PR24

UUW response - Consultation on econometric base cost models for PR24

April 2023

United Utilities

Water for the North West

Executive Summary

UUW welcomes the opportunity to respond to Ofwat's consultation on econometric base costs models for PR24. We support Ofwat's colloberative approach to base cost assessment and consider that its proposed model suite is generally well-aligned with engineering, operational and economic rationale. In particular, we strongly support the following elements of Ofwat's proposals:

- We consider that Ofwat's Weighted Average Treatment Works Size (WATS) variable is a compelling way to reflect economies of scale at wastewater treatment works. Our analysis suggests that it appropriately reflects the non-linearity in economies of scale that economic theory predicts. Furthermore, unlike the alternative measures of economies of scale, it does not require the imposition of arbitrary 'threshold' assumptions prior to model estimation. As a result, we would strongly support the exclusive use of this variable to reflect economies of scale at wastewater treatment works.
- We strongly support the collection of additional information on reservoirs. Reservoir dam maintenance is a material cost driver in water resources and can be expected to increase in future, given the increased stringency of the inspection regime following the incident at Toddbrook Reservoir in 2019. We intend to submit a cost adjustment claim (CAC) relating to reservoir maintenance, but we note that elements of this CAC could be avoided through appropriately specified models. In the event that the model suite did not include a reservoir-related cost driver the data collection exercise would support out of model adjustments for companies with large reservoir fleets.
- We welcome the recognition given to urban rainfall as a cost driver within the wastewater service. While we are clear that higher levels of urban rainfall has a significant impact on performance (particularly sewer flooding and overflows spill frequency) and costs, we consider that it would be far more appropriate to reflect urban rainfall within company-specific Performance Commitment Levels (PCL). The scale and nature of the intervention needed to enable UUW to hit Ofwat's PR19 upper quartile target for internal sewer flooding and Ofwat's proposed common target for storm overflows would represent a material increase on past activity - both base and enhancement investment (upstream to alleviate flooding incidents, and downstream investment to reduce spill frequency), and at a materially (hitherto unobserved) higher level than many other companies. In our view, it is more economic to reflect urban rainfall and combined sewers within company-specific PCLs for relevant Performance Commitments. In any case, it is unrealistic to expect that trends in past expenditure will appropriately identify the differences in base costs required to achieve common drainage-related performance targets, as equivalent service levels have not historically being achieved. It is also inappropriate to characterise such common targets as reflective of common performance – common performance implies a common level of effort and effectiveness, but this will lead to different service levels between companies operating in regions with more or less challenging environments. We consider that the most economic way to reflect an adverse operating environment when the cost of meeting equivalent service levels may be prohibitive is to apply a company specific PCL.
- We support the assumption of a linear relationship between sewage collection costs and population density. The nature of the water and wastewater networks are fundamentally different, in that wastewater networks are much more passive. In addition, it is common for properties in rural areas to have a septic tank rather than be connected to the sewage network. In contrast, almost all properties in rural areas are connected to the water network.
- While we have significant concerns with the use of Average Pumping Head (APH) at PR24 (as set out below), we support the notion that APH (when data is of good quality) should be triangulated across a diverse model suite that also contains booster pumping stations. Our analysis has revealed that APH is a poor predictor of maintenance requirements so we strongly support the use of an asset-based topography cost driver. However, as we state below we do not consider that APH data is currently of good enough quality to use at PR24.
- We welcome Ofwat's recognition that the AMP7 WINEP programme will lead to materially higher ongoing operating expenditure, which will not be appropriately reflected in historical expenditure data by time of the

PR24 Final Determinations. We intend to submit a cost adjustment claim relating to higher ongoing opex resulting from our AMP7 WINEP programme.

- We consider that Ofwat's residential retail model suite is appropriately reflecting retail costs. We strongly support the continued reflection of bill size, deprivation and dual service as cost drivers.The use of dummy variables is a pragmatic way to reflect the impact of Covid-19. We agree that it is right not to consider transiency as a cost driver – in our view, any observed impact of transiency on costs can be largely attributed to deprivation. Finally, we agree that it is appropriate to drop the percentage of metered customers as a cost driver - AMP7 and AMP8 will see a substantial proportion of customers receive a smart meter, which is a significantly cheaper meter reading technology and beneficial for water efficiency and affordability. Therefore, we consider that meter reading costs in the future will be materially different to the past and the continued reflection of meter reading in the retail benchmark might provide perverse incentives to delay the installation of smart meters.
- We agree that Ofwat is correct not to adopt Southern Water's coastal population variable. Past analysis has indicated that proximity to the coast is not a material driver of costs at a company level. Additionally, the variable derived by Sothern produces perverse results e.g. it appears to benefit companies with no coastline.

However, there are elements of the proposals where we consider there to be some scope for refinement:

- We strongly disagree with the use of average pumping head data at PR24. Our analysis indicates that this data continues to be inconsistent across the industry, with some companies appearing to report erroneously high values. While Ofwat has updated reporting guidance, we have not seen any industry progress against the recommendations made by Turner & Townsend and the Water Research Council e.g. the development and adoption of best practice guidelines. We have strong concerns that the data quality issues noted by Ofwat and the CMA remain in the dataset and we would urge Ofwat not to take comfort from the apparent statistical significance of pumping head as an explanatory variable – a spurious relationship can still appear statistically significant. Indeed, UUW analysis suggests that APH allocates a disproportionate level of cost around the industry – this may be due to a correlation with scale. Prior to the use of pumping head within cost assessment, we consider that Ofwat should assess the consistency of the underlying data across the industry. We note that it carried out a similar exercise prior to the use of booster pumping stations at PR19.
- We are concerned that an overly parsimonious modelling approach to Bioresoruces may not facilitate an efficient transition to a more challenging regulatory environment, without additional out-of-model adjustments. Bioresouces is under increasing pressure from environmental regulations applied directly (e.g. through the new Environmental Permitting Regime) and indirectly (e.g. because increasingly stringent Phosphorous consents within wastewater treatment are leading to an increase in sludge volumes with a larger proportion of this additional sludge being of poorer quality). We consider that ongoing costs in Bioresources will be materially higher than in the past. Therefore, we would promote the use of out-of-model adjustments to reflect efficient incremental expenditure needed within Bioresources to comply with more stringent environmental regulations. We will also be proposing an uncertainty mechanism to address the increased ongoing uncertainty faced by the Bioresources sector.

Contents

3. Water

3.1 Do you agree with our proposed set of wholesale water base cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
		☑		

3.1.1 We assess Ofwat's proposed models using the framework provided by our principles of regulatory cost assessment, which we published in a paper submitted to the Future Ideas Lab (FIL)[1]. We consider that close alignment to these principles will produce an appropriate outcome for companies and their customers[2]. In our FIL paper, we presented six principles. However, we focus upon four of these in this assessment because the excluded two are less relevant to cost modelling and more concerned with the wider cost assessment framework.

Define the services provided

3.1.2 Accurate understanding of the services provided by a company through its value chain enables the search for, and choice of, appropriate cost drivers and associated explanatory variables.

3.1.3 We consider Ofwat's model suite to be generally well aligned with the way in which services are delivered across the water value chain. In particular, the use of a 'water resources plus' cost aggregation recognises the substitution effects that exist between water resources and water treatment value chain i.e. engineering rationale suggests that companies with lower costs in water resources (due to gravity-fed water sources for example) will have higher treatment costs (as surface water sources require additional, more complex treatment).

3.1.4 However, while Ofwat recognises the effect of gravity fed water sources on pumping requirements through the use of APH, it has not chosen to reflect the flipside of the coin in the model suite – reservoir dam maintenance. While impounding reservoirs are associated with less power consumption (which Ofwat is seeking to ensure is reflected in the treated water distribution models via APH), they are also associated with higher maintenance costs (which is not adequately represented in the water resources models). This approach penalises companies with significant proportion of surface water sources. Legislation (e.g. Reservoirs Act 1975) requires reservoir dams be kept to a minimum standard to mitigate risk of failure to the downstream population. Reservoir dam maintenance is therefore a material cost driver in water resources and the failure at Toddbrook reservoir (owned by the Canal and River Trust) has led to an increase in statutory actions resulting from inspections and therefore is increasing maintenance requirements. We note that Ofwat's proposal to collect additional information on reservoirs will provide useful information that could be used to reflect these cost pressures in cost assessment. We strongly support this proposal.

Prioritise engineering, operational and economic rationale

3.1.5 We consider Ofwat's proposed cost drivers and associated explanatory variables to be generally well aligned with engineering, operational and economic rationale, although we do not support the exclusion of an explanatory able to capture reservoir maintenance requirements.

3.1.6 However, we consider there would be benefit in exploring alternative treatment complexity variables. The current variables used by Ofwat (% water treated in complexity levels 3-6 and weighted average

[1] UUW (2021) *The principles of regulatory cost assessment.* Available here.

[2] We note that Ofwat has published its own principles for cost assessment, which we are broadly supportive of. We have assessed against UUW's principles given the large degree of overlap between the two.

complexity) do not distinguish between surface water and groundwater sources. Surface water sources require more complex treatment as the water is subject to more environmental contamination. Linked to this, the quality of surface water is much more variable relative to groundwater, which increases operational treatment complexity. For example, UUW's traditional operational response has been to shut down a WTW if raw water quality is poor, and use our integrated network to provide compensating flows from an alternative WTW. However, going forward, the updated definition of the unplanned outages Performance Commitment means that this operational strategy is no longer viable. Therefore, we would strongly support a treatment complexity variable that appropriately reflects the additional challenges posed by surface water. We intend to give this further thought in the near future.

Protect the benchmark's independence

3.1.7 A key principle for independence of the econometric assessment is that the explanatory variables used should be independent of near-term company influence. This ensures that the benchmark set is independent of short term management action. Companies will then be exposed to the same 'price-taking' incentive faced by firms in competitive markets. This provides strong incentives for companies to become more efficient, which will benefit all customers.

3.1.8 We consider that the proposed set of cost drivers meet this test; they are largely exogenous i.e. outside of management control. That said, we have two areas where we wish to make representations in this regard. We have some comments relating to the best approach to using a population density measure (properties per km of main). These are set out in section 3.3. We also have much more significant concerns with the use of average pumping head (APH) at PR24. These are described in section 3.2.

3.1.9 We do not believe there is sufficient confidence in the robustness of APH data to justify its use. The Turner & Townsend and WRc study[3] highlighted inconsistencies in calculation and estimation methods across companies and made several recommendations for improvement. However, we are not aware of any significant progress being made against these recommendations. As we discuss in our response to question 3.2, we are still observing material inconsistencies across the industry. We also note that a statistically significant coefficient is **not** evidence of data quality. Data quality should be assessed and evidenced **prior** to model estimation to avoid a spurious correlation. Finally, APH is a calculated figure, and absent a common methodology, it is somewhat under company control. This means companies are able to influence the benchmark in the short-term.

3.1.10 As a result, we do not support the use of APH in cost assessment at PR24. We consider that APH should be only considered for use in cost assessment after the sector has:

(i) Reported on its progress against Turner & Townsend and the WRC's recommendations. This will provide confidence in the consistency of APH estimates across the sector; and

(ii) Defined and adopted a best practice approach to calculating APH.

Ensure expenditure outside of the modelled period is externally valid

3.1.11 Ofwat's model suite draws upon historical data to derive a forward looking expenditure allowance. This creates a risk that if the modelling process is overly concerned with model fit, it is prioritising the ability of the models to predict historic expenditure rather than future expenditure. We consider it crucial that the models reflect future cost pressures, where possible.

