considered in the resources and network plus controls respectively.

Furthermore we consider source type, as used in previous price reviews, to be an over-simplification of treatment complexity for some companies. Data is now available for flow and numbers of sites categorised between simple surface/groundwork (i.e. category S/GW) to complex surface/groundwater (i.e. category S/GW6) via the cost assessment working group exercises. This is a superior measure of treatment water complexity, and hence cost, and should be considered in models. We do acknowledge that source mix may be an appropriate measure for other companies, specifically companies with the majority of source water originating from surface works and therefore can be assumed to be complex (costly), however the simplification can lead to incorrect interpretation of groundwater treatment. In conclusion the simplified source mix explanatory should be dropped in favour of using now available better detail of complexity measures.

Our cost adjustment submission in content broadly remains identical to previously submitted supported with analysis undertaken by Oxera Consulting LLP. Given no further information has been issued from Ofwat regarding econometric model content our cost adjustment claim therefore remains broadly the same as submitted in May 2018. However, Oxera have continued to provide analysis and have taken the opportunity to revise their estimate in the interim period. The revisions account for cost adjustments being determined relative to the an efficient benchmark whilst also allowing for an estimate of net frontier effect of 0.32 per cent per annum on water resources, 0.57 per cent on network plus, and 0.4 per cent per annum on aggregate wholesale water. Please refer to the Oxera Wholesale Efficiency paper contained within Appendix 13 Wholesale Efficiency, for more information.

Assuming that the suite of proposed econometric models from Ofwat continue to not take account of key explanatory factors outlined in both this paper and Oxera's accompanying "Impact of geological factors on Ofwat models" (See Annex A), then we request that consideration be given for cost adjustments to allow for SEW's unique applicability. Oxera's analysis conclude the following cost adjustment estimates:

1. The impact of diseconomies of sources on resources is estimated to be £2.7 million over an AMP based on an upper quartile efficiency level. This corresponds to approximately 6 per cent of modelled botex and 2 per cent of projected business plan totex for the water resources control.
2. Applying the same efficiency assumptions, the impact of diseconomies of treatment plants and treatment complexity, on network plus would be £20.0 million. This is equivalent to approximately 4 per cent of modelled botex and 2 per cent of projected business plan totex for the network plus control.

The purpose of this paper is to support our cost adjustment submission through justification the geological characteristics unique to SEW have a cost impact are not recognised through proposed Ofwat econometric modelling. Furthermore, drivers not included in the model should equally be considered as fundamental cost drivers for the wider industry to generate appropriate baseline forecasts for all companies.

Of the important cost drivers Ofwat considered when developing their models, the number of water sources and treatment complexity drivers are of particular relevance to estimate the possible cost baseline. This paper both reviews our justification for the cost adjustment and management control constraints.

Attached as Annex A to this appendix we included the quantification of the cost adjustment, "Impact of diseconomies in sources, treatment plants and abnormal groundwater complexity in Ofwat's models". The paper was produced by Oxera Consultancy LLP who undertook the analysis to generate our finalised cost adjustment claim. The outputs of this work are also presented in the Ofwat proforma, cost adjustment claim summary form (accompanying this submission) and also the relevant submitted business plan tables (Wn6, Wr8).

2. Balanced econometric modelling

We have worked with Oxera Consulting LLP to understand the models to inform our response. Overall while some of the models are strong both statistically and from an operational real world perspective, we are concerned that principally two key observations are absent or unsatisfactorily represented in the proposed suite of models. Firstly, the number of assets present is a clear driver of cost, including the number of sources and the number of treatment works. Ofwat recognise this relationship within the consultation document but largely discount the explanatory factor thereafter.

Site asset requirements (monitors, telemetry, instrument panels, buildings, site security) generally do not vary significantly with size. To illustrate at an extreme, a 100 Ml treatment works will require potentially 3 chlorine monitors whilst 100 x 1Ml plants will need 300 monitors. The number of assets drive maintenance costs, compliance testing costs and calibration costs. Multiple smaller sites will also require more manpower to cover a greater number of sites, assets and alarm notifications.

Secondly, the level of treatment complexity, another intuitive driver of cost is not consistently utilised within the suite of econometric modelling proposed by Ofwat. Where not used the models tend to place a reliance on the crude indicator of treatment costs namely, source type (i.e. proportion of borehole groundwater) which in our view has now been made redundant as an explanatory factor of treatment complexity given the level of water treatment categorisation now provided in the cost assessment exercise. This treatment complexity data provides a richer information on complexity requirements against established definitions. As we demonstrate this information counters the historic assumption that borehole water (i.e. groundwater) is always low in complexity treatment and is therefore a cheaper solution to surface water.

SEW's operating environment is an area rich in geology that suits water provision via a number of low yielding yet complex ground water sources. This in turn means our costs are likely to be under reflected in the suite of proposed Ofwat models given the drivers currently selected. The lack or limited use of the cost drivers that capture these operating conditions has meant we feel it appropriate to submit a cost adjustment claim to correct the bias. Should Ofwat include the above explanatory factors more materially in their final suite of econometric models then we have no need for the cost adjustment claim.

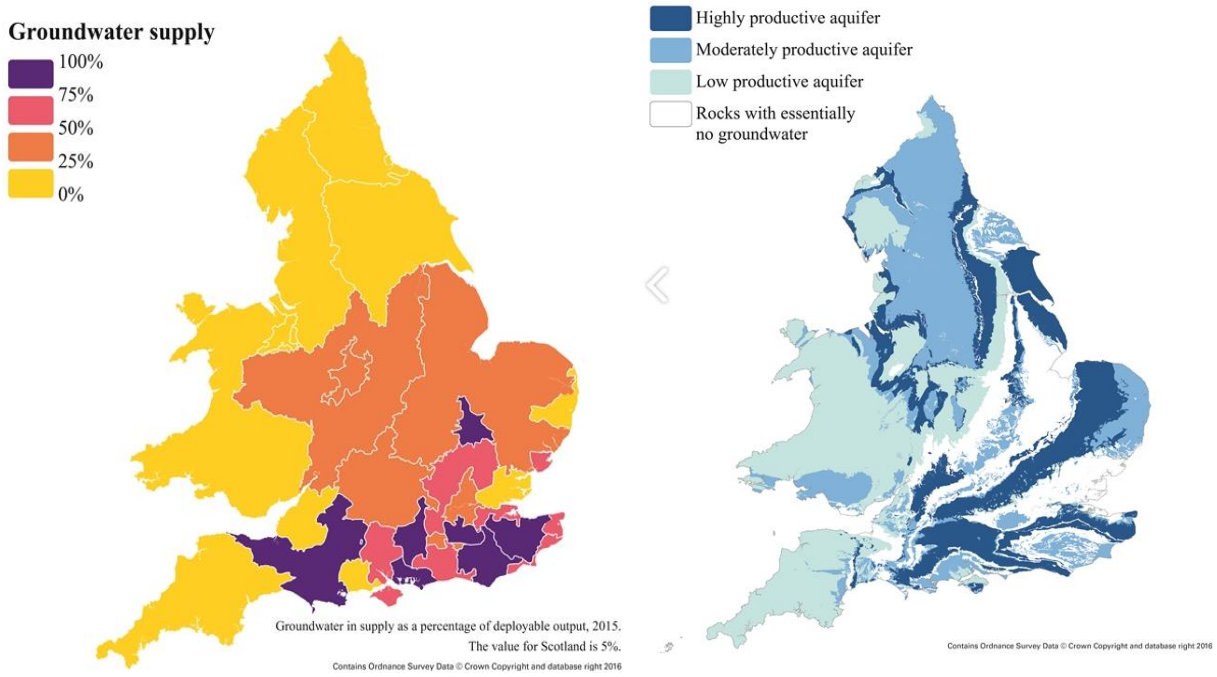
In the event that Ofwat continue to exclude these pertinent explanatory factors then this submitted cost adjustment claim proposes to offset the bias and ensure an adequate SEW baseline forecast is set. The following section provides analysis to justify our cost adjustment claim and should be read in conjunction with model quantification analysis and pro-forma.

3. Operational support for cost adjustment

3.1 Need for cost adjustment

SEW has a unique geology as outlined in Figure 1, which shows the region to be suited to the drilling of productive boreholes for abstraction purposes. It is important to note that whilst highly productive aquifers exist it is not possible to abstract (given the geology) in large volume at one (or few) sites. Instead the geology requires SEW to abstract the water through multiple, low volume sites. The constraint is in place to safeguard environmental impacts, and is enforced by the Environment Agency through appropriately low abstraction licences. This geology constraint for SEW is relatively unique in the industry, with the exception of Wessex Water. Whilst we share the same characteristic of multiple low volume boreholes with Wessex, where we differ is the presence of greensand and Ashdown bed aquifers in the SEW region which leads to complex treatment at our (groundwater) borehole sites (as opposed to Wessex utilising multiple, but low treatment complexity sites).

