Anglian Water

PR19 DRAFT DETERMINATION

SLUDGE TRANSPORT COST ADJUSTMENT CLAIM

August 2019

RESPONSIBLE BUSINESS OF THE YEAR 2017
BUSINESS IN THE COMMUNITY

THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2015

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COST ADJUSTMENT CLAIM: SLUDGE TRANSPORT

Name of claim	Sludge Transport
Business plan table lines where the totex value of this claim is reported	WWS1, line A9
Price control the claim relates to	Bioresources
Total value of claim for AMP7	£17.6m
Total opex of claim for AMP7	£17.6m
Total capex of claim for AMP7	£0m
Depreciation on capex in 2020-2025 (retail controls only)	N/A
Whole life totex of claim	£17.6m for AMP7 alone
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls	3.6% of AMP7 Bioresources totex
Does the claim feature as a Direct Procurement for Customers (DPC) scheme?	No

The basis of the claim is not that we have to invest in additional capital expenditure (by comparison to the other WaSCs) so as to move our sludge. The claim is actually that we need to spend more on operating expenses (opex) to move our raw sludge than our peers and that the reasons for this higher level of opex are:

a outside the control of management
b significant, and
c long-lasting.

Demographics and geography ultimately drive our sludge costs. We have a large, sparsely populated area. Consequently, we have a large number of small water recycling centres (WRCs) and have to move large quantities of liquid sludge.

While there are other water companies which are:

i. large
ii. have low population density, or
iii. need to move sludge to Advance Anaerobic Digestion (AAD) sites

no other WaSC has all three factors together.

Table 1 Summary of our response to Ofwat's test areas

Test	Ofwat's DD position	Brief summary of evidence to support claim	Page
Need for investment	N/A	This investment is needed because it costs us more than other companies to move raw sludge compared to other companies due to the combination of our region covering a large, sparsely populated area and the need to move sludge to Advance Anaerobic Digestion sites.	9

Need for adjustment	Fail	We revised the value of our cost adjustment claim and this takes into account the modelled allowance. Our transport costs are efficient and we have engaged with markets to ensure this, but transport costs are higher than other companies due to factors outside of our control.	3,10
Management control	Partial pass	Additional evidence is provided to demonstrate that dewatering of sludge at small WRCs is not economically viable. We continue to explore new technologies to thicken sludge on small sites including mobile sludge thickening and sludge dewatering cages.	4,10
Best option for customers	N/A	We have found the optimum number of STCs to deliver the most efficient arrangements for treating the sludge in our region. This represents the best option for customers as it means we deliver our statutory obligation to manage sludge with the lowest overall bill impact.	12
Robustness and efficiency of costs	Fail	We have challenged ourselves based on UQ unit costs for sludge transportation and an annual productivity challenge. We have accounted for the geographical benefits of having greater access to arable land in our base costs. We have engaged with neighbouring WaSCs and independent contractors to increase sludge trading, engaged with, and made use of sludge haulage contractors. We have also used sludge haulage contractors to benchmark our own transport costs to provide further evidence that we are efficient. We continue to make sure our transport solution is efficient and effective, and have provided a number of examples to demonstrated how we have done this over the previous two AMPs.	5,12
Customer protection	N/A	By developing the most efficient possible arrangements for sludge management in our sparsely populated region, we have minimised the bill impact for our customers.	16
Affordability	N/A	By optimising our sludge transport operations, we have ensured that we minimise the impact of sludge transport on affordability.	17
Board assurance	N/A	External assurance of this cost adjustment claim has been undertaken by Jacobs. Our Board has reviewed the assurance provided by Jacobs and has endorsed our cost adjustment claims.	17

Full details of our original claim included in our September plan are included in Annex 2. Whilst the basis of our claim remains we have updated it to reflect the outputs of the Bioresources model and the challenge set out by Ofwat at Draft Determination. We focus on addressing those tests which Ofwat assessed as a partial pass or a fail.

1.1 Ofwat proposals

The cost adjustment claim submitted with our September 2018 Plan was dismissed. Ofwat made the following statements in relation to our sludge transport cost adjustment claim at Draft Determination.