3.1.12 We consider that Ofwat's water models are generally capable of reflecting cost pressures in AMP8. We note that Ofwat's updated definition of the unplanned outages Performance Commitment[4] will drive additional costs for UUW in AMP8. This is because it will penalise UUW's strategy for dealing with variable raw water quality; where poor quality water enters a WTW, we shut the WTW down and use our integrated network to compensate flow in the affected area. Given that Ofwat's updated definition

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[3] Turner & Townsend and the Water Research Council (2022) *Average Pumping Head: data quality improvement*. Available here.

[4] Ofwat (2022) *Final methodology: appendix 7*. Available here.

for the unplanned outage PC means that this no longer appears to be a viable operational solution, UUW will incur additional costs to transition to a new operating model. As we stated above, Ofwat's treatment complexity variable does not distinguish between surface and groundwater, meaning the resulting benchmark will not appropriately reflect the challenges faced in treating these different types of sources.

3.2 Do you agree with the inclusion of average pumping head in a subset of treated water distribution and wholesale water models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
☑				

3.2.1 We agree that a measure that reflects the pumping effort is a valid driver of cost of water company networks. In principle, APH would appear to be an intuitive way to reflect one aspect of costs related to topographical challenges in a companies' region – the extent to which companies need to lift water to deliver it to their customers. However, APH is a calculated value and, as such, is susceptible to differences in calculation methodology between companies (and hence is partially endogenous). In the case where we were confident in the quality and consistency of reported APH data, we could be more supportive of its inclusion within a subset of the water models. However, we are not confident in the quality and consistency of APH data and so we do not support the use of APH at PR24. We consider that the continued use of booster pumping stations would be more reliable and less at risk from methodological reporting differences.

3.2.2 Ofwat and the CMA both lacked confidence in the robustness and consistency of APH data at PR19. Ofwat stated:

"We tested alternative explanatory variables to capture differences in network complexity and energy requirements (such as average pumping head and pumping capacity) but we did not find a more robust cost driver"[5]

And:

"The *low quality of average pumping head data was noted also when we quality assured the data and identified large unexplained annual variations for some companies"*[6].

The CMA said:

"…We had concerns regarding the quality of the APH data" [7]

And:

"…We decide that APH should not be included as an explanatory variable in the econometric models"[8].

3.2.3 Following PR19, Ofwat commissioned Turner & Townsend and the WRC to carry out an industry-wide survey into APH and the way in which different companies approach its estimation. The study found significant inconsistencies between the ways in which APH is reported across the industry, including:

- Significant variation between companies in the proportion of measured and estimated data in TWD for both volume and lift;

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[5] Ofwat (2019) *Draft determinations – securing cost efficiency technical appendix.* Available here.

[6] Ofwat (2020) *Response to common issues in companies' statement of case*. Available here.

[7] CMA (2021) *Final report*. Available here.

[8] ibid

- Approaches that used static estimates that had not been updated for a number of years in APH calculations;
- Some companies failing to exclude/include relevant items in the calculation of APH, which could either under or overstate APH;
- Different approaches taken to the allocation of APH across the upstream business units; and
- Different approaches taken to estimating APH data.

3.2.4 These issues (along with others noted in the study) suggest that APH is manifestly unsuited for use in cost assessment until Ofwat and the industry can be confident in its robustness and consistency.

3.2.5 The Report made some recommendations on how the industry should address the issue of poor quality APH data, for example:

- Move towards more measurement of APH's components;
- Ofwat should issue updated guidance to reduce the risk of inconsistent calculation across the industry; and
- Set up a collaborative forum to share ideas and best-practice.

3.2.6 We note that Ofwat has issued updated guidance for the industry for 2021-22 and 2022-23 reporting years, which should help to mitigate an element of the inconsistency in the calculation of APH going forward.

3.2.7 However, we are not aware of any material progress being made against any other recommendations. We attended one cross-industry working group hosted by South Staffordshire and Cambridge Water on 29 November 2022. Our observation of this session was that a wide variety of approaches are still used across the industry and the session did not establish any best practice guidance. To our knowledge there have been no subsequent meetings to promote or track progress made in APH calculation across the industry.

3.2.8 Given Ofwat's requirement for there to be a compelling reason to make changes to its PR19 model suite and its principle that data should be of good quality[9], we consider it is imperative for an in-depth appraisal of APH data to be carried out before APH could be considered for inclusion in cost assessment. This would track progress made against the Turner & Townsend and WRC recommendations and give confidence that the resulting benchmark is representative of regional operating conditions and not individual companies' APH methodology. However, we have not yet seen such an assessment.

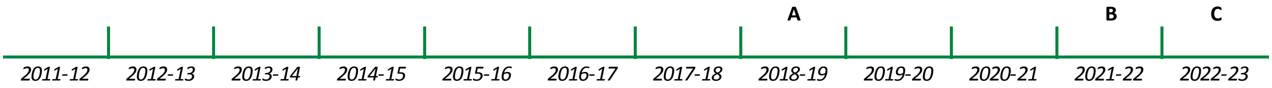
3.2.9 Even as APH data is improved going forward, inconsistent data will remain in the historical dataset. This was noted in the study:

"If companies move to using more measured data instead of estimating it is unlikely they will be able to accurately back-cast the measured data. The relationship between measured and estimated data may not be consistent over time."

3.2.10 While the detrimental effect of inconsistencies may reduce over time assuming future years' data is consistent, for PR24 we consider the relative weight of consistent versus inconsistent in the historical dataset will lean towards inconsistent data. This is illustrated in Figure 1, which shows the data judged to be unsuitable for use by Ofwat and the CMA at PR19 still comprises the majority of the years used in the consultation model suite. It also shows that any improvements made to APH calculation will only just start to feed into cost assessment through years 2021-22 and 2022-23 (and we note that many consistency issues will likely be present within these years, as we discuss in paragraph 3.2.11).

[9] Ofwat (2022) *Final Methodology. Appendix 9: Setting expenditure allowances*. Available here.

Figure 1 - Timeline of work relating to improving APH data



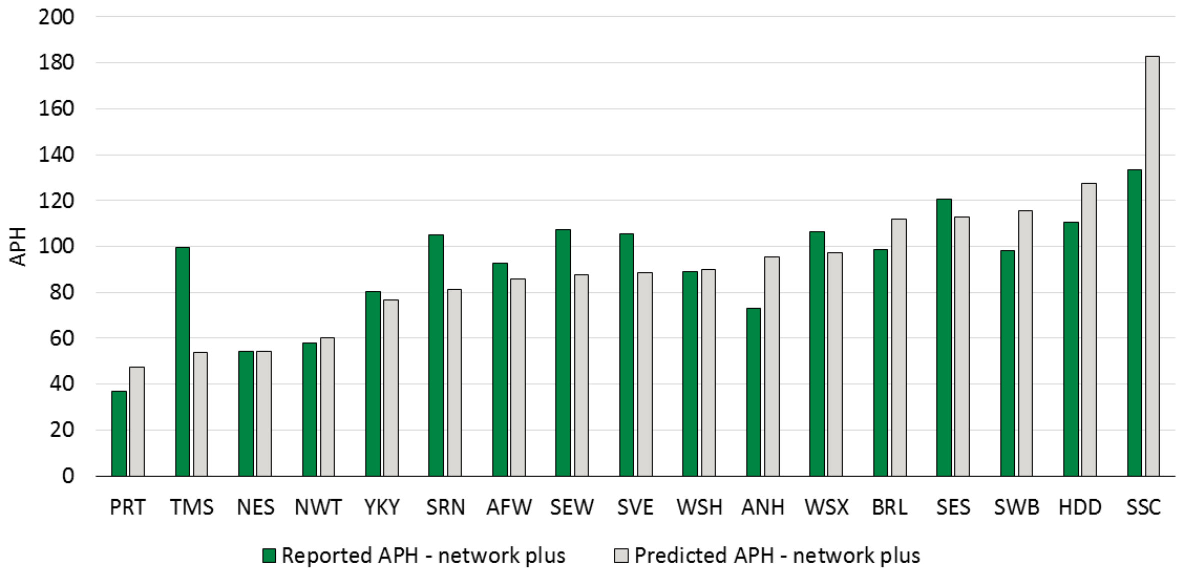
A: Ofwat and the CMA do not use APH in cost assessment due to concerns about data quality.

B: Ofwat appoints Turner & Townsend and the WRC to investigate data quality surrounding APH.

C: The Report is published.

3.2.11 Despite updated guidance from Ofwat, we have identified cases in the 2021-22 APR data where APH appears to be materially overstated, through comparison to an equivalent and independently verifiable proxy (energy consumption divided by distribution input, see Appendix A for derivation and proof). Figure 2 illustrates reported and 'predicted' APH[10] using 2021-22 APR data. It is clear that while the majority of companies' predicted APH is in line with reported APH, a number of companies report APH that is substantially higher. This type of unexplained inconsistency is a key reason why UUW is so concerned at the use of APH in cost assessment at PR24.

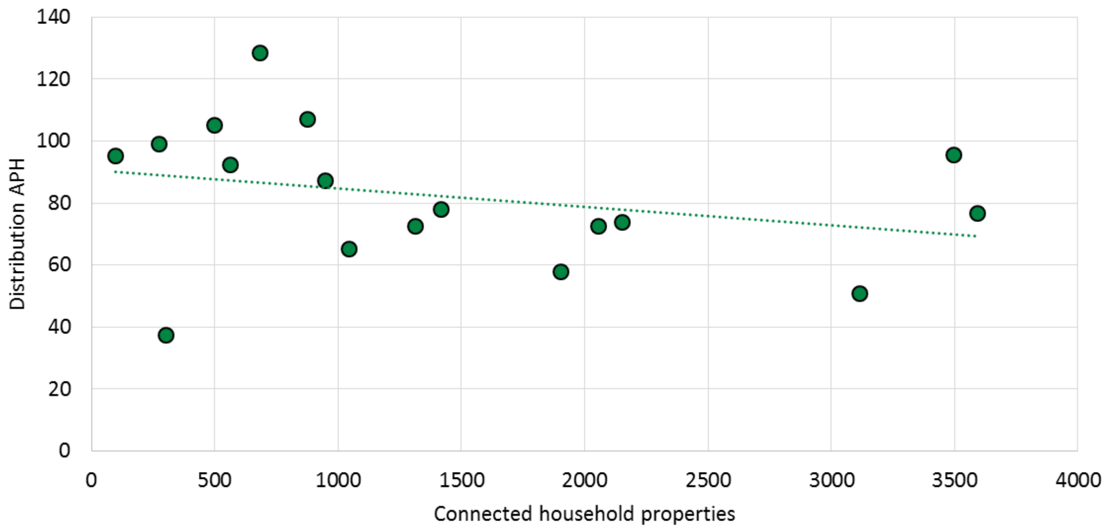
Figure 2 - There are material inconsistencies between reported and predicted average pumping head in 2021-22 data



3.2.12 While the coefficient on APH is statistically significant across all of Ofwat's models, this does not justify its use. If the underlying data is inconsistent, then any resulting benchmark will be inappropriate, even despite the associated coefficients being statistically significant. It is entirely possible for inconsistent data to produce a statistically significant but spurious relationship, for example through a correlation with another explanatory variable. Indeed, as Figure 3 illustrates, we have noticed a slight negative correlation between APH and company scale. We also note that we have observed APH to allocate disproportionate levels of cost around the industry - this relationship with company scale may explain why.