Figure 1: Map of groundwater supply and aquifer productivity (Source: British Geological Survey)



The high reliance on groundwater can be demonstrated via data obtained from the cost assessment datashare which shows:

- **71 per cent** of SEW water delivered is from borehole sources in 2016-17
- this contrasts to an industry average of **38 per cent** for the same period

The above relationship is stable for the period of the cost assessment information exercise.

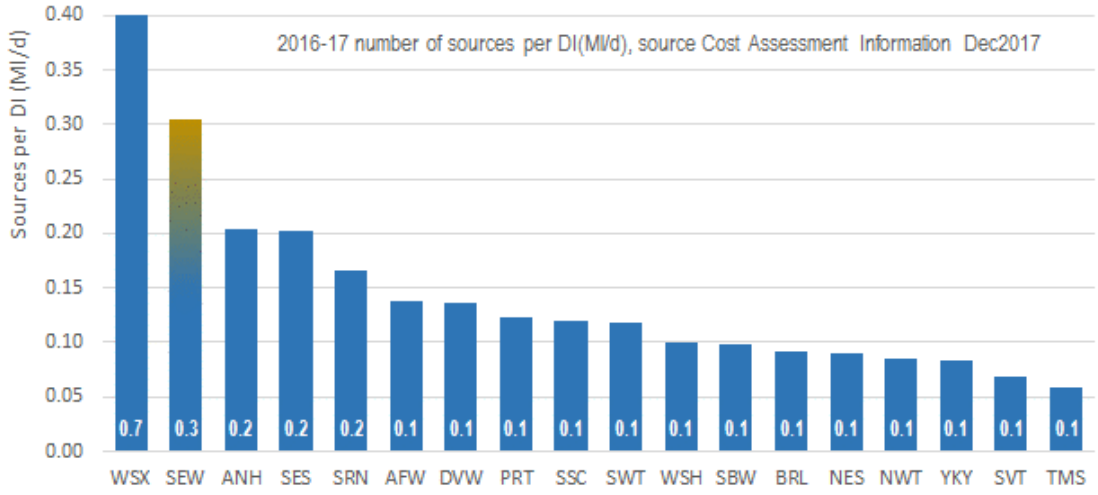
3.1.1 Large number of sources / treatment works

With regard to the geology leading to multiple sources being required to abstract water from ground we can again use the cost assessment datashare to demonstrate the fact:

- In 2016-17 SEW number of sources per distribution input (Ml/d) was 0.31
- this contrasts to an industry average of 0.16 for the same period

The large number of sources required is therefore demonstrably unique versus the industry, with the single exception of Wessex Water. The contrast is outlined in Figure 2, which demonstrates SEW's unique position versus the remaining industry (please note due to graph scaling to demonstrate SEW's position, Wessex Water go beyond the graph scale outlined).

Figure 2: 2016-17 number of sources per DI



The dependence on multiple sites has a clear impact on costs. From an operational perspective, relative to a single large treatment site, multiple small sites can be expected to incur higher costs for the same level of output through higher maintenance costs and inferior scale economy.

As previously mentioned, asset requirements generally do not vary significantly with size with cost impact driving up maintenance, compliance testing and calibration costs. Multiple smaller sites will also require more manpower to cover a greater number of sites, assets and alarm notifications.

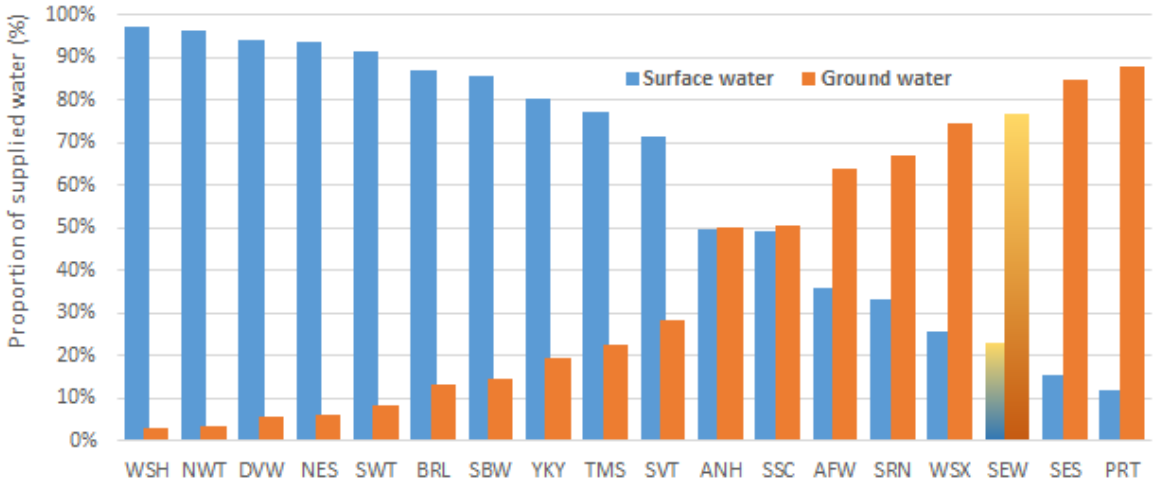
3.1.2 Treatment complexity

A related and impacting factor is not only do we operate a large number of small sites but the sites we operate are more complex in nature due to the largest sandstone

formation in the country encompassing much of SEW's eastern region (from the coastline east of Eastbourne and inland through Royal Tunbridge Wells). Much of the raw water abstracted from Greensand and Ashdown bed aquifers in SEW's supply zone has high levels of Iron and Manganese, which necessitates expensive treatment in order to comply with the regulatory prescribed concentration values of 200 and 50 micrograms per litre respectively and to reduce the impact iron and manganese can have on the appearance of water at customers taps.

Historically econometric models have over simplified complexity using the proportion of distribution input from borehole/groundwater with the simplified inference being that groundwater is less complex and therefore cheaper to treat. The following chart outlines the (2016/17) proportion of supplied water either surface or groundwater (i.e. S/GW+3). Where a simplified approach is adopted, as is the case in a number of proposed Ofwat models, companies indicating a high proportion of surface water within the explanatory factor will mostly benefit, ignoring the actual complexity of groundwater treatment which is being experienced by SEW. As an initial observation, proposed models by Ofwat using a simplified approach of using proportion from boreholes/groundwater to measure treatment complexity do not adequately reflect complex treatment practices now in place across both surface and groundwater sources of treatment. We would therefore recommend that Ofwat focus on using actual complex treatment categories for explanatory factors, particularly given their availability using the cost assessment submission – to do so would materially change our view of cost adjustment to be submitted.

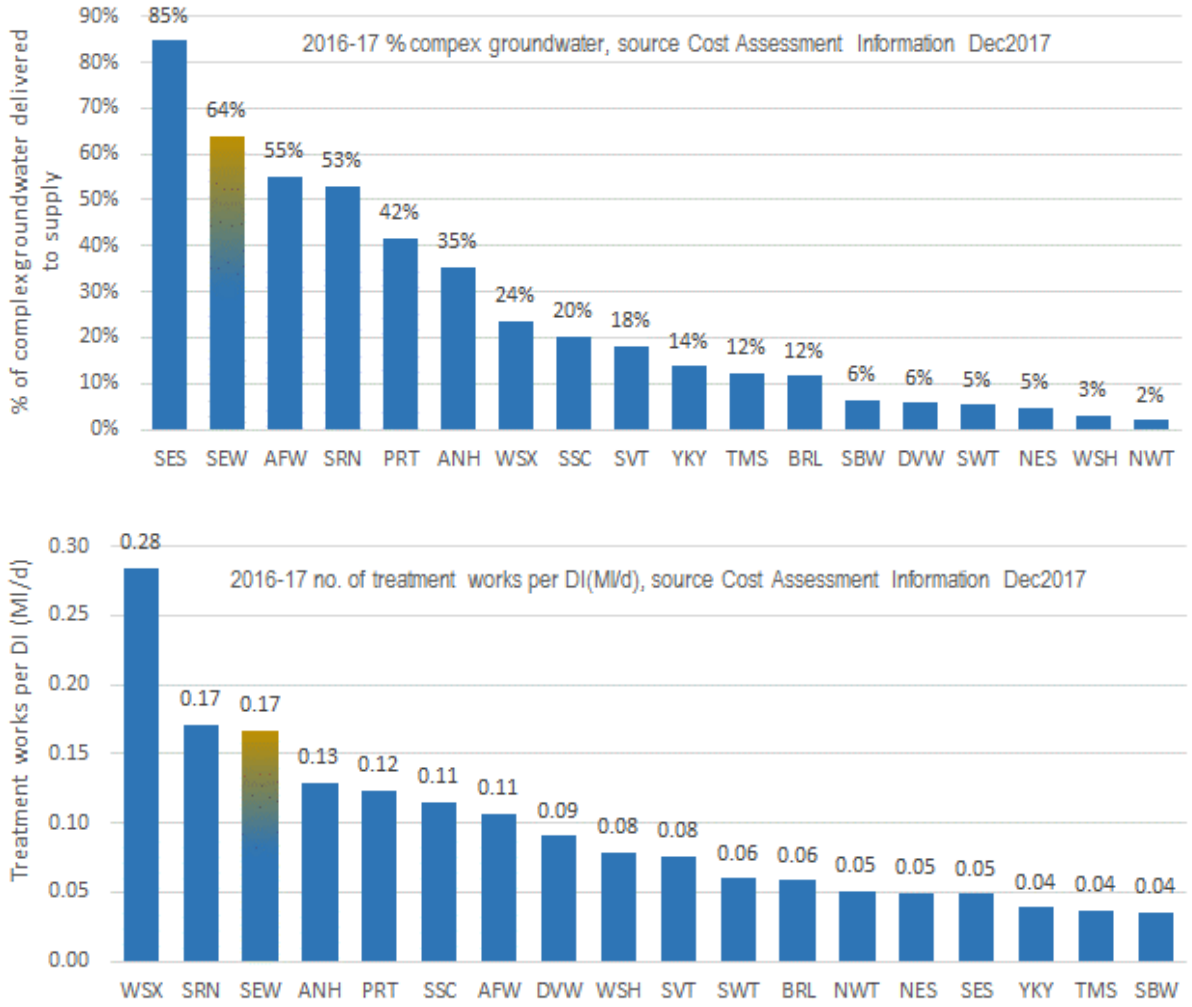
Figure 3: 2016-17 proportion of supplied water from either groundwater or surface water