1.1.1 Need for adjustment

We have not identified any new evidence and retain our assessment from IAP.

Ofwat has revisited its IAP bioresources models. Model BR1 at draft determination includes a variable to account for the influence on transport costs in bioresources of dispersed rural treatment works, ie the proportion of load treated in bands 1-3. Given that the model is giving an allowance, the need for adjustment of this claim fails. In its cost claim, Anglian Water states "No cost adjustment would be required if the models used to assess costs adequately captured the sludge transport factor" (p. 216).

We further note that Anglian Water presents evidence that its transport costs are a higher proportion of bioresources costs than other companies. The fact that Anglian Water's transport costs account for a greater proportion of total bioresources costs could be because its disposal costs are more efficient than other companies, rather than demonstrating that the company has higher transport costs. Our analysis shows that indeed Anglian Water's sludge disposal unit costs are the lowest in the industry.

1.1.2 Management control

Anglian Water explains that there are two elements in its management control - the location of the STCs and the thickness of the sludge being transported. The company provides enough evidence to demonstrate that, while it could in theory increase the number of STCs and build further (smaller) STCs to decrease its sludge transport costs, the current number of STCs is optimal. However, we found a lack of persuasive evidence that the company has taken all reasonable steps to optimise the arrangements governing the thickness of the sludge. The claim states that "it is not economically viable to dewater sludge at small WRCs so as to produce raw sludge cake rather than liquid", but there is no evidence presented in support of this statement. Furthermore, there could be other solutions the company has not explored.

1.1.3 Robustness and efficiency of costs

We have not identified any new evidence and retain our assessment from IAP.

1. The company considers two different approaches to calculating the impact of atypical transport on its costs and presents its claim based on the lower of the two figures. However, the claim is based on industry average cost data. The analysis does not (a) calculate costs on the basis of upper quartile costs or (b) apply an ongoing efficiency assumption.

2. The benefit of geography and population sparsity in the Anglian region is that the company has easier access to arable land than any other company, with associated savings in sludge disposal costs and the ability to charge farmers for the biosolids they use as fertiliser replacement reducing net costs further. Anglian Water provides no evidence that it has accounted for the benefits of its geography to offset its claim.

3. In its business plan submission, Anglian Water has demonstrated a lack of market engagement on trading bioresources. The company provided high-level statements in its original business plan (ie September 2018), with a lack of evidence of firm plans in place. Sludge trading has the potential to reduce sludge transport costs, and we consider that the company has not pursued opportunities to maximise cost efficiency in this area.

4. We found a lack of evidence to demonstrate that the company is adopting an efficient transport solution. Given that the claim relates to transport costs we expect Anglian Water to provide evidence, including from engagement with market providers, that their transport solution is efficient

1.2 Our Position

1.2.1 Need for adjustment

Whilst we acknowledge the Bioresources cost models have made some allowance to account for sparsity and the geographical nature of our region we consider this not to be adequately covered. Our cost adjustment claim in our September Plan was £41.6m and the Ofwat Bioresources modelled output was £18m. We have therefore removed £18m from our cost adjustment claim to give £23.6m.

We have further challenged ourselves on this cost by applying an upper quartile unit cost challenge and an ongoing productivity challenge to give a revised cost adjustment claim total of £17.6m. The detail of how we have derived this value is shown in section 1.3.

We consider that our transport costs are efficient. We engage in effective market testing: 31% of work done is by third party hauliers. While we accept that our unit cost of transport (cost per m3/km) is not frontier, we contend that this is a consequence of the size of tankers required by the large number of small WRCs where dewatering is not economically viable. Ofwat notes that we have the lowest sludge disposal unit cost in the industry, we acknowledge that this is in part due to geographical advantage, but Ofwat's analysis fails to take into account a number of other points:

- Our baseline operating costs includes any historic benefit of geography, in terms of our biosolids recycling and disposal operations, however this is limited for various reasons;
  - Most farmers would not historically pay for biosolids, in cases where soils Phosphate indices were already at acceptable levels. There has always been a balance between the opportunity to charge for biosolids, willingness of farmers to pay and the distance we need to haul the material.
  - Any historic benefit will not be there in future. Farming Rules for Water now require all applications to match crop off-take in terms of phosphate across the rotation.
- We actively brand and market our biosolids products to farmers, on the basis of the nutrient equivalent value, receiving higher revenue than the majority of the remaining industry collectively receives. This commercial approach aligns with Ofwat's objectives surrounding markets and this helps to reduce the overall unit cost of our recycling operation.
- Whilst the Anglian Water region includes a significant amount of arable (cropped) land area, which is potentially suited to biosolids application, there are a number of restrictions in terms of access to this land. There are annual nitrogen and rotational phosphate limits which have to be met when applying biosolids to land. Under the New Farming Rules for Water, some elements of good agricultural practise have now become mandatory (legal) requirements for the future. We also commissioned a land bank study as part of our September 2018 plan that demonstrates access to land is becoming more challenging due to tightening standards. Together with an increase in competition from other organic wastes as anaerobic digestion and composting of other materials becomes more prevalent.
- The proportion of raw sludge hauled is approximately seven times the tonnage of treated product hauled to land for recycling.

1.2.2 Management control

We provide further information on how our costs are influenced by factors outside of management control, and how we have exhausted alternative options.

72% of our WRC's serve less than 2,000 PE, with 95% of sites producing less than 550 TDS/y of sludge (circa 25,000 PE based actual load taken from our 2019 Bioresources market information). We consider in the majority of cases a PE of 25,000 or greater mechanical thickening becomes viable. We continue to strive to seek innovative solutions and new technologies to thicken sludge on our small sites; examples include our recent innovation projects on mobile sludge thickening with Orege and installation of sludge dewatering cages.

We have taken all reasonable steps optimise our sludge thickness arrangements. To illustrate this point, installing a mechanical thickener sized for 550 tds/y has a capital build cost of £640k from our cost models. The associated opex is £79.8k allowing for labour, chemical, power, maintenance etc) Over five years this would give total expenditure of £1,039k for the thickening asset excluding any capital maintenance. Therefore the investment would need to generate a transport saving of approx. £208k per year. Thickening 550 tds/y of sludge from circa 2.5% to 5.5% DS would reduce the volume from 22,000 to 12,000m3/y using our average cost per m3 of £0.257 the distance from the receiving STC would need to be in excess of 81km from the WRC to deliver the required saving. The average distance travelled for our tankered sludge to our STC's is 40km, another way of looking at the problem would be on average the starting dry solids would need to be at less than 1.3% DS thickening to greater than 5.5% DS to deliver the required saving.

1.2.3 Robustness and efficiency of costs

With regards to Ofwat's challenge to adoption of an efficient transport solution we provide the following evidence to support our strategy and approach to demonstrate it is efficient and provides a resilient service in the interest of customer, environmental compliance and business resilience.

Market engagement

We regularly engage with markets on sludge transport activities. In 2018-19, as included within our published Bioresources market information, we engaged with twenty contractors for sludge haulage and thirty one percent of sludge transported was through the twenty five sub contractor haulage contracts we have in place. We regularly benchmark our internal tankering rates against the open market, the table below shows a recent comparison of our internal rate in £/hr versus two leading industry tankering service providers. This demonstrated that our rate was on average 10% less than the market for 11 of 12 scenarios considered

Table 2 Haulage cost comparison between Anglian and external suppliers

Tanker size (m3)	Supplier A (£/hr)	Supplier B (£/hr)	RES (average) (£/hr)	Variance to A	Variance to B
In Hours					
15	46.22	50.37	47.66	103%	95%
21	48.27	51.61		99%	92%
>21	51.35	56.15		93%	85%
Out of Hours					
15	51.35	55.27	47.66	93%	86%
21	53.92	57.04		88%	84%
>21	56.49	61.89		84%	77%
				Average	90%

We believe we offer a lower totex cost for the service based on a focused, robust and long standing strategy for our haulage fleet.