[10] Estimated using the proxy variable.

Figure 3 - There is a slight negative correlation between APH and company scale



3.2.13 We do not consider it is best practice to rely on a coefficient's statistical significance when assessing data quality. The robustness of the underlying data (and the engineering rationale underlying the cost driver) should be confirmed **before** any variable is tested within a statistical model. Otherwise, there is a risk of relying on a spurious relationship within cost assessment.

3.2.14 Therefore, we do not consider that Ofwat should judge the robustness of APH using statistical significance alone without a thorough examination of the underlying consistency of the data. For example, at PR19, Ofwat checked the consistency of booster pump data by issuing a query to companies prior to its use in cost assessment:

"In May 2019 we issued a clarification to the definition of booster pumping stations and asked companies to resubmit the data"[11].

We consider that Ofwat should conduct similar consistency checks on APH data prior to its use at PR24.

3.2.15 As a result, we do not support the use of APH in cost assessment at PR24. We consider that APH should be only considered for use in cost assessment after the sector has:

(i) Reported on its progress against Turner & Townsend and the WRC's recommendations. This will provide confidence in the consistency of APH estimates across the sector; and

(ii) Defined and adopted a best practice approach to calculating APH.

We consider that Ofwat should continue to use booster pumping stations at PR24.

UUW agrees that (consistent) APH should be triangulated with alternative topography variables

3.2.16 While we are concerned about the robustness of APH data at this moment in time, we do agree with the principle of triangulating models including (consistent) APH data with models including booster pumping stations per km of main. As we have previously promoted[12], cost assessment should triangulate across a diverse set of models to ensure the benchmark reflects a variety of relationships between cost and cost driver.

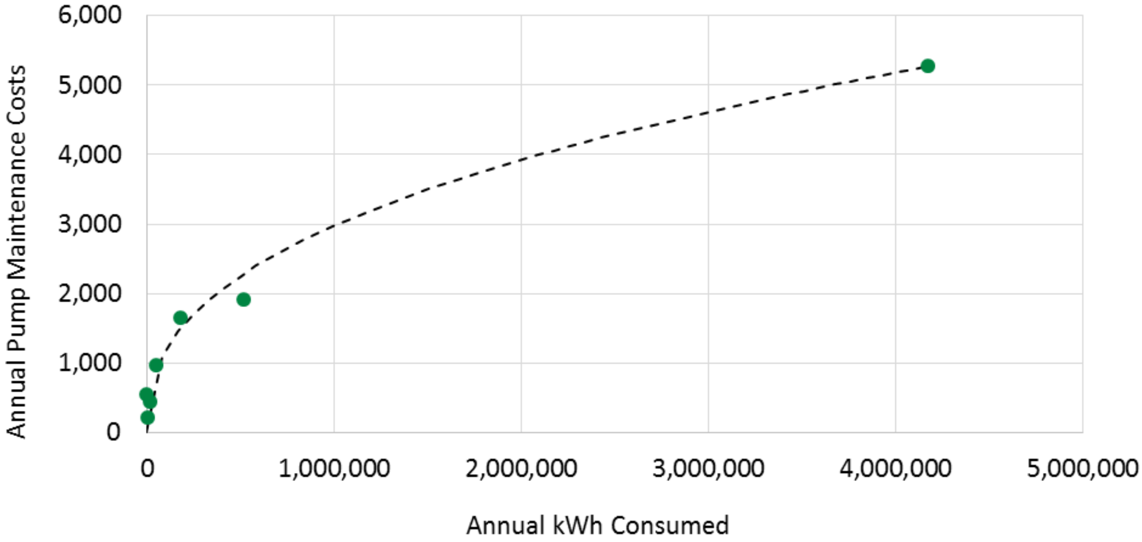
3.2.17 The use of booster pumps per km of main will ensure that cost assessment reflects a different aspect of costs relating to topography – asset maintenance, which typically represents a much larger proportion of botex than power. Our internal data demonstrates that APH is a poor predictor of maintenance requirements. Figure 4 shows that small pumps have maintenance requirements that are

[11] Ofwat (2019) D*raft determinations: Securing cost efficiency technical appendix*. Available here.

[12] UUW (2022) *What lessons can we learn from cost assessment at PR19?* Available here.

disproportionate to their contribution to overall pumping, which results in a non-linear relationship. This demonstrates that the use of pumping head without an alternative asset maintenance cost driver would fail to capture an important aspect of costs relating to topography.

Figure 4 - The relationship between maintenance costs and pumping is non-linear



3.3 Do you agree with our approach to modelling population density? Which of the three explanatory variables do you support?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
			☑	

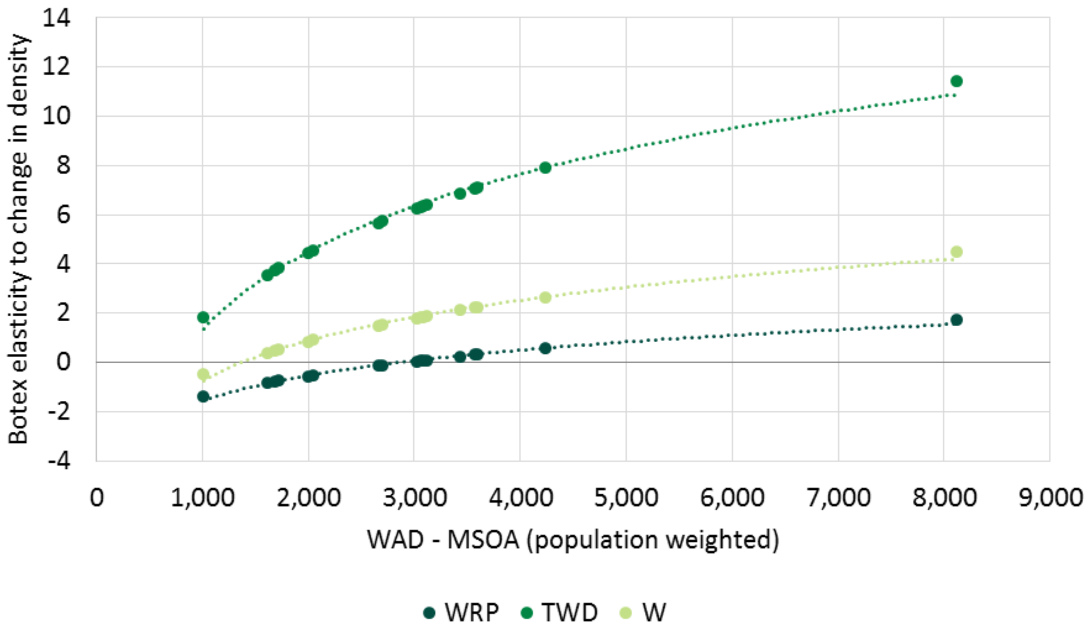
3.3.1 We agree in principle with the use of different cost drivers within a suite of appropriately triangulated models. This means that it may be appropriate to use all three approaches to modelling population density. This could ensure that different aspects of the relationship between costs and density are reflected within the benchmark and mitigate the risk that one variable is unduly beneficial or harmful to a particular company.

3.3.2 However, this principle does not mean that inappropriate variables should be used. We have tried to establish whether it would be appropriate to use all Ofwat's proposed density measures or whether a subset should be used. To do this, we have examined the elasticity[13] of each density variable with respect to modelled botex. This reveals what relationship the models are estimating between botex and density. We are then able to assess whether this relationship aligns with engineering, operational and economic priors.

3.3.3 Figure 5 presents the elasticity of modelled botex with respect to density, where density is measured using Ofwat's WAD – MSOA (weighted by population) measure. The elasticity of each cost aggregation is produced by triangulating all models within each aggregation that use that density measure. So for example, the elasticity of water resources plus (WRP) in Figure 5 has been estimated using the appropriate coefficients in models WRP1 and WRP2 in Ofwat's consultation. It's clear that 'WAD – MSOA' estimates a strong relationship between density and treated water distribution (TWD) botex. We can also see that no company has a negative elasticity for TWD density, which means the model does not estimate a u-shaped relationship between TWD cost and density for companies in the industry.

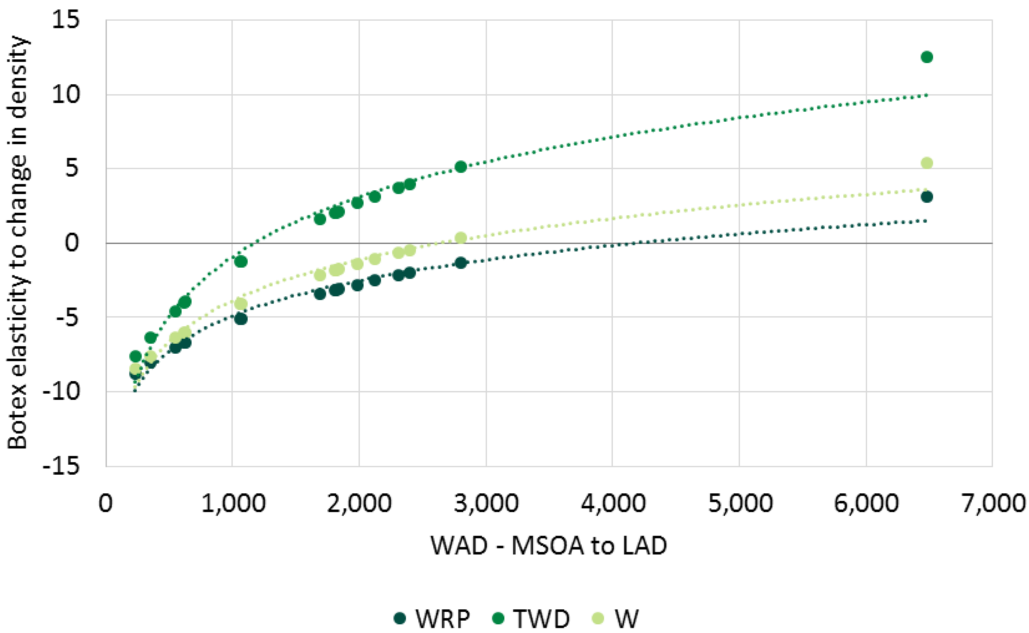
[13] Elasticity is a term used in economics to describe how one variable changes relative to another.