To illustrate SEW's comparative groundwater complexity further we can demonstrate using data from the cost assessment datashare which shows that in 2016-17 64 per cent of our groundwater was treated through complex treatment, i.e. GW3+. This

contrasts to an average of 26 per cent for the industry. This is outlined in Figure 4. Also shown in Figure 4 is evidence to support our claim regarding large number of treatment sites – this is demonstrated by treatment works per distribution input with SEW recording 0.17 for 2017-18, again comfortably exceeding industry average at 0.09. This clearly mimics the similar observation of utilising a large number of sources.

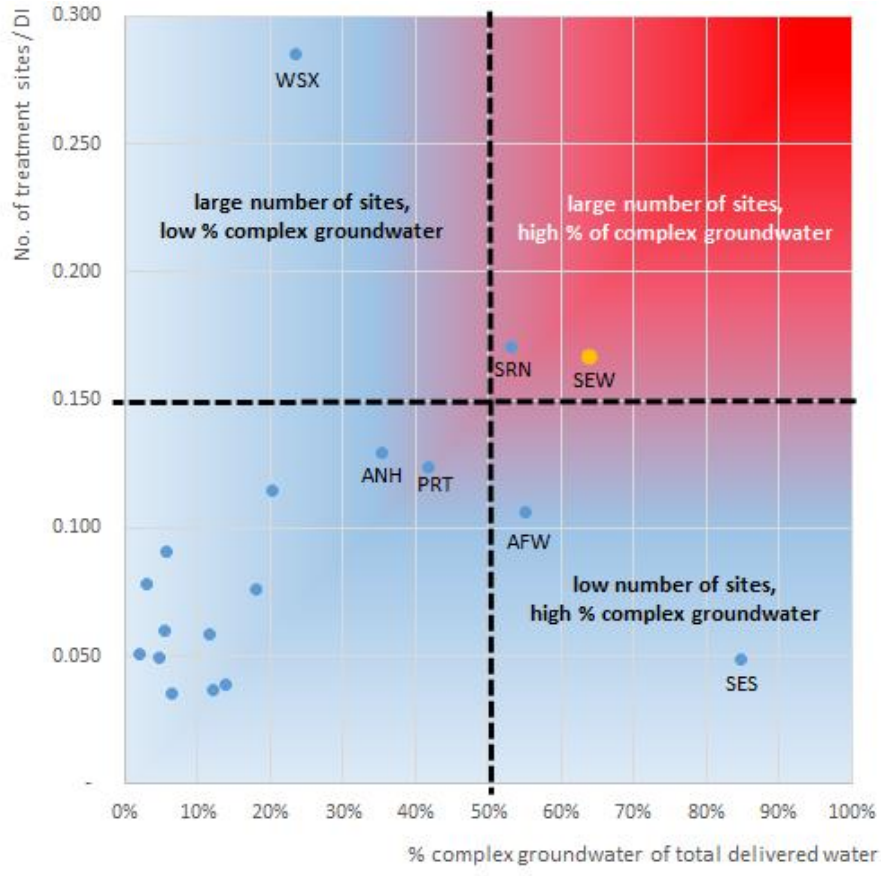
Figure 4: 2016-17 number of treatment works per unit of distribution input and proportion of complex groundwater



We have therefore demonstrated that SEW has a high number of low yielding sites and that the majority of those sites require complex treatment. Taking the observation further and combining the two measures results in SEW being a company that is identified as being uniquely exposed to both of these factors. We have demonstrated the combined result in the scatter diagram (Figure 5) which shows SEW being clearly in the top-right quadrant. The dual effect of having both a high number of sites coupled with complex treatment intensifies the cost impact. This contrasts to the majority of the industry who generally are not exposed to either, or

just exposed to one impact. For example, Wessex Water operating a high number of treatment works but at low complexity (and therefore low treatment cost); or SES Water operating few sites but with complex treatment.

Figure 5: 2016-17 number of treatment works per DI and proportion of complex groundwater



We consider evidence obtained from the cost assessment datashare therefore justifies SEW's requirement to either 1) ensure suitable explanatory factors are present in econometric modelling to recognise the cost; or 2) be allowed a cost adjustment to recognise the cost incurrence.

3.2 Management control

SEW considers geology constraints to be beyond management's control. SEW's responses to Ofwat's criteria for beyond management control justification are summarised as below.

- Is the cost driven by factors beyond management control?

  Given the evidence provided in the above section we believe natural geology constraints do not allow SEW to correct the cost adjustment through direct management control, i.e. SEW is unable to consolidate a large number of

small volume sites into fewer larger volume sites. It should be noted that geology remains the key constraint to the development of large volume sites, but also the significant re-structure of the network to accommodate a switch to large sites would be cost prohibitive. The abandonment of smaller sites in favour of larger sites is further constrained by the environmental impact this would cause and is controlled via Environment Agency abstraction licences. We operate in an area of environmental stress and a significant number of our existing sources are already being subject to sustainability reduction assessments in this and the next period. The abandonment of existing sites to replace them with larger sites would therefore clearly cause further environment impact on the area and therefore is not a feasible option.

With regard to the management control of treatment complexity this is again constrained by geology and is coupled with the lack of alternative water sources available in a water stressed area. For these reasons, the treatment complexity and the associated cost impact to which SEW is exposed is unavoidable.

- Is there persuasive evidence that the company has taken all reasonable steps to control the cost?

  Ultimately geology characteristics provide a natural barrier that cannot be easily overcome via management control. The cost feasibility of operating smaller sites is continually reviewed, and we operate a site optimising tool to ensure least cost sites are prioritised. However, given that SEW operate within a water stressed area we continue to rely upon these low yield sites for the following reasons:

  – Continued dependence to ensure daily demand is met, specifically at peak demand
  – provide an element of current resilience cover
  – continue to be important sources of water within our WRMP

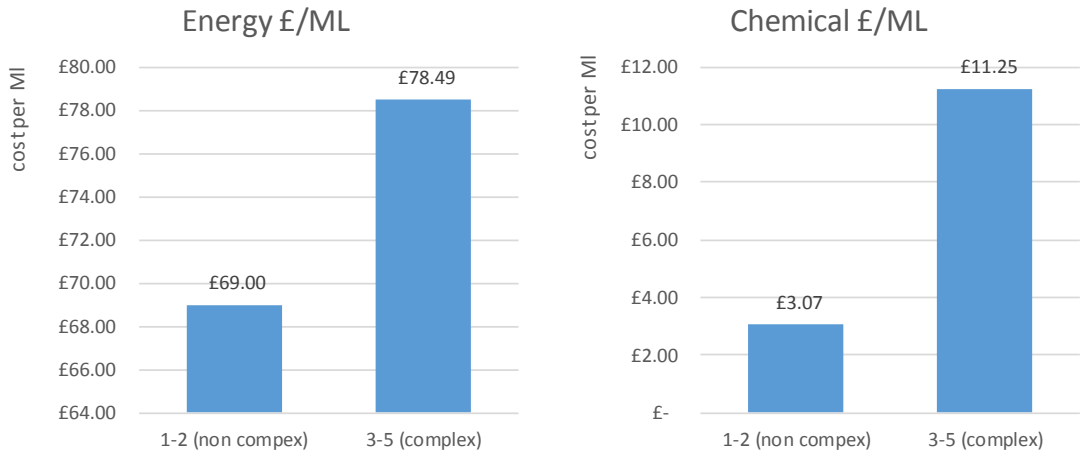
3.3 Bottom-up engineering validation

To further justify our cost adjustment claim we have also analysed energy and chemical costs per mega-litre of delivered water at our key groundwater sites. This analysis clearly demonstrates that complex works (i.e. GW3+) are on average more expensive.