We size and resource our haulage capability based on maintaining a fleet operating at high levels of productivity. We do not have standing tanker resource and we use the supply chain and our haulage partners for seasonal variations in workload and support when required during operation emergencies.

Providing a resilient haulage service is also a vitally important consideration. The sludge haulage market is highly competitive and at times volatile with a significant number of suppliers entering and leaving the market. Over the past two years, four of our contracted suppliers have entered administration, ceased trading or withdrawn from the contract and currently three are wishing to renegotiate to increase the agreed unit rate or withdraw as they face financial difficulties. We believe a haulage strategy over reliant on the market or lacking direct management control of day to day planning and scheduling poses a significant risk to service, with potential to significantly impact customers and the environment. This is particularly important to us as we move over 70% of our raw sludge production by road to our STC's (Sludge Treatment Centres) and RDW's (Raw Dewatering Hubs) for treatment.

A recent example of this was the recent flooding of Wainfleet in Lincolnshire due to heavy rainfall. We were able to work closely with the EA and local authority to re-plan, prioritise and mobilise a significant proportion of our in-house fleet and sub-contractor resources whilst maintaining a number of tankers on high priority sludge operations. Tankers were deployed to move raw sewage from the affected areas, limiting the pollution impacts to customers. It would have been significantly more difficult to quickly react and take action were we wholly reliant on out sourced tankering resource

We are actively engaging in new markets and further evidence was included in our April IAP response document. Key points include;

- Trading has regularly taken place with Yorkshire Water and we have regular dialogue exploring potential trades with neighbouring WASCs (Severn Trent, Thames and Yorkshire). We have recently been approached by Southern Water regarding potential trades.
- We have recently entered contracts to receive sludge from contractors serving MOD sites within our area, historically this sludge has been taken outside of area for treatment by another WASC.
- We have undertaken modelling to identify sites where our source works is closer to a neighbouring WASC's STC that our own. To date we have provided details of the identified sites with the neighbouring WASC's in terms of volumes, sludge type and quality. We have also exchanged draft contract terms and anticipate that trading around these opportunities will commence during this financial year.
- We are active in supporting policy makers and regulators in the review and reform of environmental regulation to potentially open up opportunities for co-treatment of organic waste with sewage sludge.
- We have led the development and implementation of the Biosolids Assurance Scheme which we see as a vehicle for the industry to use to support the continued route of treated biosolids to agriculture together with any future co-treated products.

Maximising sludge haulage efficiency in AMP5 and AMP6

Management of LGV fleet: Our LGV fleet is managed by a specialist management team, with extensive knowledge and experience gained within the external haulage industry. The team recharges for work completed on a unit costs basis (i.e. £/m^3 moved), which incentivises productivity within the internal haulage fleet, ensuring that internal totex unit costs remain competitive against subcontract rates.

The internal LGV haulage fleet is sized to ensure that all vehicles are fully utilised and productive throughout the year, despite the seasonal fluctuation in sludge and biosolids production, with any shortfall during peak periods being handled by subcontractors as necessary.

Revised LGV drivers terms and conditions: We regularly benchmark our LGV drivers terms and conditions and rates of pay against the external haulage market. The current terms, including rates of pay, were negotiated and agreed in 2015 to ensure the internal business unit's costs remain efficient by comparison with the external market.

LGV drivers shift patterns: LGV drivers shift patterns were last changed in 2015, to provide a full 24/7 tankering service. Operating the LGV fleet on a full 24/7 basis minimises the totex unit cost of the haulage operation.

IT scheduling and monitoring systems: We use haulage scheduling software to ensure the LGV vehicle fleet is deployed in the most efficient manner on a daily basis. The systems include workload planning and daily routing of vehicles.

Workload is planned to ensure an even delivery of sludge across the full 24 hour period to our ten sludge treatment centres. This ensures that vehicle delays, as a result of multiple vehicles arriving together is minimised and anaerobic digestion processes are optimised.

All LGV vehicles are fitted with both tracking and on-board vehicle management systems, providing real time information regarding the performance of both vehicles and drivers. We have implemented incentives to ensure LGV drivers operate vehicles in a safe and fuel efficient manner, delivering significant fuel and maintenance savings, in a similar manner to other hauliers in the sector.