Figure 5 - Botex elasticity to a change in density (measured using WAD - MSOA, weighted by population)



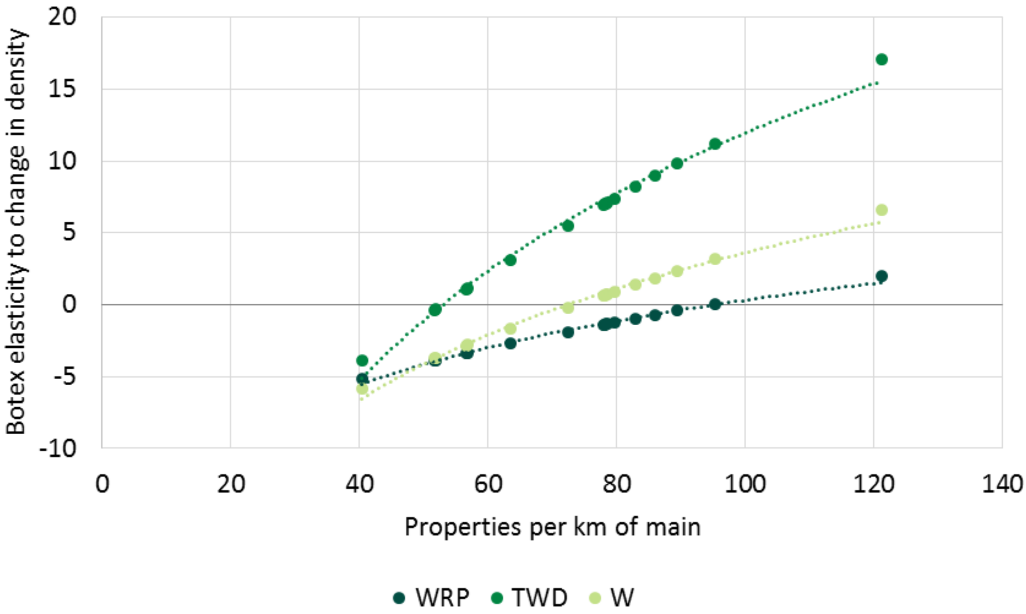
3.3.4 Figure 6 presents the elasticities for the other WAD-based density measure used by Ofwat in its consultation, WAD – MSOA from LAD. It suggests there is a slightly different relationship between density and botex. Firstly, it estimates a less powerful relationship between density and botex. Secondly, unlike Figure 5, it suggests there are some companies with a negative totex elasticity to density for TWD. Thirdly, it suggests more companies are associated with a negative totex elasticity across WRP and Water (W) cost aggregations, relative to Figure 5.

Figure 6 - Botex elasticity to a change in density (measured using WAD - MSOA to LAD)



3.3.5 Finally, Figure 7 illustrates the elasticity of botex to density as estimated using property density. Similar to Figure 6, this density measure estimates a negative elasticity in TWD for some companies.

Figure 7 - Botex elasticity to a change in density (measured using property density)



3.3.6 All three measures are statistically significant in the model suite and all three broadly align with engineering priors. It is interesting that each appears to reflect a slightly different relationship between density and botex. For example, WAD measured at the MSOA level suggests only the 'right-hand side' of the parabola is relevant for TWD costs in the industry i.e. no company is rural enough to incur higher costs in treated water distribution. The other two density measures estimate a different relationship for TWD in that they do suggest some companies sit on the 'left-hand side' of the parabola, where less density is associated with higher costs.

3.3.7 We do not consider these results to be contradictory. Instead, we see this as a compelling reason to use a wide variety of density measures within cost assessment. Each density measure is able to capture a different aspect of population density and the use of a diverse set within a triangulated model suite mitigates the risk that any one company is unduly affected by a particular driver. Therefore, in theory we would support the use of all three drivers in cost assessment.

3.3.8 That being said, the WAD measures are more compelling candidates for inclusion as they are entirely exogenous. In a FIL paper[14], we argued that exogenous factors should be used in cost assessment where possible. As Ofwat notes, property density is marginally under management control. Given the WAD variables are entirely outside of management control, it seems more appropriate to focus upon these. Additionally, as Ofwat notes, the WAD measures draw upon more granular population data so better reflect population density.

3.3.9 We would support the use of both WAD measures within different models in the model suite. As Figure 5 and Figure 6 show, each WAD variable estimates a slightly different relationship between botex and density. The use of both within the model suite could produce a more diverse and robust benchmark.

3.3.10 However, if Ofwat wanted to only focus upon one density driver, we consider the WAD (MSOA to LAD) would be the superior driver. This is because, of the two WAD measures, it aligns best to Ofwat's engineering rationale (which we endorse) of a u-shaped relationship between botex and density across elements of the water value chain, as illustrated in Figure 6.

[14] UUW (2021) *The principles of regulatory cost assessment.* Available here.

3.4 Do you agree we should collect additional data on the number of reservoirs that are designated as high-risk by the Environment Agency and Natural Resources Wales? Do you have a view on the appropriateness of capturing a variable for reservoir inspection and maintenance requirements under the Reservoir Act 1975 in the water resources plus models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

3.4.1 Yes. Reservoir maintenance is a material cost driver within water resources and we consider that it should be reflected within cost assessment.

3.4.2 Ofwat states that: *"The relative cost of different water sources is unclear. Different water sources will bring differing levels of operating and capital maintenance expenditure, and factors could balance out in the round"*. We do not consider this to be sufficient grounds to exclude a legitimate cost driver from the model suite – indeed further significant work would be needed to prove this assertion. The adoption of a 'reservoir maintenance' variable within a water resources plus model would reflect the relative cost differences between reservoir sources and groundwater sources because the coefficient would reflect the net cost effect of dam maintenance and pumping requirements, to the extent this is not already captured as a result of the 'water resources plus' modelling cost aggregation and existing variables. Indeed, we consider that the inclusion of APH within the proposed model suite provides undue benefit to companies with a large proportion of groundwater sources, but without properly recognising the additional cost of reservoir maintenance in water resources.

3.4.3 Therefore, we would strongly support the collection of additional data and would be happy to support the specification of any related request. We consider that care should be taken to ensure any resulting data would appropriately reflect maintenance costs. This is because some large service reservoirs fall under the EA's high risk designation, but these service reservoirs do not necessarily have dams. Therefore, in our view it would only be appropriate for the data request to consider service reservoirs that do have dams e.g. some of UUW's service reservoirs are old converted impounding reservoirs.

3.4.4 We also note that it will be important to ensure there aren't any inconsistencies between England and Wales. Legislation means that reservoirs of different sizes are subject to the same legislative requirements in these countries e.g. in Wales, the threshold is 10,000m^3 whereas it is 25,000m^3 in England. While the key cost driver of interest is number of dams rather than volume of water stored, we do consider that the data request must have a consistent definition of a reservoir across the two countries e.g. it should count all reservoirs greater than 10,000m^3 across *both* England and Wales or all reservoirs greater than 25,000m^3. Otherwise, it may be difficult for the models to estimate a robust relationship between dam maintenance requirements and water resources plus costs.

4. Wastewater

4.1 Do you agree with our proposed set of wastewater network plus base cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
		☑		

4.1.1 Similar to water, we have structured our response around UUW's principles of regulatory cost assessment.

Define the services provided

4.1.2 We consider that Ofwat's proposals are generally well aligned with services companies provide. For example, the recognition of urban rainfall as a cost driver reflects the fact that the wastewater service provides two services: foul sewerage and surface water drainage.

4.1.3 However, we do not agree that the efficiency of Bioresources and wastewater treatment can be assessed separately. Bioresources services are provided in different ways across the industry. In particular, some companies provide an equivalent service in a different price control e.g. sludge thickening can be carried out in either wastewater network plus or in bioresources, depending upon a company's asset configuration across the bioresources boundary line. Therefore, we consider that efficiency challenges should be applied at a wholesale wastewater level, which will prevent the benchmark company being informed by a company with a lower proportion of assets located in Bioresources.

Prioritise engineering, operational and economic rationale

4.1.4 We consider that Ofwat's proposed model suite is generally supported by engineering, operational and economic rationale:

- We strongly support the reflection of urban rainfall within the regulatory framework, as we discuss in our response to 4.5. However, we consider that the most appropriate way to reflect this pressure within the regulatory framework is through a company-specific performance target for relevant PCs.
- Ofwat's new weighted average treatment works size (WATS) measure is a compelling addition to the model suite and is superior to previous variables used to capture economies of scale in treatment, as we discuss in our response to question 4.2.
- Ofwat is correct to assume a linear relationship between costs and density in sewage collection, as we discuss in our response to question 4.4.
- While we consider that there is some evidence to suggest coastal proximity drives costs at a local level, we do not consider these costs to be material at a company level. Therefore, we support Ofwat's decision not to include Southern's proposed coastal population variable within its model suite, as we discuss in our response to question 4.7.

4.1.5 However, we consider that there are some key cost drivers missing:

- Past UUW publications to the Future Ideas Lab have demonstrated a clear theoretical and statistical link between combined sewers and performance on the wastewater network - a high prevalence of combined sewers means that urban rainfall has a much more detrimental effect on performance and costs. In this way, we consider that it is essential for the regulatory framework to reflect the combined effect of urban rainfall and combined sewers. We discuss this more in our response to question 4.5.

- We note the only treatment complexity variable relates to ammonia. Ofwat is correct to recognise meeting AMP7 phosphorus consents will lead to higher ongoing costs. We consider an out of model adjustment will be needed at PR24 because the historical dataset will not contain sufficient evidence of the expenditure needed to meet these more stringent permits in AMP8.

Protect the benchmark's independence

4.1.6 We consider Ofwat's proposals to be largely exogenous and outside of management control.

Ensure expenditure outside of the modelled period is externally valid

4.1.7 Overall, we consider that Ofwat has identified the majority of salient cost drivers in wastewater. We also support Ofwat's recognition that AMP7 WINEP schemes will lead to higher ongoing opex that would not be reflected within modelled allowances. We intend to submit a cost adjustment claim relating to this emerging cost pressure.

4.1.8 However, UUW would not consider the addition of an urban rainfall variable sufficient to move towards Ofwat's common wastewater Performance Commitment Levels. As we discuss in our response to question 4.5, the scale and nature of the activity that would be required is not reflected in the historical costs used within the model.

4.2 Do you agree with our approach to modelling economies of scale at sewage treatment works? Which of the three proposed explanatory variables do you support? A) Percentage of load treated in STWs bands 1-3 B) Percentage of load treated in STWs serving more than 100,000 people C) Weighted average sewage treatment works size

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

4.2.1 As we described in our Future Ideas Lab paper[15] and in our response above (see paragraphs 3.2.16 and 3.3.1), it is entirely legitimate to include a diverse range of cost drivers within an appropriately triangulated model suite. However, after careful examination of Ofwat's proposed explanatory variables we strongly support the sole use of weighted average treatment works size (WATS) to reflect economies of scale at wastewater treatment works.

4.2.2 This is because the alternative variables (percentage of load treated in bands 1-3 and percentage of load treated in WwTW serving more than 100,000 people) impose restrictions on the ability of the model to find an appropriate relationship between cost and cost driver. The specification of these variables assumes that diseconomies of scale begin at size band 3 and below and that economies of scale begin at treatment works serving more than 100,000. While we do not consider these to be unrealistic assumptions, they are to an extent arbitrary in that alternative thresholds could also legitimately be chosen. While the use of such 'threshold' variables is entirely legitimate in the absence of a superior alternative, we consider that the existence of WATS means that these variables should not be considered further as explanatory factors for economies of scale at wastewater treatment works.