Chemical costs are more significant with costs increasing from £3.07 per mega-litre of water delivered from groundwater treatment work graded from simple disinfection to GW2, to £11.25 for treatment works graded GW+. Energy also shows, on average across all appropriate sites, a step increase in cost against more complex treatment

works, although accepted other factors can influence the cost – specifically average pumping head.

Figure 6: SEW groundwater energy and chemical costs



Recalling our earlier observation that 64 per cent (Figure 4) of groundwater is subject to complex treatment the cost impact outlined in this analysis becomes significant. Therefore whilst we are unable to collate data from the remaining industry, we believe our internal analysis demonstrates the correlation of treatment complexity leading to increased cost.

3.4 Customer evidence

As this cost adjustment claim relates to explanatory factors in a range of econometric models it would not be appropriate to carry out customer research in relation to the details of the claim. The claim is not about a different service that customers would receive, it is in relation to the completeness of the cost models and therefore provides a form of protection to customers from the use of an incomplete set of variables in the econometric models for PR19, which given the unique circumstances in SEW's operating environment would generate insufficient expenditure to maintain our current service.

We have discussed this issue with our Customer Challenge Group and that a relevant and understandable question in relation to our claim could not be formulated for researching with customers.

4. Conclusion

The objective of this appendix, in parallel to the supporting quantification paper produced by Oxera (Annex A), has been to reinforce the importance of ensuring that the final suite of econometric modelling proposed by Ofwat should include intuitive operational explanatory facts. Our observation is that the absence, or underplaying the inclusion of number of sources/treatment works, combined with treatment complexity as an explanatory factor to the cost modelling would be a key omission to the industry econometric modelling.

If these drivers are not used in a material way in the cost assessment models we would seek a cost adjustment outside of the model. The cost adjustment proposed is as follows:

1. The impact of diseconomies of sources on resources is estimated to be **£2.7 million** over an AMP based on an upper quartile efficiency level. This corresponds to approximately 6 per cent of modelled botex and 2 per cent of projected business plan totex for the water resources control
2. Applying the same efficiency assumptions, the impact of diseconomies of treatment plants and treatment complexity, on network plus would be **£20.0 million**. This is equivalent to approximately 4 per cent of modelled botex and 2 per cent of projected business plan totex for the network plus control.

We have used this appendix to demonstrate that the unique geology of the SEW region leads to the importance of these explanatory factors in explaining SEW cost. We consider this paper has outlined that proposed SEW explanatory factors appropriately justifies the cost impact, but also the management control constraints to reducing the cost. In parallel with the Oxera quantification paper (Annex A) we consider this robust cost adjustment under the current scenario of proposed econometric modelling.

Annex A Impact of geological factors on Ofwat's models – Oxera

Impact of diseconomies in sources, treatment plants and abnormal groundwater complexity in Ofwat's models

Prepared for South East Water Ltd

17 August 2018

Executive summary

The PR19 methodology report[1] and previous discussion of operational drivers consider geological factors such as the number of sources and treatment plants, as well as treatment complexity, as material drivers of costs for the industry. In the modelling consultation,[2] Ofwat appears to place less emphasis on the geological factors, while the approach to controlling for treatment complexity varies across models.

Apart from Ofwat and South East Water (SEW), eight other companies have recognised and controlled for economies of scale at the source and/or treatment works level, as well as for granular measures of treatment complexity, supporting that view that these are material drivers for the industry as a whole.

SEW's supply zone has an atypical sandstone geology that results in abnormal groundwater treatment requiring expensive treatment. An additional feature of this geology is a disproportionate number of sources and treatment plants,

[1] Ofwat (2017), 'Delivering Water 2020: our final methodology for the 2019 price review', 13 December, https://www.ofwat.gov.uk/publication/delivering-water-2020-final-methodology-2019-price-review/.
[2] Ofwat (2018), 'Cost Assessment for PR19 – a consultation on econometric cost modelling', 29 March, https://www.ofwat.gov.uk/consultation/cost-assessment-pr19-consultation-econometric-modelling/.

resulting in diseconomies in the resource, raw water distribution and treatment parts of the business. As noted by the CMA in the Bristol Water inquiry,[3] the two factors are linked—there is a negative correlation between the average size of a company's water source and water from boreholes, which tends to be cheaper to treat than water from other sources. However, due to sandstone with high levels of iron and manganese, treatment of SEW's borehole water is similar to that of river water. Moreover, information on water treated at different treatment bands helps to disentangle the two effects, mitigating a limitation highlighted by the CMA.

This note estimates the cost adjustments that may be required for SEW due to its unique operational characteristics, based on data and models that Ofwat has published in the modelling consultation.[4] If these factors were to be suitably accounted for in Ofwat's models as a result of this consultation, then such cost adjustments would not apply. Conversely, should Ofwat feel the inclusion of these variables is not required to deliver an appropriate assessment of company funding, SEW would request to consider these special factor adjustments given their unique applicability to it.

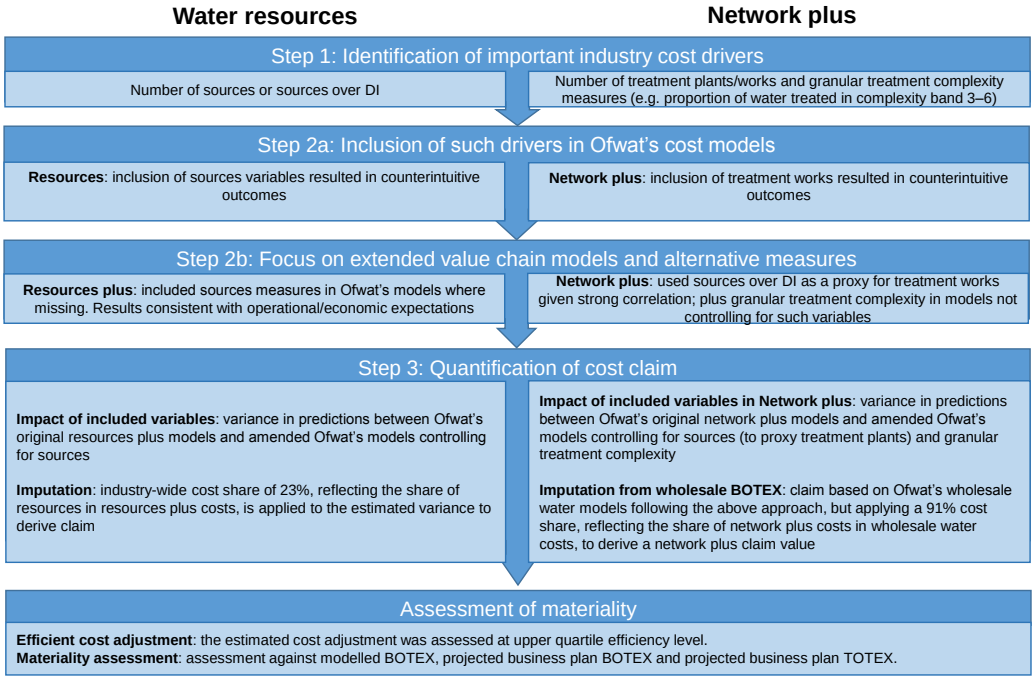
To be consistent with the cost adjustment pro-forma,[5] we have identified one claim for **diseconomies in sources** on resources, and another joint claim for **abnormal treatment complexity** and **diseconomies in treatment plants** on network plus. We have also estimated a **combined claim** at the wholesale water BOTEX level to both impute a value of the claim on network plus as well as cross-check the individual claims to assess double- or under-counting of adjustments.[6]

The main approach that we have used involves comparing the predictions for SEW when appropriate drivers for the factors are included in Ofwat's models, while ensuring that the additional factors are sensible from an economic and operational perspective. Owing to the nature of top-down modelling, we consider that this approach provides a practical way of quantifying a cost adjustment claim, and has been considered by Ofwat in the past.[7]

The diagram below outlines the logical steps that we have followed to quantify the claim.