Telemetry monitoring of treatment centre performance: We have installed telemetry monitoring at sludge treatment centres, to provide the schedulers controlling the LGV vehicle fleet with a real time indication of whether sludge treatment centres can accept further deliveries. This allows the schedulers to minimise vehicle delays at sludge treatment centres, by rescheduling vehicles and/or removing subcontract vehicles from the daily plan as necessary.

Tank equipment refurbishment: In terms of sludge tankers, we took the decision to move to stainless steel tanker barrels c.18years ago, influencing our suppliers to adopt this approach. The benefit is that a stainless steel tanker barrel has a much longer life span (>25years) than that of a mild steel alternative (c.10years), for a relatively small increase in capital cost (c.20%). We transfer existing tank equipment between LGV chassis cabs/tractor units at planned intervals, based on usage, to minimise the overall totex cost of the vehicle.

Fleet management: We monitor the cost of each individual vehicle via a fleet management IT package. The system allows the management team to accurately monitor the costs of each vehicle, providing many years of supporting evidence to ensure vehicles are scheduled for replacement at a frequency which ensures the minimum whole life cost.

Reduction in subcontract rates: Subcontract rates are subject to formal tender at regular intervals, with 25 subcontractors currently holding contracts for sludge and/or biosolids haulage activities. The rates schedule for subcontractors aligns in terms of structure with the internal unit cost approach used for the internal LGV fleet.

Upper quartile cost comparison and ongoing efficiency

Notwithstanding these points, we have challenged ourselves based on the upper quartile unit cost measure for sludge transportation. We have also imposed the 1.5% pa productivity challenge, offset by 0.4% pa real price effect, in line with the approach taken by Ofwat at Draft Determination.

The calculations are set out in section 1.3. The overall impact of these changes is to reduce our Cost Adjustment Claim for sludge transport to £17.6m.

1.3 Efficiency Computation for sludge transport cost adjustment claim

Table 3 Cost adjustment claim value after modelled costs are removed

	£m	Notes
Sept 18 CAC value	41.6	
Modelling adjustment	18.0	Additional cost driver impact on Bioresources
Net Value	23.6	This is worth £4.72m pa across AMP7

The following table is derived from Tables 4E and 4R of the 2018-19 APR.

Table 4 Company unit costs for sludge transport

	ANH	NWL	SRN	SVT	SWB	TMS	UUW	WSH	WSX	YKY
Sludge transport (£/m^3)	10.3	4.9	5.2	7.9	9.8	7.6	5.0	8.8	5.3	5.9
Sludge transport (avg km)	40.1	26.8	25.4	19.3	44.4	13.9	20.9	16.0	19.3	25.4
Sludge transport (£/m^3/ km)	0.257	0.184	0.206	0.412	0.220	0.546	0.241	0.551	0.275	0.232

On this basis, the Upper Quartile for sludge transport is 19.8p/m^3/km

This, in turn implies a challenge for Anglian Water of 23%.

The on-going net productivity challenge is set out in the following table.

Table 5 Productivity challenge

On-going challenge (1.5% Productivity and 0.4% RPE)	
2021	1.1%
2022	2.2%
2023	3.3%
2024	4.5%
2025	5.6%

The overall impact of the catch up and the on-going productivity on our net claim is set out below.

Table 6 Derivation of our revised cost adjustment claim value

£m	Pre catch up and efficiency	Post catch up	Post RPE and Productivity
2021	4.72	3.64	3.60
2022	4.72	3.64	3.56
2023	4.72	3.64	3.52
2024	4.72	3.64	3.47
2025	4.72	3.64	3.43
Total	**23.60**	**18.18**	**17.57**

1.4 Our September 2018 Plan

The narrative below is as provided in our September 2018 Plan.