4.2.3 We note that Ofwat considers WATS to be a measure that captures the average size of each company's WwTW, and in Appendix 3 of its consultation specifies WATS in the following way:

[15] UUW (2022) *What lessons can we learn from cost assessment at PR19?* Available here.

$$WATS = \sum_{n=1}^{6} \frac{Load_{band\ n}}{WwTW_{band\ n}} \times percentage\ of\ load\ in\ band_n$$

This can equivalently be written as:

$$WATS = \sum_{n=1}^{6} \frac{Load_n}{WwTW_n} \times \frac{Load_n}{Load}$$

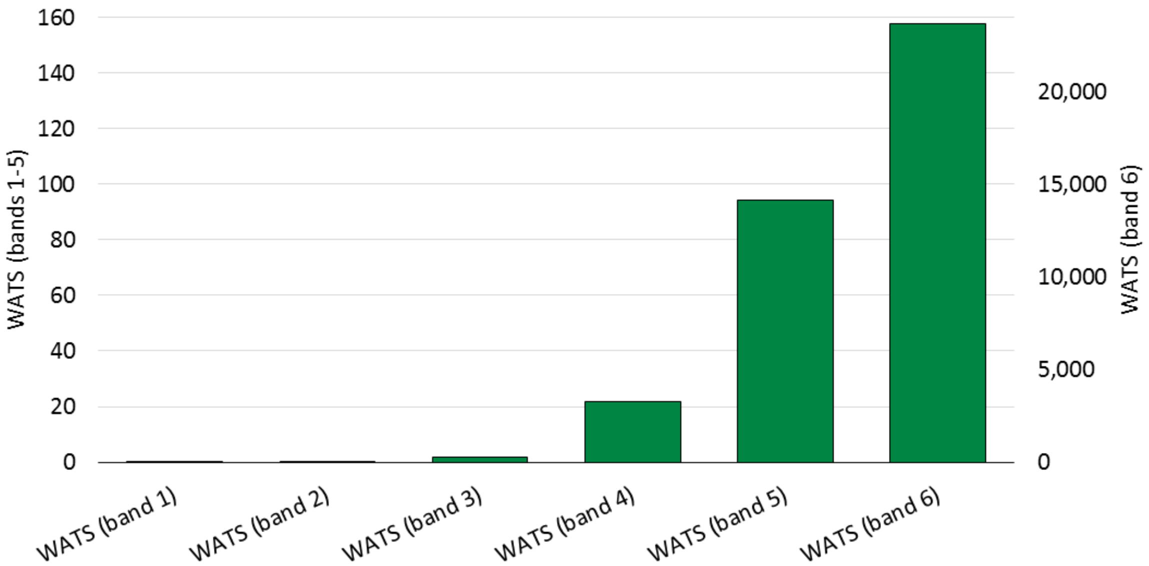
Which in turn is equivalent to:

$$WATS = \sum_{n=1}^{6} \frac{Load_n^2}{WwTW_n \times Load}$$

4.2.4 In this way WATS can be seen to capture the economies of scale at each size band (through the non-linearity expected by economic theory), weighted by the relative mix of a company's WwTW across the size bands.

4.2.5 Therefore, we consider WATS to be an intuitive and compelling way to reflect economies of scale across all wastewater treatment works size bands. It best aligns to the engineering prior that economies of scale exist at WwTW because it reflects the non-linearity that defines economies of scale. Figure 8 illustrates the industry average value of WATS at each WwTW band. It's clear that WATS reflects an exponential relationship[16], which is the relationship engineering, operational and economic rationale predicts between cost and economies of scale at wastewater treatment works.

Figure 8 - WATS appropriately reflects non-linearity in economies of scale at WwTW



4.3 Do you agree with our approach to modelling population density? Which of the three explanatory variables do you support?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
			☑	

[16] We graphed WATS at band 6 on a different axis scale to facilitate comparisons.

4.3.1 As we said in our response to question 3.3, we consider there may be value in triangulating across a diverse set of cost drivers. However, similar to our response to question 3.3, we would prefer to focus cost assessment upon WAD measures because they are entirely exogenous.

4.3.2 We strongly support Ofwat's assumption of a linear relationship between population density and sewage collection costs as we discuss in our response to question 4.4.

4.4 Do you agree with our proposal to assume a linear relationship between population density and sewage collection base costs?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

4.4.1 Yes. Engineering and operational rationale dictates that the nature of the relationship between costs and density across water and wastewater networks is very different for two reasons:

(1) Many rural areas are not connected to a wastewater network and instead use septic tanks to collect and dispose of sewage. This means network costs in such areas will be minimal. In contrast, these rural areas will still require connection to the water network.

(2) Unlike water, wastewater networks are designed to be passive (moreso than water networks) and generally use gravity to flow to wastewater treatment works. This means much less monitoring and intervention is required in rural areas - for example, because a lower population results in less blockages that require clearing. In contrast, rural water networks require intervention, to fix leaks and maintain pressure for example.

4.5 Do you agree with the inclusion of urban rainfall in our sewage collection and wastewater network plus models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

4.5.1 UUW strongly supports the recognition of urban rainfall within the regulatory framework. Our extensive work in this area[17] has revealed the detrimental impact that urban rainfall has on performance and cost. Importantly, this work highlighted that the effect of urban rainfall must be considered alongside the effect of combined sewers. This is because engineering rationale dictates that these two factors have a compounding relationship on performance and costs e.g. because high levels of rainfall will have a stronger impact in areas with a high prevalence of combined sewers because there is less headroom within the wastewater network relative to an area with a separate system.

4.5.2 In a Future Ideas Lab publication[18], we proposed a performance modelling approach that adjusted performance targets to ensure that companies operating in different regions face an equivalently stretching incentive. This approach seeks to ensure that the performance target reflected the pressures placed upon companies by exogenous factors like:

[17] UUW (2022) *What lessons can we learn from cost assessment at PR19?* Available here, Arup and Vivid Economics (2017) *Understanding the exogenous drivers of wholesale wastewater costs in England and Wales.* Available here, Arup and Vivid Economics (2018) *Use of econometric models for cost assessment at PR19.* Available here.

[18] UUW (2022) *What lessons can we learn from cost assessment at PR19?*

- urban rainfall – urban rainfall dictates the volumes of water being collected into wastewater systems. High volumes can lead to hydraulic incapacity;
- combined sewers – combined sewers tend to run closer to capacity more of the time. This means that blockages can have a more detrimental and immediate effect and that high volumes of urban rainfall can quickly lead to hydraulic incapacity, relative to a separate system; and
- food service establishment density – this impacts on the build up of fats, oils and greases, which increase the risk of sewer blockages.

4.5.3 In isoloation, each of these can have a significant impact on the risk of sewer flooding, and on costs. However, in combination, these factors can lead to a significantly increased risk of flooding.

4.5.4 In our view, adjusting the performance targets represents the most appropriate outcome for customers. The scale of investment that would be required to move UUW towards Ofwat's common PCLs would be uneconomic. This is because the nature of activity that would be needed **would not be base activity** (i.e. a change in operating model or more efficient use of existing resources) **but enhancement** (i.e. a complete overhaul/re-plumbing of the existing legacy sewer network). Although Ofwat has included 'reduce flooding risk for properties' enhancement within the scope of modelled cost, the scale of activity entailed in removing combined sewers from the North-West's sewer network would be substantially larger than anything incurred in the past, by any company.

4.5.5 This means that while the addition of an urban rainfall variable into the model will help UUW to manage existing cost pressures (e.g. the maintenance of larger assets) it will not allocate sufficient costs to manage new cost pressures (e.g. enabling UUW to move towards Ofwat's common PCLs). Indeed, UUW analysis indicates that the addition of urban rainfall into Ofwat's proposed model suite allocates an additional £35m of cost to UUW overall. This is clearly insufficient to facilitate a stepchange in asset structure and so support a move towards Ofwat's common PCLs.

4.5.6 Therefore, while we strongly support Ofwat's recognition that urban rainfall is a material factor at an industry level, we would not support the idea that reallocating historical expenditure would enable companies with adverse operating conditions to move towards common industry targets. Substantial and sustained enhancement expenditure that has not been observed in the historic cost base would be required for this, and the nature of the interventions would be highly disruptive to all customers and the local economy. As a result, we consider the most economic option is to include urban rainfall within a performance modelling approach. This would ensure that all companies receive an equivalent challenge and that customers in benign operating regions are not paying too much for the service they receive.

4.5.7 While urban rainfall is a legitimate factor to reflect within the regulatory framework, we consider that it must be considered alongside the prevalence of combined sewers, which can materially compound the detrimental effect of high levels of urban rainfall. This is why our proposed performance models[19] include an interaction term (which enables the model to reflect this compounding relationship) and our submission to the model consultation also included a model with an interaction term. We consider that there is compelling engineering rationale to support an interaction term, and we have consistently found this interaction term to have a material and statistically significant impact on costs and performance.

4.5.8 While we consider the most economic outcome would be achieved by reflecting urban rainfall within a company-specific PCL, were urban rainfall to be included within cost models, we strongly consider it should be included across all relevant specifications – we note that is is only included across half of the proposed sewage collection and wastewater network plus model suite. Urban rainfall is a valid cost driver for the wastewater business, and as such it should be included across all model specifications. Otherwise, customers living in regions of relatively low rainfall will pay more than they should for a given level of performance.

[19] ibid

4.6 Do you agree with our approach to capturing sewage treatment complexity in our proposed WwNP base cost models? What are you views on our proposed options to account for additional ongoing cost associated with P-removal? a. Models with a P-driver (eg percentage of load with a P-permit <= 0.5mg/l) fixed at the 2024/25 level. b. A post-modelling adjustment that funds efficient ongoing opex associated with P-removal using data provided by companies in APRs. c. Cost adjustment claims.

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
			☑	

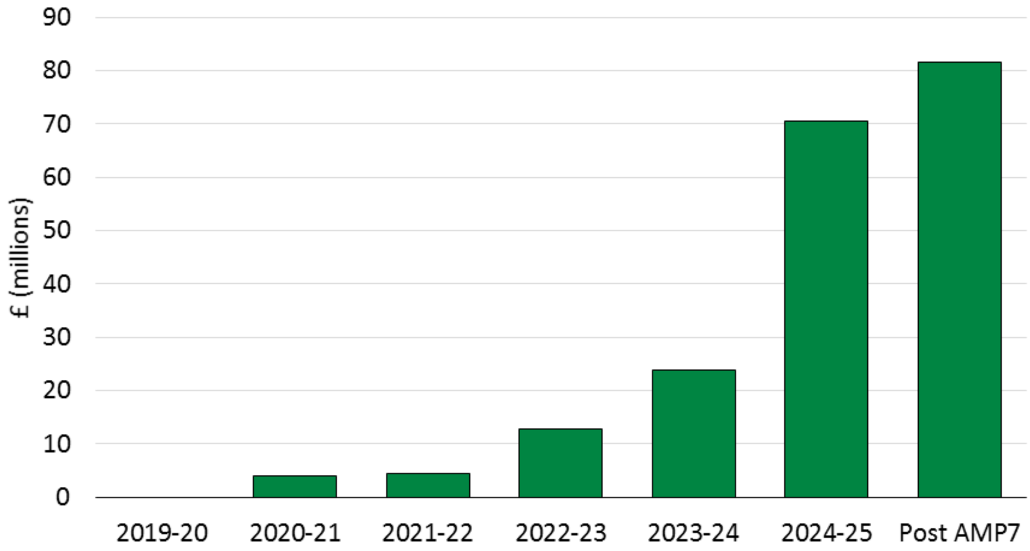
4.6.1 We agree that P-removal ongoing opex will require a specific adjustment, and we intend to submit a related cost adjustment claim.

4.6.2 In its consultation, Ofwat notes that: *"…The additional ongoing cost associated with more stringent phosphorus removal programmes across the sector may not be fully captured in our proposed base cost models"*. Our business plan development has identified that ongoing opex relating to P-removal in AMP8 will be materially largely than in previous AMPs. We support the exploration of potential ways to recognise this incremental pressure in cost assessment.

4.6.3 Whichever approach is ultimately chosen, it will be important for cost assessment to appropriately recognise the alternative ways companies can meet stringent P-removal consents. In some cases, it may be more efficient for companies to adopt a chemical solution and dose wastewater with ferric sulphate. In other cases, a biological solution would be more appropriate. These solutions are equally legitimate but have different cost profiles – chemical solutions are associated with higher opex and biological solutions are associated with higher capex. It will be important for cost assessment to ensure that companies are incentivised to adopt the most efficient long-term solution.