[3] Water Services Regulation Authority (2015), 'Bristol Water plc: A reference under section 12(3)(a) of the Water Industry Act 1991: Appendices 1.1–4.3', 4 March, https://assets.publishing.service.gov.uk/media/5627995aed915d101e000001/Appendices_1.1_-_4.3.pdf.
[4] Ofwat (2018), 'Cost Assessment for PR19 – a consultation on econometric cost modelling', 29 March, https://www.ofwat.gov.uk/consultation/cost-assessment-pr19-consultation-econometric-modelling/.
[5] Ofwat (2018), 'Price review early submissions on 3 May 2018 for performance commitment definitions and cost adjustment claims', Information notice, March, https://www.ofwat.gov.uk/wp-content/uploads/2018/03/IN-1802-Price-review-early-submissions-on-3-May-2018-for-performance-commitment-definitions-and-cost-adjustment-claims2.pdf
[6] In other words, at the overall BOTEX level, the effect of sources, treatment works and treatment complexity is jointly estimated to get a combined effect or a single adjustment; given controls for Resources and Network Plus in PR19, we have identified the effect of sources on Resources separately, and that of treatment works and treatment complexity jointly on Network Plus. We have used the combined effects estimated on overall BOTEX to impute a value of the claim on Network Plus
[7] For example, in the consideration of special cost factor analysis in the context of Fawley oil refinery for Sembcorp Bournemouth at PR14.

Flow diagram of the cost adjustment approach



Source: Oxera.

The general conclusions from the analysis are as follows.

- If geological factors are not appropriately accounted for in the econometric models, the estimated baseline cost for some companies in the industry can be biased.
- The proportion of DI from boreholes or the average pumping head does not provide an appropriate proxy for the treatment complexity that some companies in the industry deal with. Water treated at different treatment bands, as considered by Ofwat in some of the models[8] (and exploring sensitivity to the band threshold), provides a useful alternative and a direct measure of the complexity of companies' treatment processes.
- Models that appropriately control for the number of sources, and the treatment complexity, predict a level of cost that is more likely to be aligned with the cost requirements for some companies. The adjustments that have been estimated for SEW in this note do not appear to be overly sensitive to the modelling specifications considered.
- Ofwat has noted that the cost adjustment claims need to be determined relative to an efficient benchmark. Oxera's assessment of Ofwat's wholesale water BOTEX models developed as part of the modelling consultation[9] indicate that a benchmark between the upper-quartile and upper-quintile efficient levels may be appropriate for SEW on the dataset published in the consultation. As there is no conclusive evidence on which of the two

[8] And previously at PR14 (for Bristol Water), and by the CMA in the Bristol price appeal inquiry.
[9] Ofwat (2018), 'Cost Assessment for PR19 – a consultation on econometric cost modelling', 29 March, https://www.ofwat.gov.uk/consultation/cost-assessment-pr19-consultation-econometric-modelling/.

benchmarks is more appropriate, the results presented in this note focus on an upper-quartile benchmark as a conservative assumption and to be consistent with Ofwat's approach at PR14. A per-annum net frontier shift of 0.32% on water resources, 0.57% on network plus, and 0.4% on aggregate wholesale water is also applied to the estimates.[10]

- The impact of diseconomies of sources on resources is estimated to be **£2.7m** over an AMP based on an upper-quartile efficiency level.[11]
- Applying the same efficiency assumption, the impact of diseconomies of treatment plants,[12] and treatment complexity, on network plus is estimated to be between **£19m and £20m** over an AMP. The lower-end estimate is based on imputing a value from BOTEX models, while the upper-end estimate comes from including relevant factors in network plus.

Ofwat has noted that the materiality of a cost adjustment claim needs to be contingent on projected business plan TOTEX.[13] While we acknowledge Ofwat's intention to set a high evidential bar for accepting cost adjustment claims made by companies, it is not clear why the focus has been placed on projected TOTEX rather than BOTEX, given that the modelling approach focuses on the latter and the issue identified is a modelling anomaly. As such, the table below shows the estimated claim values and their share with respect to modelled BOTEX, projected BOTEX and projected TOTEX for the relevant controls.[14]

Estimated cost claim for water resources and network plus (£m)

	AMP7 Claim value	% modelled BOTEX	% projected BOTEX*	% projected TOTEX*
Water resources	2.7	6%	3%	2%
Network plus	20.4	4%	3%	2%

Note: All costs are in 2017/18 prices. Cost claim values reflect an upper-quartile correction and a net frontier effect of 0.32% on water resources and 0.57% on network plus. *Projected BOTEX and TOTEX include post-modelling adjustments.

Source: Oxera.

Lastly, with further data refinements on the 2017/18 APR data and model development that Ofwat is likely to undertake with companies' business plan information, the cost claims derived in this note should be seen as directional and indicative. Consistent with Ofwat's framework on the criteria that cost adjustment claims need to meet, evidence from a bottom-up/engineering

[10] See Oxera (2018), 'South East Water wholesale BOTEX assessment', accompanying SEW's business plan submission, for a full discussion on benchmark selection and net frontier shift assessment.
[11] As noted in the flow diagram, the adjustment comes from imputing a value from resources plus. We attempted to directly include a measure of the number of sources in water resources models. However, the coefficient was unintuitive, a point that was also noted by Ofwat in its consultation.
[12] Given the correlation between the number of sources and treatment plants, we used sources to proxy treatment plants in network plus to provide an indicative value of its impact. Including treatment plants in network plus would be a more direct option, but this did not result in intuitive results.
[13] Ofwat (2018), 'Price review early submissions on 3 May 2018 for performance commitment definitions and cost adjustment claims', March.
[14] Projected BOTEX and TOTEX include post-modelling adjustments—i.e. abstraction charges, rates, third party service and pension deficit payment.

perspective should further corroborate the claim value. Operational evidence are provided in the accompanying SEW justification paper.[15]

1 Introduction

In March 2018, Ofwat released a consultation document showing cost models that it and water companies developed as part of the price review for PR19. Ofwat has recognised that companies with larger numbers of sources are expected to incur higher operating costs due to diseconomies.[16] However, some of Ofwat's models place less emphasis on geological factors such as the number of sources and treatment plants, and treatment complexity appears to be controlled for differently, and possibly inadequately, in some of the models. These drivers are operationally relevant to the industry as a whole, as are discussed in our response to the econometric models and the model submissions in March.

Several companies apart from SEW have considered geological factors and treatment complexity measures in their submissions, as follows.

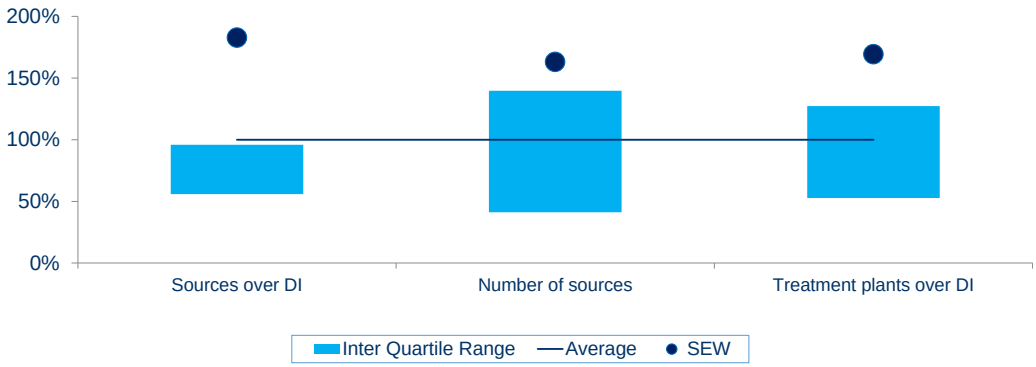
- **Number of sources (aggregate or on a per-DI basis)**. Used in resources models submitted by Anglian Water, Bristol Water, Yorkshire Water and Southern Water, and in wholesale water models submitted by Southern Water, Welsh Water, Yorkshire Water and South Staffordshire.
- **Number of water plants or water treatment works (aggregate or on a DI/property basis)**. Used in network plus models by Severn Trent, and in wholesale water models submitted by Affinity Water.
- **Treatment complexity (granular measures)**. Used by Anglian Water, Bristol Water, Southern Water, Welsh Water, Severn Trent, Affinity Water, Yorkshire Water and South Staffordshire.

The fact that a number of company-submitted models explicitly controlled for these variables supports the view that these geological factors are relevant cost drivers for the industry as a whole, not just for SEW in particular.

SEW has a large number of sources as well as treatment plants per distribution input (and is an outlier in the industry). This is illustrated in Figure 1.1 and, more extensively, in SEW's separate justification paper.[17]

[15] The reader is referred to the South East Water (2018), 'Cost Adjustment – Early Submission. South East Water justification', May, for more details.
[16] Ofwat (2018), 'Cost assessment for PR19: a consultation on econometric cost modelling', March, https://www.ofwat.gov.uk/wp-content/uploads/2018/03/Cost-assessment-for-PR19-A-consultation-on-econometric-cost-modelling.pdf.
[17] South East Water, 'Cost Adjustment – Early Submission. South East Water justification', May 2018.