Table 7 Cost adjustment claim in our September Plan

Name of claim	Sludge Transport Claim
Claim identifier	ANH03
Business plan table lines where the totex value of this claim is reported	£41.6m in WWS1, line A9
Total value of claim for AMP7	£41.6m
Total opex of claim for AMP7	£41.6m
Total capex of claim for AMP7	£0m
Depreciation on capex in AMP7 (retail controls only)	N/A
Remaining capex required after 31 March 2025 to complete construction	N/A
Whole life totex of claim	£41.6m in AMP7 alone
Do you consider that part of the claim should be covered by our cost base- lines? If yes, please provide an estimate	No, the claim is net of the amount provided through an efficient cost baseline, unless the method for assessing bioresources costs allows fully for the impact of sludge transport
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls	10.0% of AMP7 Bioresources totex
Does the claim feature as a Direct Procurement for Customers (DPC) scheme?	No

1.4.1 1. Need for investment expenditure

There is no need for any investment expenditure with regard to this cost adjustment claim. The basis of the claim is not that we have to invest in additional capital expenditure (by comparison to the other WaSCs) so as to move our sludge. The claim is actually that we need to spend more on operating expenses (opex) to move our raw sludge than our peers and that the reasons for this higher level of opex are:

a outside the control of management
b significant and
c long-lasting.

We recognise that sludge trading has the capacity to reduce our sludge transport costs at the margin. We are vigorously pursuing opportunities to trade sludge and have been doing so since the start of 2016. While we are disappointed that after more than two years, we have only managed to trade very small volumes of sludge, we continue to work towards a number of agreements with contiguous WaSCs. At present, the expectation is that we might be able to trade up to 10% of sludge produced during AMP7 under the most favourable circumstances, half of which would be liquid sludge and the other half raw cake. Given the uncertainty surrounding the current negotiations, this cost adjustment claim does not take into account the potential for reduced sludge miles by virtue of sludge trading. Should we achieve this maximalist scenario, our claim would reduce by £4.2m.

1.4.2 Need for cost adjustment

Demographics and geography ultimately drive our sludge costs. We have a large, sparsely populated area. Consequently, we have a large number of small water recycling centres (WRCs) and have to move large quantities of liquid sludge.

While there are other water companies which are:

i. large
ii. have low population density and
iii. need to move sludge to Advance Anaerobic Digestion (AAD) sites

no other WaSC has all three factors together.

Ofwat has collected two measures of work done for sludge transport as part of its cost collection exercises. The first, ttds km/year, is collected for all modes of transport. The second, m3 km/year, is collected for tankered liquid sludge alone. We argue that for liquid tankered sludge, the correct measure is the m3 km/year as this is measuring actual work done. The tds measure takes no account of the physical volume of the sludge (in other words, what is actually moved), because the dry solids account for only 5 per cent at most of the moved mass. Put otherwise – the volume of dirty water is ignored. Given that we move a disproportionate amount of liquid sludge, working on the basis of tds km understates the problem for us. The reason why we move a higher proportion of liquid sludge is that it is not economically viable to dewater sludge at small WRCs so as to produce raw sludge cake rather than liquid.

No cost adjustment would be required if the models used to assess costs adequately captured the sludge transport factor. All of the models which we reported in our March 2018 cost modelling report included factors which account for sludge transport. Ofwat's cost models reported in the cost modelling consultation of March 2018 all use measures of work done with tds as the quantity rather than volume. If the models used for assessing the cost baselines ultimately use the measures of work done with tds as the quantity rather than volume, then the need for a cost adjustment will remain.

1.4.3 Outside management control

The demographics and geography of our region are both evidently outside management control.

We could reduce the amount of sludge transport we do by increasing our number of sludge treatment centres (STCs) but in doing so we would lose the financial benefits which come from treating sludge at scale. Modelling and other evidence have shown that we have found the 'sweet spot' in terms of the number of STCs that we operate and that we have controlled our transport costs to the most efficient extent.