4.6.4 Of the three options suggested by Ofwat, we would not support an attempt to consider models with a P-driver at PR24. As Figure 9 illustrates, AMP7 P-removal schemes will complete towards the end of AMP7 meaning the associated higher opex will not be sufficiently reflected in the historical dataset. This would result in an unrealistically low benchmark. It may be more appropriate to consider this option for PR29.

Figure 9 - Ongoing P-removal opex over time (Table 7F from APR22)



4.6.5 We consider the remaining two options (use APR data to identify efficient ongoing opex and cost adjustment) to be appropriate ways to reflect P removal ongoing opex at PR24. We are currently preparing a cost adjustment claim relating to ongoing P removal opex; we note that such cost adjustment claims should not be assumed to be symmetric because higher ongoing P removal opex is not present in the historical dataset.

4.6.6 We would caution that the use of APR data published in 2021-22 and earlier may not reflect the actual solutions companies adopt. This is because a large proportion of the 7F data during this period was based upon forecasts of the appropriate solution. From 2022-23 onwards, the final form of the majority of solutions have been decided and so we consider the data will be much more representative of the actual ongoing opex companies expect to incur following AMP7.

4.6.7 We also note that Ofwat appears to have been unable to replicate the UV models proposed by UUW. Upon reestimation with Ofwat's April data release, we found a similar result to that stated by Ofwat in its consultation. The reasons for this aren't immediately clear to us but we will continue to explore the issue.

4.7 Do you agree with Southern Water's proposal to include the percentage of population living in coastal areas in sewage treatment models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	☑			

4.7.1 UUW serves a region with a long coastline and a significant coastal population and we have assets located in close proximity to the coast as a result. We do agree with Southern that proximity to the coast can drive certain costs. For example, we have noticed a tendency for sewers near to the coast to fill with sand and therefore require more regular maintenance.

4.7.2 However, our past work in this area has suggested that the difference in ongoing base costs relating to coastal proximity (e.g. saline erosion), relative to managing inland populations, tend to be not material at a company level. For example, UUW has previously examined the effect of proximity to the coast on large WwTW operating expenditure using the large works dataset. We did not find that coastal proximity was a significant cost driver[20]. In general, we have never considered the higher costs associated with coastal proximity to meet the materiality threshold for a cost adjustment claim.

4.7.3 We do note that coastal proximity can drive resilience costs, for example through the need to protect critical assets from coastal erosion. However, UUW views such expenditure as enhancement and as such we consider it is better dealt with via enhancement cost assessment.

4.7.4 We also have some concerns about the specification of Southern Water's variable. We would reasonably expect a deterioration of efficiency scores for companies with little or no coastal populations when a coastal variable is added (assuming the coefficient is of an intuitive sign)[21]. However as Table 1 shows, the movement in efficiency scores does not appear to consistently reflect Southern's underlying cost driver. For example, one company with no coastline (Thames) sees an improvement in efficiency scores.

Table 1 - Change in efficiency scores for SWT models when coastal population variable is added (negative indicates an improvement)

Company	SWT1	SWT2	SWT3	% coastal population
ANH	2%	3%	4%	10%
NES	6%	5%	1%	24%
NWT	-2%	-2%	-1%	11%
SRN	-17%	-17%	-10%	41%
SVH	6%	6%	4%	0%
SWB	-1%	-1%	1%	39%
TMS	-1%	-1%	-2%	0%
WSH	-4%	-3%	-3%	28%
WSX	5%	5%	2%	23%
YKY	8%	8%	5%	8%

4.7.5 This appears to be driven by a collinearity within the model, likely between the scale driver and the coastal population variable. As Table 2 shows, the inclusion of the coastal population variable causes the size of the scale coefficient to increase materially. This explains why Thames (a relatively large company) appears to benefit from the coastal population variable despite having no coastal population and Wessex (a relatively small company) appears to be penalised despite serving a region that has above average population density in coastal areas.

Table 2 – The inclusion of Southern's coastal population variable strengthens the coefficient on the scale driver

Cost driver	Explanatory variable	Scenario	SWT1	SWT2	SWT3
Scale	Load (log)	No coastal variable	0.653	0.723	0.788
Scale	Load (log)	With coastal variable	0.833	0.892	0.873
		Difference	28%	23%	11%

[20] We note that this analysis was restricted to UUW's own WwTWs due to the need to know which works are situated near to the coast.

[21] This would occur because a company with no coastline would be predicted to need to spend less by the model. Given that historical costs remain fixed, this would lead to a higher ratio of (actual cost:predicted cost), which is how Ofwat defines efficiency.

4.7.6 As a result, we do not support the use of the coastal population variable. Its apparent correlation with scale could be driving a spurious relationship between coastal population and overall cost. Because of this, we do not consider there to be sufficient evidence that proximity to the coast is a material cost driver at a company level, despite it likely being a legitimate cost driver at a localised level. Additionally, our analysis demonstrates that its use in cost assessment would result in material allocative inefficiency.

5. Bioresources

5.1 Do you agree with our proposed set of bioresources cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
	☑			

5.1.1 We consider that the cost drivers chosen by Ofwat are supported by engineering, operational and economic rationale, although we consider that some salient drivers of bioresources costs have been excluded. We are not confident that Ofwat's proposed approach is capable of reflecting the cost pressures bioresources will face in future. Furthermore, we note the poor performance of bioresources models, relative to other business units. In our view, this could be explained by the lack of recognition given to legitimate cost drivers and to the different asset configuration adopted across the industry.

5.1.2 We strongly consider that the continued poor performance of bioresources models means that Ofwat should ensure that the overall cost assessment framework does not mistakenly impose unachievable stretch on companies by placing inappropriate weight on the modelled results alone. Bioresources is subject to increasingly stringent environmental regulations and there is a risk that placing too much weight on a backwards-looking benchmarking exercise will result in unobtainable cost targets that are not reflective of forward-looking requirements.

Define the services provided

5.1.3 We do not consider that Ofwat's models appropriately reflect the way bioresources services are provided across the industry. In particular, some companies provide an equivalent service in a different price control e.g. sludge thickening can be carried out in either wastewater network plus or in bioresources, depending upon a company's asset configuration across the bioresources boundary line.

5.1.4 We have previously drawn attention to this issue on several occasions. However, the consultation suggests that Ofwat remains confident that its models appropriately reflect asset configuration differences, such that a bioresources-specific efficiency challenge is appropriate. We remain concerned that no evidence has been provided to support this position. We consider that bioresources models will continue to be of relatively poor quality unless an appropriate solution is found e.g. a cost driver that reflects asset configuration[22]. Absent this, poorer quality models should be compensated for via a realistic efficiency challenge i.e. one calculated at the wholesale level, which will mitigate any issues created by differences in asset configuration.

Prioritise engineering, operational and economic rationale

5.1.5 Ofwat's proposed models focus upon scale, economies of scale and sparsity. While these are legitimate cost drivers, both economies of scale and sparsity are reflected within the same explanatory variable, which may lead to estimation issues. For example, a more densely populated area will allow sludge treatment to benefit from greater economies of scale, while it may mean that sludge needs to be transported over shorter distances to be treated. At the same time, the same exogenous factors may require companies to drive further to dispose of sludge i.e. because sludge treatment centres would tend to be located in urban areas, which aren't close to appropriate disposal sites. There may not be enough variation in the sample size for the model to appropriately reflect these competing pressures within a single coefficient.

5.1.6 Additionally, statutory requirements within wastewater network plus can lead to material cost pressures for Bioresources. As we discuss in the next section, the WINEP is leading to higher volumes of

[22] As the consultation notes, UUW proposed a percentage co-location variable to proxy for asset configuration but this wasn't adopted.

nutrients being received by Bioresources, which has a material cost impact upon Bioresources that won't be reflected by increases in volumes alone (e.g. due to the presence of more inert material per unit of sludge produced). UUW suggested a cost driver that reflected the average P consent but this wasn't adopted by Ofwat. We disagree with this decision - we consider that such a cost driver will become increasingly relevant in future AMPs.

5.1.7 Overall, the Bioresources sector is becoming increasingly complex, and it isn't clear that an overly parsimonious modelling approach is capable of efficiently reflecting this complexity.

Ensure expenditure outside of the modelled period is externally valid

5.1.8 The AMP7 WINEP programme is leading to a significant increase in the amount of nutrients being removed from discharged effluent during the wastewater treatment process. The resulting higher opex within wastewater network plus is recognised by Ofwat within its consultation document. These nutrients remain within the sludge received by Bioresources as 'inert material'. Higher levels of inert material will increase the total amount of sludge produced and require more complex treatment within Bioresources. We support Ofwat's recognition of the higher associated costs within wastewater treatment but we do consider that it is necessary to give equivalent recognition to the pressures the WINEP programme is placing upon Bioresources.

5.1.9 The AMP7 and expected AMP8 WINEP programmes are leading to a material increase in the rate of growth in sludge produced in AMP8. This can be seen in Figure 10 and Figure 11, which compare the fit of a linear trend and an exponential trend on UUW's sludge growth over time. The higher r squared on the graph with an exponential trend evidences an increase in the rate of increase in sludge growth.

Figure 10 - Sludge produced with linear trend

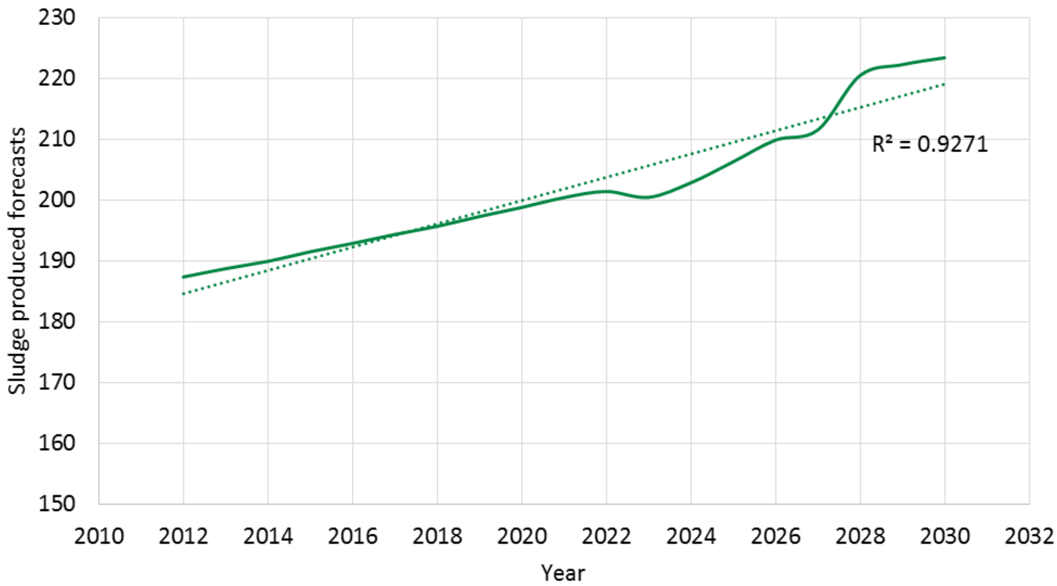
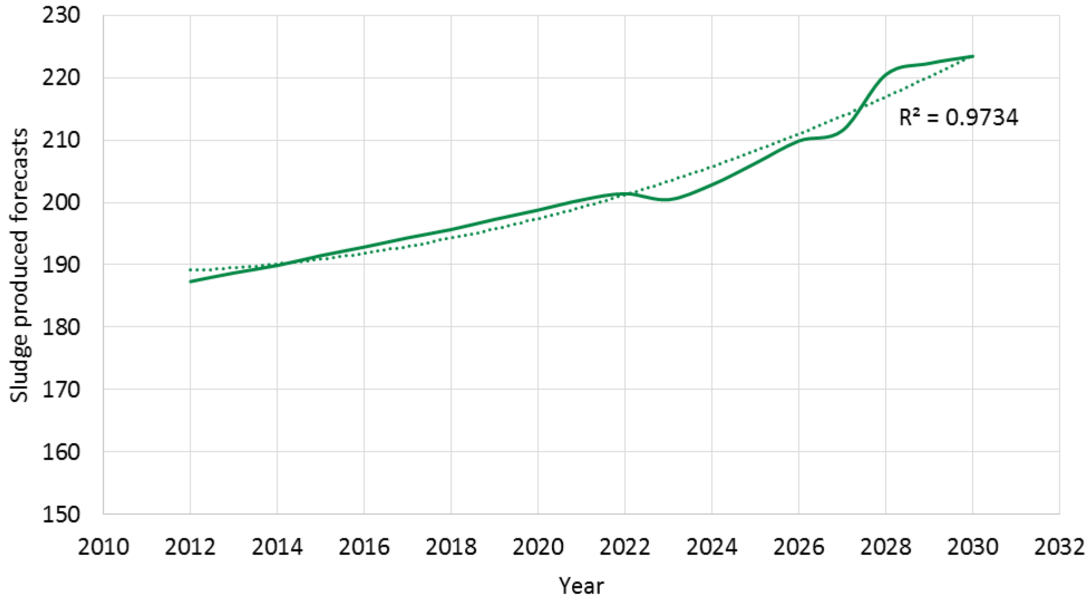