Figure 1.1 Number of assets



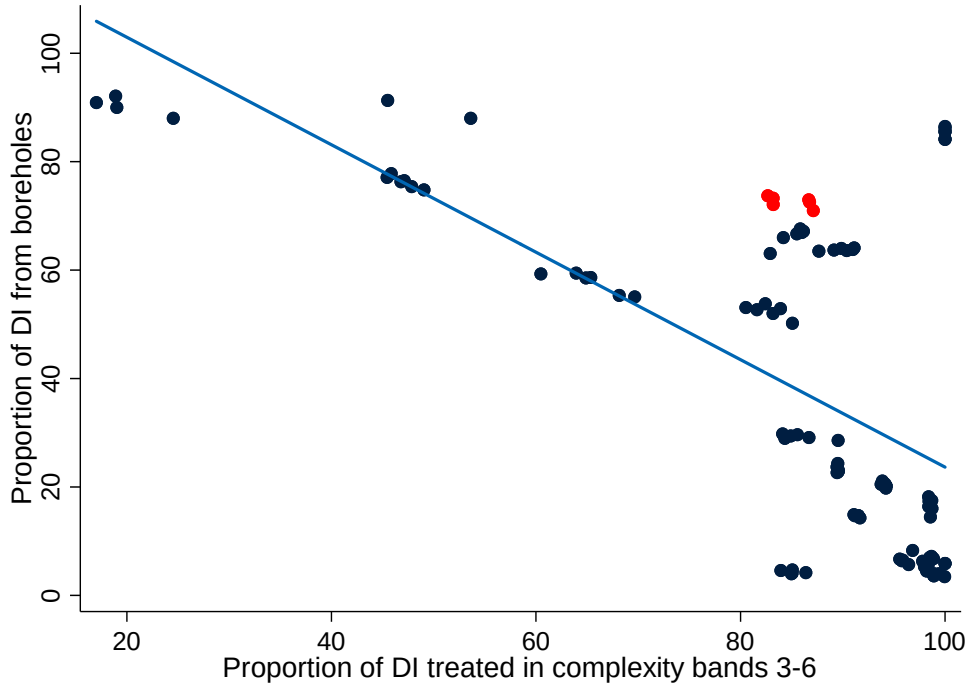
Source: Oxera.

In addition, while SEW's source mix consists largely of water from boreholes, the quality of the abstracted water from these boreholes is more complex than that of SEW's comparators with a similar source mix, owing to the largest sandstone formation in the UK encompassing much of SEW's eastern region. This results in water extracted from these sources being similar to water extracted from rivers.

This unique situation is highlighted in Figure 1.2. SEW (shown in red) has a higher proportion of DI treated in complexity bands 3 to 6 relative to the majority of its peers with a similar or higher proportion of DI from boreholes (see further evidence on the reasons why granular measures of treatment complexity may capture SEW's unique operational circumstances better is provided in SEW's separate justification paper).[18]

[18] South East Water, 'Cost Adjustment – Early Submission. South East Water justification', May 2018.

Figure 1.2 SEW's position in relation to treatment complexity variables



Note: Observations for SEW are highlighted in red.

Source: Oxera.

This note quantifies the impact of omitting geological factors on the models that Ofwat has produced as part of the consultation. Should Ofwat's revised models adequately account for these factors (i.e. diseconomies in sources and treatment plants, as well as having more complex water to treat relative to peers of similar source mix), the need for a cost adjustment claim may not arise.

Operational insights into why controlling for the number of assets and granular measures of treatment complexity is important are presented in a separate note from SEW.

Section 2 below sets out the approach used to quantify the impact of SEW's operational characteristics in Ofwat's water resources and network plus models.

2 Quantification of the cost adjustment

2.1 Estimation approach

We have considered the following approaches to estimating the cost adjustments for SEW.

- **Approach 1**. Observing the difference in SEW's performance in models that control for the two key cost drivers relative to its performance in models that do not. While this approach has the advantage the quantification is based

on Ofwat's models, it provides limited scope to undertake a like-for-like comparison in many cases.[19]

- **Approach 2**. Including key cost drivers in Ofwat's models that are not accounted for. By replicating Ofwat's models and including geological variables (i.e. the number of sources and treatment complexity) when absent, it is possible to assess their incremental impact while ensuring that comparisons across models are still like-for-like.

These approaches are broadly consistent with those followed by Ofwat at PR14 in quantifying appropriate cost adjustments. We focus on Approach 2, which:

- provides an 'in the round view', given the nature of top-down modelling, by analysing the impact of SEW's key characteristics in econometric models;
- ensures that models are economically sound and operationally supported, and that they have acceptable statistical properties;
- estimates the net incremental impact of SEW's unique geology.

Ofwat has emphasised that the cost adjustment claims need to be efficient (i.e. derived relative to an efficient benchmark).[20] However, the quality of the models varies considerably, and at this stage it is not clear what Ofwat's approach would be to select the appropriate benchmark.

Oxera's assessment of Ofwat's wholesale BOTEX models developed as part of the modelling consultation[21] indicates that a benchmark between the upper-quartile and upper-quintile efficiency levels may be appropriate for SEW. As such, the analysis presented in this note estimates the impact of geological factors for SEW relative to these two benchmarks, although the focus is on an upper-quartile correction, in line with Ofwat's approach at PR14.[22]

2.2 Water resources

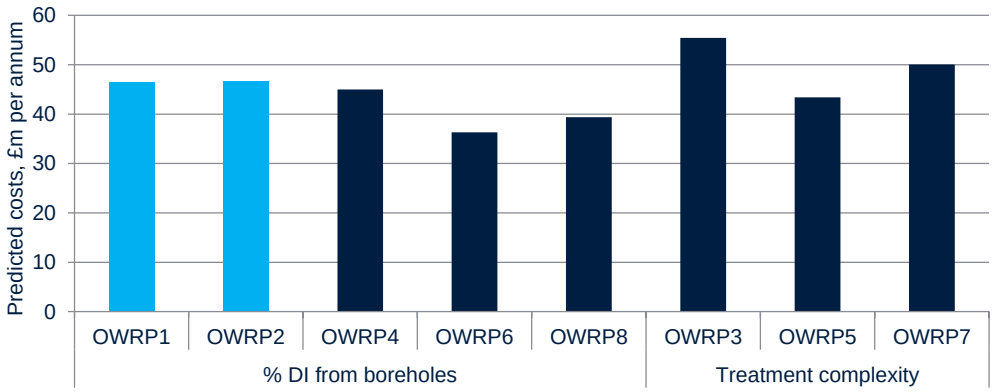
We attempted to directly include a measure of the number of sources in water resources models to quantify its impact. However, the coefficient was unintuitive, a point that was also noted by Ofwat in its consultation. So we focused on extended value chain models, in particular the resources plus models that combine resources activities with raw water distribution and water treatment.

Ofwat submitted eight water resources plus models, two of which control for the number of sources (OWRP1 and OWRP2). These models include DI per source and the number of sources, the number of properties as a scale variable and the proportion of DI from boreholes.

[19] This is because it does not offer a 'base' Ofwat model to compare the incremental effects against.
[20] See Ofwat (2017), 'Delivering Water 2020: Our final methodology for the 2019 price review', Appendix 11: Securing cost efficiency, Box 2: Evidence to support cost adjustment claims.
[21] Ofwat (2018), 'Cost Assessment for PR19 – a consultation on econometric cost modelling', 29 March, https://www.ofwat.gov.uk/consultation/cost-assessment-pr19-consultation-econometric-modelling/.
[22] See Oxera (2018), 'South East Water wholesale BOTEX assessment', accompanying SEW's business plan submission, for a full discussion on benchmark selection and net frontier shift assessment.

The figure below shows SEW's predicted costs for the eight models. Alongside the share of DI from boreholes and scale, OWRP4 controls for the weighted density measure, OWRP6 for average pumping head, and OWRP8 for both. The final three models (OWRP3, 5, 7) are equivalent to models OWRP4, 6, and 8 respectively, but control for treatment complexity instead of the proportion of DI from boreholes.

Figure 2.1 SEW's cost predictions—water resources plus models



Note: All costs are in 2017/18 prices. Models OWRP4, OWRP6 and OWRP8 include the proportion of DI from boreholes to proxy treatment complexity, while OWRP3, OWRP5 and OWR7 include water treated at bands 3 and above.

Source: Oxera.

In order to quantify the impact of geology, we include the number of sources or DI per source when absent in Ofwat's models, and compare the prediction against models that do not control for it (OWRP4, 6 and 8). The estimated coefficients from the sources variables are consistent from an economic and operational perspective, and are generally statistically significant.

By comparing cost predictions from Ofwat's original models (dark blue bars) with predictions from Ofwat's amended models including sources (light blue bars), Figure 2.2 shows that controlling for the number of sources and DI per source tends to result in higher cost predictions for SEW. Specifically, looking at models OWRP4, 6, and 8, the overall magnitude of the change (per annum) in cost prediction is in the range of £1m–£6m—i.e. approximately £3m on average. This corresponds to an approximate value of £0.6m per annum or £3m over an AMP in water resources, reflecting a 23% share of water resources plus costs.[23]

The difference in model predictions would need to be corrected for an appropriate benchmark. Our assessment of Ofwat's wholesale water BOTEX models suggests that a benchmark between the upper-quartile and upper-quintile efficient levels may be appropriate for SEW on the dataset published in the consultation. As there is no conclusive evidence on which of the two benchmarks is more appropriate, we focus on an upper-quartile benchmark as a conservative assumption and to be consistent with Ofwat's approach at

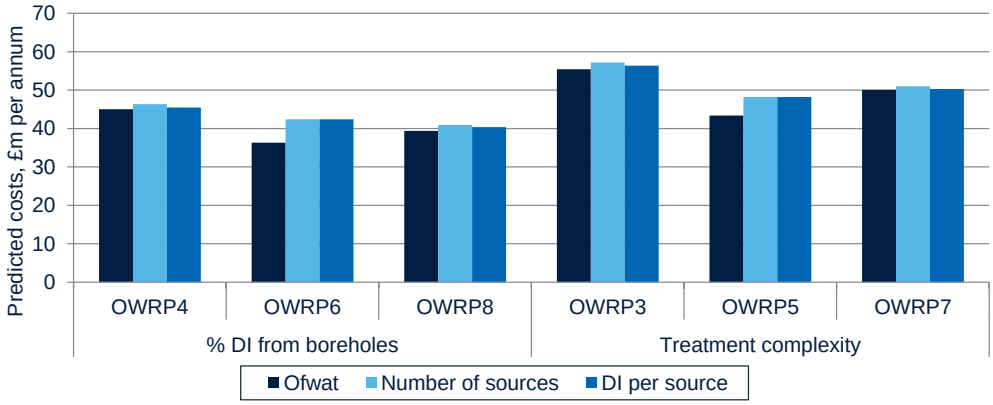
[23] How Ofwat intends to use water resources plus models to impute a cost allowance for water resources is not clear. For SEW, the approximate share of water resources modelled BOTEX in water resources plus modelled BOTEX is 23%, while it is 21% for the average company.

PR14. Finally, a net frontier shift of 0.32% has been applied to these adjustments to ensure that they reflect efficient forward-looking costs.[24]

As a result, the estimated value of the claim is approximately £2.7m based on an upper-quartile adjustment over an AMP. This corresponds to approximately 6% of modelled BOTEX and 2% of projected business plan TOTEX for the water resources control.

Figure 2.2 shows that controlling for treatment complexity (models OWRP3, 5 and 7) results in higher predictions for SEW, as expected.

Figure 2.2 SEW's cost predictions controlling for the number of sources—water resources plus models



Note: All costs are in 2017/18 prices. Models OWRP4, OWRP6 and OWRP8 include the proportion of DI from boreholes to proxy treatment complexity, while OWRP3, OWRP5 and OWR7 include water treated at bands 3 and above.

Source: Oxera.

2.3 Network plus

SEW's unique groundwater treatment complexity may not be adequately captured in aggregate models, where Ofwat controls for average pumping head instead of treatment complexity explicitly.

Although average pumping head may capture treatment complexity to a limited degree by reflecting topography and the volume of water pumped, explicit measures of treatment complexity are only included in a quarter of wholesale water models and half of network plus models.[25] From an operational perspective, there is no direct link between pumping head and treatment complexity. Pumping requirements tend to be similar for sites of the same size and location, with costs reflecting power, chemical and manpower needed to

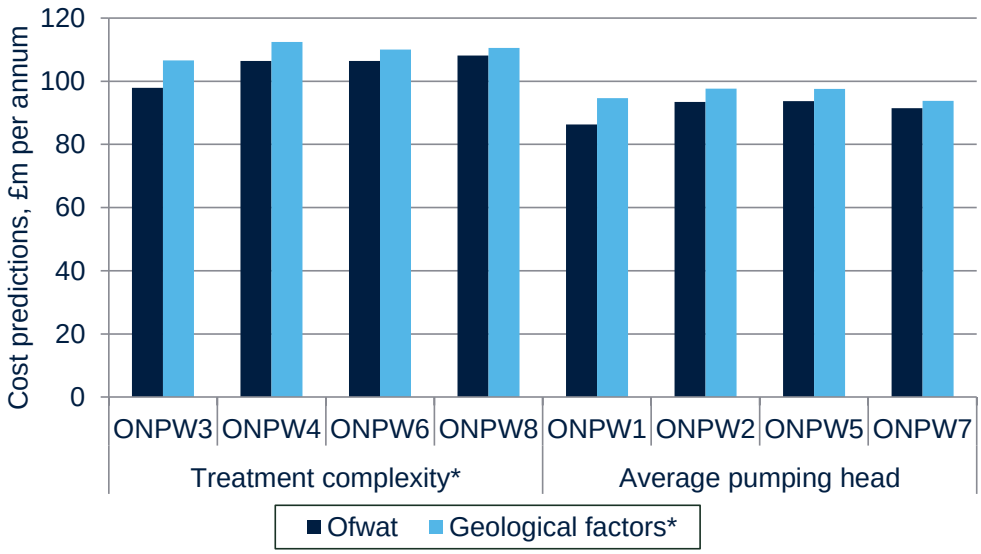
[24] See Oxera (2018), 'South East Water wholesale BOTEX assessment', accompanying SEW's business plan submission, for a full discussion on the net frontier shift assessment.
[25] It is also unclear why Ofwat has controlled control for average pumping head in water resource plus in BOTEX models and average pumping head in water treatment in network plus models, thus always excluding pumping activity in treated water distribution. Average pumping head in treated water distribution plays a major role in capturing SEW's overall pumping activity, which is not accounted for in any of the models currently submitted by Ofwat. We have highlighted our issue with the average pumping head variables used in our response to the econometric models.

run and maintain the extra treatment steps rather than pumping from source or into distribution. (See SEW's separate justification paper for details).[26]

By amending Ofwat's model, we have quantified the impact of including variables that may capture SEW's unique operating geology in models that do not control for it.

Figure 2.3 shows a comparison of Ofwat's original models with equivalent models that control for treatment complexity and the number of sources (over DI).[27] Note that the models labelled 'treatment complexity' already control for granular treatment complexity, so the only change to these models was to append the sources over DI variable.

Figure 2.3 SEW's cost predictions controlling for the number of sources and treatment complexity—network plus models



Note: * In models that already explicitly control for treatment complexity, the only addition to Ofwat's original models was to append a sources over DI variable. In models that did not control for treatment complexity explicitly, both treatment complexity and sources over DI were appended. All costs are in 2017/18 prices.

Source: Oxera.

The treatment complexity and sources over DI variables are always positive and are generally statistically significant. They are, however, statistically insignificant in models ONPW5 and ONPW7.

Focusing on models that originally control for average pumping head (ONPW1, 2, 5 and 7), we estimate the size of the claim to be approximately £4.8m per annum of £24m over an AMP. These models show the joint impact of including treatment complexity and sources over DI.

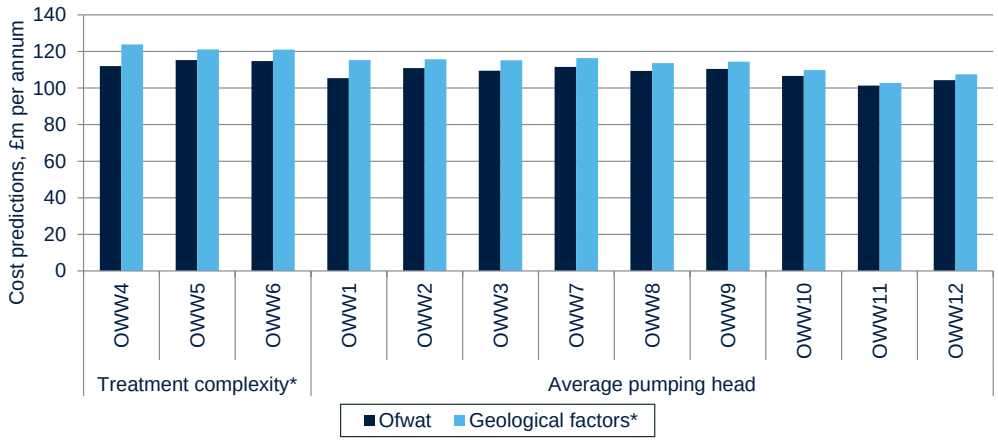
[26] South East Water, 'Cost Adjustment – Early Submission. South East Water justification', May 2018.
[27] The number of treatment plants, number of treatment plants per connected property and number of treatment plants over DI all estimated highly insignificant and often counterintuitive coefficients. Given the correlation and conceptual link between the number of sources and the number of treatment plants, we have used sources over DI to provide a suitable proxy.

Applying an upper-quartile correction and a net frontier shift of 0.57% p.a., the estimated value of the claim over an AMP would be approximately **£20m**. This corresponds to approximately 4% of modelled BOTEX and 2% of projected business plan TOTEX.