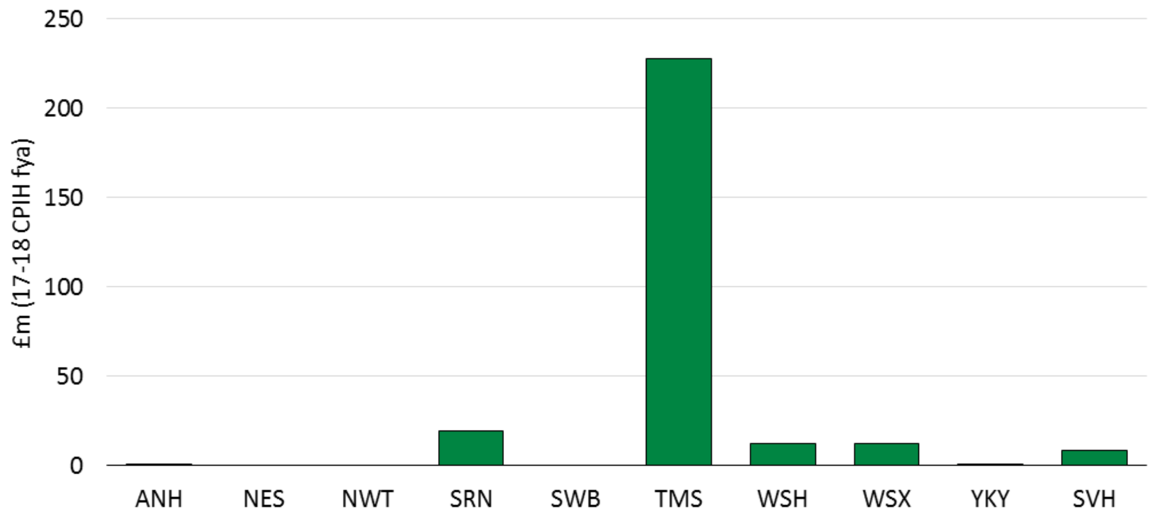
Figure 11 - Sludge produced with exponential trend



5.1.10 We do not consider that Ofwat's proposed Bioresources models will appropriately reflect growth requirements in AMP8. The industry average growth rate of sludge produced over the period of the historical panel is 1.7 percent. However, over AMP8, UUW is forecasting a 6.5 percent increase. This cannot be expected to be reflected within allowances through simply applying a historical unit rate with higher forecast sludge volumes. The unit rate will include a unit allowance for growth aligned with the historical average rate of growth (1.7 percent), not the future expected rate of growth (6.5 percent for UUW). The implicit allowance for growth within the unit rate will not scale up when it is combined with higher forecasts of sludge produced – it is constant.

5.1.11 Additionally, as Figure 12 shows, the distribution of growth expenditure across the industry has been uneven. This means some companies will be faced with increasing capacity constraints and as such will likely need to undertake significant investment in capacity at sludge treatment centres. We do not consider that there is sufficient expenditure within the historical dataset to facilitate this activity. Our market testing has found that there is not sufficient capacity in the wider market to facilitate more volumes without investing in capacity.

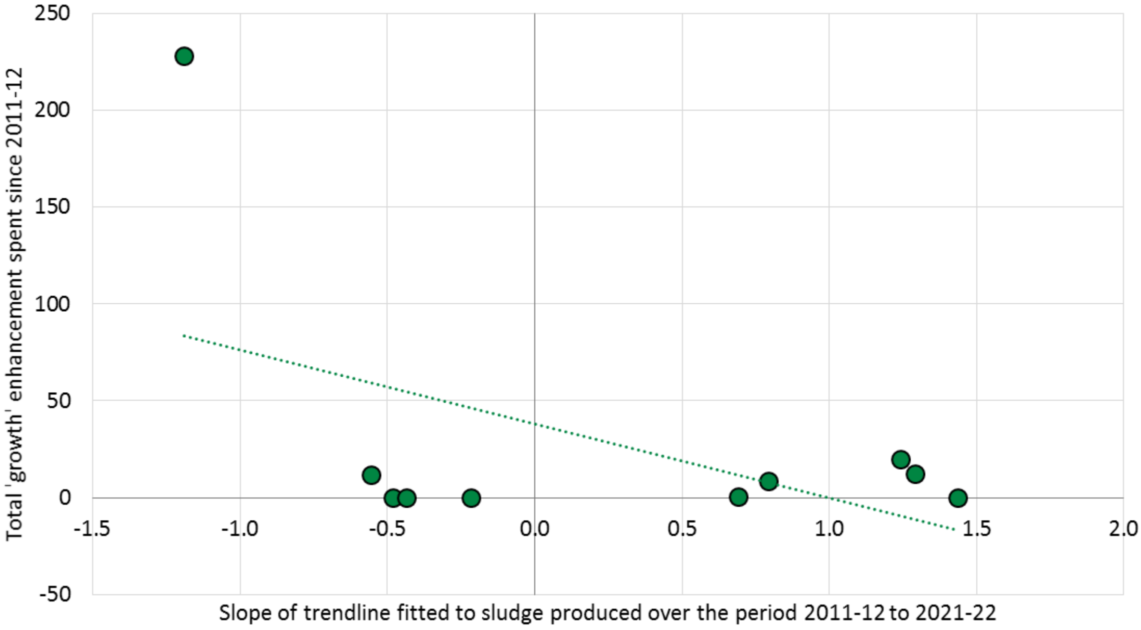
Figure 12 - Total Bioresources growth expenditure since 2011-12



5.1.12 Additionally, we have not found any historical relationship between past investment in new capacity and growth in sludge produced. We would expect companies with increasing sludge produced to be associated with growth enhancement expenditure. Conversely, we would not expect (all else equal) companies with a declining trend in sludge produced to incur growth enhancement expenditure.

5.1.13 However, as Figure 13 shows, some companies have in fact invested significantly in growth expenditure without an associated increase in sludge produced. The horizontal axis in this figure reflects whether a company has an increasing or decreasing trend in sludge produced over time. Companies with a negative value have an overall trend of decreasing sludge produced and vice versa. This reveals that some companies have invested in additional capacity despite the volumes of sludge produced declining overall. There are also some companies who have seen an overall trend of increasing sludge volumes but have not yet invested in extra capacity. We may reasonably expect such companies to need to invest in additional capacity in the near future.

Figure 13 - There is no clear historical relationship between growth in sludge produced and growth enhancement expenditure



5.1.14 We do not consider that the proposed model will be capable of appropriately reflecting the engineering prior whereby growth in sludge produced leads to higher costs due to the need to invest in new capacity. This is because – as Figure 13 clearly shows – the historical data does not reflect the positive relationship that we would expect to observe, following from the engineering, operation and economic rationale. Therefore, we cannot expect the model to estimate a relationship that is capable of facilitating the marginal cost of future growth requirements when future growth requirements are materially higher than the past. This suggests that adding historical growth expenditure into the scope of modelled costs means that allowances will be insufficient to meet future growth requirements.

5.1.15 In general, we have not seen evidence that would make us confident that including growth enhancement within the scope of botex modelling will appropriately allocate costs to companies that need to invest in new capacity[23]. As a result, customers in areas with no need for new capacity will effectively pay too much, while companies with a need to invest in new capacity won't receive an efficient allocation of costs. While we understand the direction of travel is towards a revenue benchmarking approach, for such an approach to work, at PR29 there must be evidence in the historical

[23] We recognise that UUW proposed models including growth enhancement expenditure in its submission to this consultation - that proposal was made in conjunction with a variable that attempted to reflect the average P consent in wastewater treatment within bioresources cost assessment. Therefore, our proposed models attempted to control for a major source of growth in sludge produced. However, our work since our consultation submission has caused us to become increasingly sceptical that including growth enhancement costs in the scope of the models will provide sufficient growth-related allowances.

dataset that supports an efficient allocation of all expenditure, including investment in new capacity. However, if the PR24 approach does not appropriately support investment in new capacity and leads companies to long-term inefficient operational solutions then the PR29 approach will not be able to draw upon evidence of efficient activity and it will result in an inefficient outcome as a result.

5.1.16 Therefore, we consider that, prior to Ofwat including growth enhancement within the scope of modelled costs, it should:

- Assess whether historical growth rates are representative of future growth rates and therefore whether including historical growth enhancement expenditure in modelled costs will allow the sector to meet future demand. This assessment should include whether the unit cost of growth can reasonably be expected to be higher in the future relative to the past. If so, then a backwards-looking model would provide an unrealistically low estimate of enhancement requirements;
- Assess whether the market is currently sufficiently developed to provide incremental capacity such that including historical growth in modelled costs can reasonably be expected to ensure sufficient capacity going forward; and
- Assess the impact of current and future WwNP WINEP programmes on sludge quality and how this might affect i) net Bioresources costs across the sector and ii) market demand for sludge.

5.1.17 We consider that this assessment will inform whether the proposed approach to Bioresources will best facilitate the sector's adaption to future exogenous changes in the operating environment. Currently, UUW is concerned that an overly backwards-looking approach is unable to reflect emerging pressures. As a result, it may be more appropriate to assess growth requirements on a bespoke basis, outside of the botex model. This will help to ensure that the Bioresources sector is efficiently and effectively responding to the challenges it faces, which in turn increases the likelihood that Ofwat's move towards a revenue benchmark at PR19 is supported by efficient and sufficient activity captured within the historical dataset.

5.1.18 There are also additional regulatory pressures within Bioresources that will materially increase costs relative to the past:

- **Industrial Emissions Directive (IED) costs**. The latest regulatory standards mean that new assets will be required (i.e. new OCU units or forced ventilation) or additional monitoring and/or management activities will be needed, as prescribed by the permits (e.g. liquor sampling or bioaerosol monitoring). The operation and maintenance of these new assets or incremental activities will result in a material upwards pressure on costs. These costs are directly related to evolving regulatory requirements and so we consider that the cost assessment framework should appropriately recognise this step change. It would be entirely inappropriate for these additional costs to represent an implicit efficiency challenge. We also note that while all companies will incur these costs, the impact may be asymmetric across the industry. While Ofwat has stated its intent to deal with IED permit compliance costs as an unmodelled element, this definition only relates to a subset of IED costs. We consider that all IED-related costs (and other waste permitting costs) should be dealt with outside of the cost models.
- **Future restrictions in available landbank** – Farming Rules for Water (FRfW) is a significant issue impacting the future of sludge disposal – its full impact on water companies is currently being abated by a DEFRA instruction (statutory guidance) to the EA not to prosecute farmers for water companies continuing to use Sludge Use in Agriculture (SUIA) exemptions for land spreading (DEFRA instruction to be reviewed by Sept 2025). The FRfW changes will (once the Defra instruction is lifted) result in a significant change to the Bioresources business model for the sector – modelling indicates that FRfW would leave only one third of the required land to dispose of current sludge, leading to very significant investment requirements in product improvement and/or alternative disposal routes (e.g. incineration).

- Also, the EA's sludge strategy plans to remove the SUIA exemption – that means that FRfW will more directly apply to water companies. The EA has not yet recognised that this would represent a clear legal change, and hence it is unclear whether Ofwat will assess these additional costs as being base or enhancement. Regardless, these will be essential future additional costs of managing Bioresources, which needs to be recognised within the price control, and it is clear that Bioresorces cost models that only reflect historic costs will be wholly inadequate to reflect these future additional costs.
- We have also proposed that some of this required investment be subject to an AMP8 uncertainty mechanism. Precise investment requiremens for each company are uncertain due to:
  - uncertainty over the longevity of the Defra exclusion, and implementation timing of EA sludge strategy;
  - impact of further restrictions being considered by EA; and
  - uncertainty over the allocation of investment required by each company to meet an impending significant national shortage of landbank - that means it is not reasonable to expect each company independently to assess their own investment requirements, without a degree of co-ordination to assess how best to meet that national constraint. We have suggest a RAPID-style framework be established to co-ordinate those requirements efficiently between companies.

5.2 Do you agree we should use unit cost models to assess Bioresources expenditure?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
		☑		

5.2.1 We note that this model specification imposes a constant returns to scale assumption at the company level. We consider that this could be appropriate if economies of scale were thought to exist at an asset level. Indeed, Vivid Economics[24] found this to be the case. Therefore, this move can be justified on theoretical grounds.

5.2.2 Ofwat also reports that a company-level economies of scale driver is insignificant when included in these unit cost specifications: *"The estimated coefficient on sludge produced in the unit cost models was not statistically significant."* This suggests that there is statistical evidence that supports the theoretical basis for unit cost models.

5.2.3 As we said in our response to question 3.3, we consider there may be value in triangulating across a diverse set of cost drivers and models. Therefore, there may be some benefit in including both unit cost model specifications and total cost model specifications in the final model suite.

[24] Arup and Vivid Economics (2017) *Understanding the exogenous drivers of wholesale wastewater costs in England & Wales*. Available here.

6. Residential retail

6.1 Do you agree with our proposed set of residential retail cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

6.1.1 UUW strongly supports Ofwat's proposed set of residential retail cost models. It aligns well with UUW's principles of regulatory cost assessment, as set out in our Future Ideas Lab paper[25].

Define the services provided

6.1.2 Ofwat utilises a bottom-up and top-down modelling approach. The use of 'bad debt' and 'other cost' models allows the benchmark to be informed by more granular understanding of cost drivers in each of these service areas. This should result in a more robust and realistic outcome as a result.

Prioritise engineering, operational and economic rationale

6.1.3 Ofwat's set of cost drivers are aligned to operational and economic rationale (engineering rationale is less relevant for residential retail):

- We consider a constant returns to scale assumption to be appropriate in residential retail. Companies are able to engage in activities to benefit from economies of scale e.g. through joint ventures and joint billing arrangements . For this reason, we agree with Ofwat that a low r-squared is not problematic; it occurs as a direct result of Ofwat's legitimate specification of the dependent variable.
- A larger company bill means more revenue is at risk if a customer defaults, which will lead to higher bad debt costs all else equal. We strongly support the continued inclusion of bill size as an explanatory variable.
- Areas of high deprivation are associated with higher default risk. Deprivation is a well-established and widely accepted driver of bad debt costs, which accounts for almost half of all residential retail costs. We strongly support the inclusion of deprivation as a cost driver.
- Companies with a larger number of dual service customers can reasonably expect a higher volume of customer contacts. We support the continued inclusion of a dual service cost driver.
- Covid-19 had a significant impact on retail operations. It is correct for Ofwat to control for its impact within the cost model estimation process. We consider that Ofwat's use of dummy variables is a pragmatic way to do this.

Protect the benchmark's independence

6.1.4 We consider Ofwat's cost drivers to be largely exogenous i.e. outside of company control. We do have a slight concern with the proposed use of an economies of scale variable – we have observed economies of scale to be within company control in residential retail e.g. through joint ventures and joint billing arrangements.

Ensure expenditure outside of the modelled period is externally valid

6.1.5 Ofwat's model suite draws upon historical data to derive a forward looking expenditure allowance. This creates a risk that if the modelling process is overly concerned with model fit, it is prioritising the ability

[25] UUW (2021) *The principles of regulatory cost assessment.* Available here.

of the models to predict historic expenditure rather than future expenditure. We consider it crucial that the models reflect future cost pressures, where possible.

6.1.6 We consider that the models are well aligned with this principle. We expect the chosen set of cost drivers to continue to have a material effect on costs throughout AMP8.

6.1.7 We also consider that it is correct to remove % of metered customers as a cost driver. The move to smart metering has fundamentally changed the nature of meter reading costs, and we expect this trend to become increasingly prevalent across the entire industry. Therefore, removing % metered customers ensures that cost assessment is externally valid and capable of appropriately forecasting expenditure in AMP8.

6.2 Do you agree with our approach to modelling deprivation, and/or have any views on the selected variables?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
			☑	

6.2.1 Deprivation is a key driver of retail costs and we strongly support its reflection within cost assessment.

6.2.2 We broadly agree with the way Ofwat has reflected deprivation in its model suite. We note that there are equally legitimate variables available, such as the credit risk index (RGC102). However, overall we support Ofwat's choice of deprivation variables.

6.2.3 We also strongly support the use of 'bottom-up' cost aggregations such as the bad debt and other cost models. This should lead to a stronger relationship between costs and cost driver, which will result in a more robust and realistic benchmark.

6.3 Do you agree with the inclusion of Covid-19 dummy variables in the residential retail cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
			☑	

6.3.1 Covid-19 presents considerable challenges for retail cost assessment. The pressures created by the pandemic led companies to engage in a different mix of activities to that adopted in normal times. This could create inconsistencies in the historical dataset and so make it difficult for the model to estimate an appropriate relationship. In this sense, Covid-19 is a significant confounding factor.

6.3.2 Dummy variables are widely used in econometrics to control for confounding factors. We consider that Ofwat's use of Covid-19 dummy variables is a pragmatic way to mitigate the risk that the benchmark is subject to bias and statistical noise. Our analysis of Ofwat's retail models suggests that the inclusion of Covid-19 dummy variables improves the overall performance of the model suite.

6.3.3 However, it is important for the regulatory framework to recognise that companies did incur higher costs during this period. It would be inappropriate for pandemic-related risk to be borne entirely by water companies because such risk is entirely exogenous and the retail control does not benefit from cost sharing in the same way as other wholesale controls.

6.4 Do you agree with the removal of transience from the residential retail cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

6.4.1 Transiency costs result from:

(i) The opening and closing of accounts; and

(ii) Unpaid bad debt left behind by the previous account holder.

6.4.2 The process of opening and closing accounts is a small proportion of total cost for a modern, efficient retailer.

6.4.3 Unpaid bad debt associated with closed accounts is a more material and exogenous cost driver. However, we consider the primary cost driver to be deprivation i.e. customers in more deprived areas are more likely to leave behind bad debt when closing an account. UUW analysis of internal data has found that transiency has an immaterial effect on bad debt costs once deprivation is taken into account.

6.4.4 The weakness of the effect also seems to suggest why transiency is unstable in company level models of retail cost. For example, at PR19 Economic Insight[26] found that 24% of transiency coefficients were negative across its 'model suite A', while 43% were negative across its 'model suite B', which is an unintuitive result. We continue to find that transiency has an immaterial and inconsistent effect on retail costs.

6.4.5 In UUW's view, the use of a deprivation driver is sufficient to ensure that the benchmark appropriately reflects any cost pressure relating to population transiency.

6.5 Do you agree with the removal of 'proportion of metered customers' from the residential retail cost models?

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
				☑

6.5.1 Companies are increasingly able to mitigate meter reading related costs. For example, in some areas UUW uses AMR technology to get weekly customer meter readings through sensors attached to waste collection vehicles. As smart meters become increasingly prevalent, we expect that 'traditional' meter reading costs will become increasingly immaterial.

6.5.2 We also consider that removing 'proportion of metered customers' from the model suite aligns with good incentive properties because it encourages companies to adopt the cheapest meter reading technology - smart meters. In turn, smart meters help customers to keep track of usage and mitigate any affordability issues, which in turn could have a positive impact on bad debt costs.

6.5.3 We expect to observe a material shift in AMP8 towards smart meters. As such, it doesn't make intuitive sense to maintain a cost driver within the model suite that is not reflective of future circumstances. We strongly support its removal from cost assessment.

[26] Economic Insight (2018) *Population transiency as a driver of household retail costs.* Available here.

Appendix A 'Predicted' pumping head derivation

In this appendix, we provide the basis by which we calculate 'predicted' pumping head and why 'predicted' pumping head is equivalent to reported pumping head.

This proof relies on the following three equations:

1) $Pumping\ Energy\ Consumed = Pumping\ Efficiency \times Potential\ Energy$

2) $Potential\ Energy = Pumped\ Volume \times Water\ Density \times Gravitational\ Constant \times Height$

3) $Average\ Pumping\ Head = \dfrac{Height * Pumped\ Volume}{Total\ Company\ Volume}$

By substituting 2) into 1):

4) $Pumping\ Energy\ Consumed = Pumping\ Efficiency * Pumped\ Volume * Water\ Density * Gravitational\ Constant * Height$

Equation 3) can be rearranged:

5) $Height * Pumped\ Volume = Average\ Pumping\ Head * Total\ Company\ Volume$

By substituting 5) into 4):

6) $Pumping\ Energy\ Consumed = Pumping\ Efficiency * Water\ Density * Gravitational\ Constant * Average\ Pumping\ Head * Total\ Company\ Volume$

For this analysis water density, pumping efficiency and the gravitational constant can be treated as constants. Therefore, the pumping energy consumed is proportional to average pumping head:

7) $\dfrac{Pumping\ Energy\ Consumed}{Total\ Company\ Volume} = Constant * Average\ Pumping\ Head$

8) $\frac{Pumping\ Energy\ Consumed}{Total\ Company\ Volume} \propto Average\ Pumping\ Head$

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