2.4 Wholesale water

Results from wholesale water models can provide an alternative estimate for the claim value for network plus and act as a cross-check to the individual claims. The figure below shows SEW's estimated cost prediction when treatment complexity and the number of sources (over DI) are controlled for in Ofwat's models.

Figure 2.4 SEW's cost predictions controlling for the number of sources and treatment complexity—wholesale water models



Note: * In models that already explicitly control for treatment complexity, the only addition to Ofwat's original models was to append a sources over DI variable. In models that did not control for treatment complexity explicitly, both treatment complexity and sources over DI were appended. All costs are in 2016/17.

Source: Oxera.

The estimated coefficients from the amended models are all of the expected sign (positive) and are usually statistically significant, with the main exception being models OWW10–12, where the coefficients on both drivers are insignificant.

Using the same approach as in section 3.3.4, by focusing on models that originally did not control for treatment complexity, we estimate the total value of the claim to be approximately £4.7m per annum in wholesale water. As modelled network plus costs are approximately 91% of modelled wholesale water costs for SEW, this equates to an imputed network plus claim value of approximately £19m over an AMP based on an upper-quartile adjustment and a net frontier shift of 0.4%.[28] This compares to an estimate from network plus models of £20m over an AMP.

[28] Imputed value is similar using SEW's as well as the industry average share of network plus in BOTEX.

These results provide an alternative estimate that is broadly in line with the results from Network plus-level analysis. The exact value from the analysis is contingent on how Ofwat chooses to impute network plus baseline costs from wholesale water models.

2.5 Conclusion

The results presented in this note quantifies the impact of operational evidence on the geological factors provided in the accompanying SEW justification paper, which are restated below for ease of reference.[29]

- SEW has an area rich in geology that suits water provision via a number of low yielding yet complex ground water sources.
- Geology characteristics provide a natural barrier that cannot be easily overcome via management control. SEW operate within a water stressed area and the reliance upon low yield sites remain a key source of supply within SEW's WRMP.

The table below provides a summary of the approaches used to quantify the impact of sources and treatment complexity on SEW's cost predictions in the different segments of the value chain.

[29] Reader is referred to the South East Water, 'Cost Adjustment – Early Submission. South East Water justification', May 2018, for more details.

Table 2.1 Summary of approaches used to quantify cost adjustments

Price control	Cost driver	Method	Monetary value (£m over an AMP)
Water resources	Number of sources	Comparison between Ofwat's water resources plus models not controlling for number of sources or treatment complexity (OWRP 4, 6, 8) with identical models including number of sources/DI per source.	£2.7m
Network plus	Combined effect of treatment works and granular treatment complexity	Comparison between Ofwat's network plus models not controlling for treatment complexity and number of sources (ONPW1, 2, 5, 7) and equivalent models including both treatment complexity and number of sources.	£20.4m
Wholesale water	Combined effect of sources, treatment works, and granular treatment complexity	Comparison between Ofwat's wholesale water models not controlling for treatment complexity and number of sources (all except OWW4, 5, 6) and equivalent models including both treatment complexity and number of sources.	£19m imputed on network plus

Source: Oxera.

Annex B Cost adjustment claim summary form – network plus

Cost adjustment claim summary form

Name of claim	South East Water Ltd's geological factors - diseconomies in treatment plants and abnormal groundwater complexity	
Name and identifier of related claim submitted in May 2018	A2	
Business plan table lines where the Totex value of this claim is reported.	Given our cost adjustment is relevant to our base expenditure the impact is felt across numerous lines in WS1, including: line1 power; line4 bulk supply; line7 other operating expenditure; line12 maintaining the long-term capability of assets infrastructure; and line13 maintaining the long-term capability of assets non-infrastructure.	
Total value of claim for AMP7	£20.5m	
Total opex of claim for AMP7	N/A	
Total capex of claim for AMP7	N/A	
Depreciation on capex in AMP7 (retail controls only)	N/A	
Remaining capex required after AMP7 to complete construction	N/A	
Whole life totex of claim	N/A	
Do you consider that part of the claim should be covered by our cost baselines? If yes, please provide an estimate	Yes - £20.5m If 'diseconomies in treatment plants and abnormal groundwater complexity' were to be suitably accounted for in Ofwat's models, such cost adjustment would not apply.	
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls.	4% (of network plus modelled BOTEX) 2% (of network plus projected business plan TOTEX – including uncontrollable costs)	
Does the claim feature as a Direct Procurement for Customers (DPC) scheme? (please tick)	Yes	No
		✓

	Brief summary of evidence to support claim against relevant test	List of accompanying evidence, including document references, page or section numbers
Need for investment/ expenditure		
Need for the adjustment (if relevant)	SEW has a high dependence on ground water and multiple treatment sites. The geology constraints regarding SEW's boreholes also require complex treatment.	See section 1 of Oxera's accompanying note (Annex A) and section 3.1 of this appendix.
Outside management control (if relevant)	SEW considers geology constraints to be beyond their management control. Lack of alternative water sources prevent SEW from avoiding the necessary complex water treatment requirements. SEW believes the efficient position of SEW estimated by models that include geology is a reflection that SEW is actively controlling the costs to an efficient outcome.	See section 3.2
Best option for customers (if relevant)		
Robustness and efficiency of claim's costs	The analysis presented in Oxera note estimates the cost impact for SEW relative to an upper quartile benchmark. It also overlays to such estimates a net frontier-shift of 0.5%	See section 2 of Oxera's accompanying Annex A and section 3 of Oxera's report on SEW's wholesale BOTEX assessment (efficiency appendix).
Customer protection (if relevant)		
Affordability (if relevant)		
Board assurance (if relevant)	Relying on comprehensive governance framework and stringent quality assurance, the Board of South East Water states that it has ownership of the overall strategy and direction in the long term and that it has satisfied itself that this business plan is of high quality, innovative, deliverable and will enhance operational, financial and corporate resilience over the next control period and the long term	Appendix 20 PR19 Governance and assurance

Annex C Cost adjustment claim summary form –water resources

Cost adjustment claim summary form

Name of claim	South East Water Ltd's geological factors - diseconomies in sources	
Name and identifier of related claim submitted in May 2018	A1	
Business plan table lines where the totex value of this claim is reported.	Given our cost adjustment is relevant to our base expenditure the impact is felt across numerous lines in WS1, including: line1 power; line4 bulk supply; line7 other operating expenditure; line12 maintaining the long-term capability of assets infrastructure; and line13 maintaining the long-term capability of assets non-infrastructure. The adjustment will also affect table Wr2, affecting: line1 power; and line4 other direct.	
Total value of claim for AMP7	£2.7m	
Total opex of claim for AMP7	N/A	
Total capex of claim for AMP7	N/A	
Depreciation on capex in AMP7 (retail controls only)	N/A	
Remaining capex required after AMP7 to complete construction	N/A	
Whole life totex of claim	N/A	
Do you consider that part of the claim should be covered by our cost baselines? If yes, please provide an estimate	Yes - £2.7m. If 'diseconomies of sources' is suitably accounted for in Ofwat's models, such cost adjustment would not apply.	
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls.	6 % (of water resources modelled BOTEX) 2% (of water resources projected business plan TOTEX – including uncontrollable costs)	
Does the claim feature as a Direct Procurement for Customers (DPC) scheme? (please tick)	Yes	No
		✓

	Brief summary of evidence to support claim against relevant test	List of accompanying evidence, including document references, page or section numbers.
Need for investment/ expenditure		
Need for the adjustment (if relevant)	SEW has a high dependence on ground water and multiple treatment sites. SEW note that the geological constraints regarding boreholes also require complex treatment.	See section 1 of Oxera's accompanying Annex and section 3.1 of this appendix.
Outside management control (if relevant)	SEW considers geology constraints to be beyond their management control. Lack of alternative water sources prevent SEW from avoiding the necessary complex water treatment requirements. SEW believes the efficient position of SEW estimated by models that include geology is a reflection that SEW is actively controlling the costs to an efficient outcome.	See section 3.2 of this appendix.
Best option for customers (if relevant)		
Robustness and efficiency of claim's costs	The analysis presented in Oxera supporting evidence (Annex A) estimates the cost impact for SEW relative to an upper quartile benchmark. It also overlays to such estimates a net frontier-shift of 0.3%	See section 2 of Oxera's accompanying Annex A and section 3 of Oxera's report on SEW's wholesale BOTEX assessment (see Appendix 13).
Customer protection (if relevant)		
Affordability (if relevant)		
Board assurance (if relevant)	Relying on comprehensive governance framework and stringent quality assurance, the Board of South East Water states that it has ownership of the overall strategy and direction in the long term and that it has satisfied itself that this business plan is of high quality, innovative, deliverable and will enhance operational, financial and corporate resilience over the next control period and the long term	Appendix 20 PR19 Governance and assurance

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