In points i) to iv) below, we bring forward evidence to support the contention that the number and locations of our STCs is at or close to optimal. We aim to demonstrate that we have efficiently traded off the dis-benefits of fewer STCs (which increases sludge transport costs) and more STCs (which increase sludge treatment costs through loss of scale economies).

i. Our AADs have been part of our enhancement capex spending over the last three AMPs

We have implemented our sludge strategy focused on AAD over the last three AMPs. At successive price reviews, the business cases for the individual sites have been subject to detailed scrutiny by Ofwat. As such, the size and location of the existing base of AADs has (relatively) recent acceptance of their validity. It does leave open the possibility that there ought to be further STCs which would reduce the requirement for sludge transport both by virtue of the additional indigenous sludge generated and by virtue that an additional STC would allow for the reduction in aggregate sludge miles travelled. This is addressed under point iv) below.

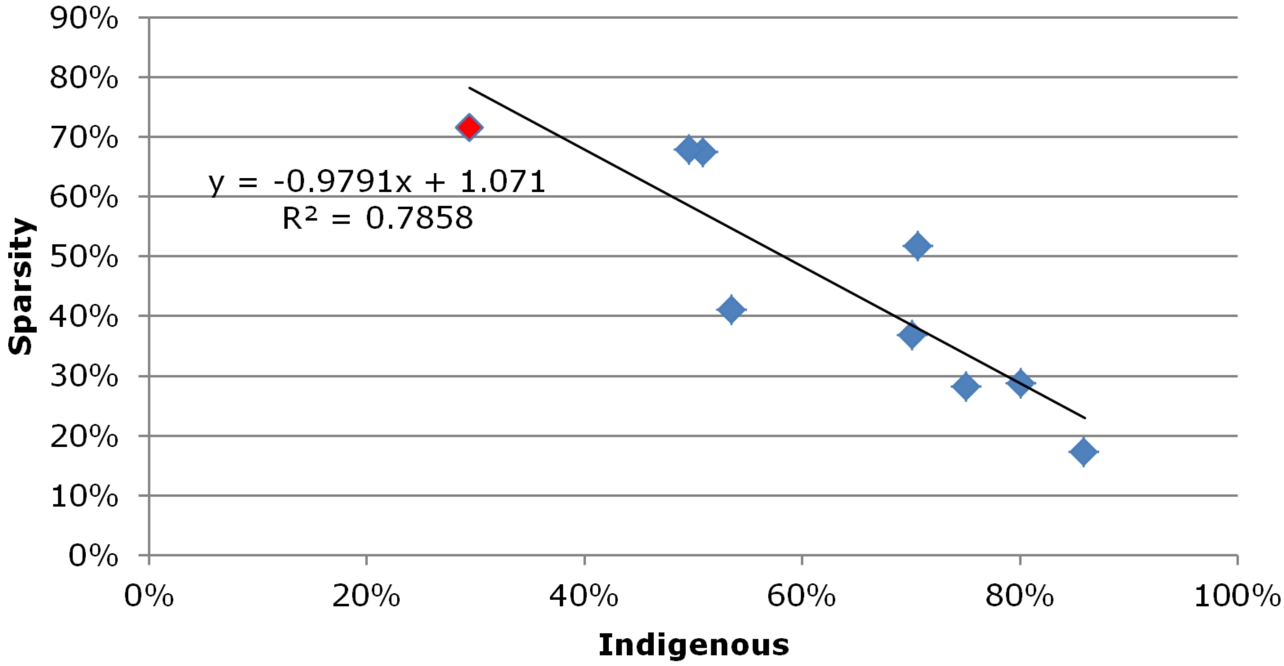
ii. The relationship between indigenous sludge and population sparsity

Figure 1 demonstrates that there is a strong correlation between population sparsity (here defined as the medium level of sparsity defined by Ofwat, that is <600 persons/km^2) and the proportion of sludge generated at a WRC co-located with a STC ('indigenous sludge'). The individual datum points show the respective sparsity and indigenous shares for each WaSC in the 2017 Information

Request (IR17). The graph suggests that at the extreme where sparsity is close to 100%, the indigenous proportion would be close to zero. Contrariwise, if indigenous is at 100%, sparsity will be close to zero.

All water companies have to make the trade off described above between more STCs and higher transport costs. The strong correlation between the factors in the chart below (R2 = 0.79) reveals a collective consensus about the optimum relationship between demography and STC numbers.

Figure 1 Relationship between indigenous sludge and sparsity (Source: IR17)

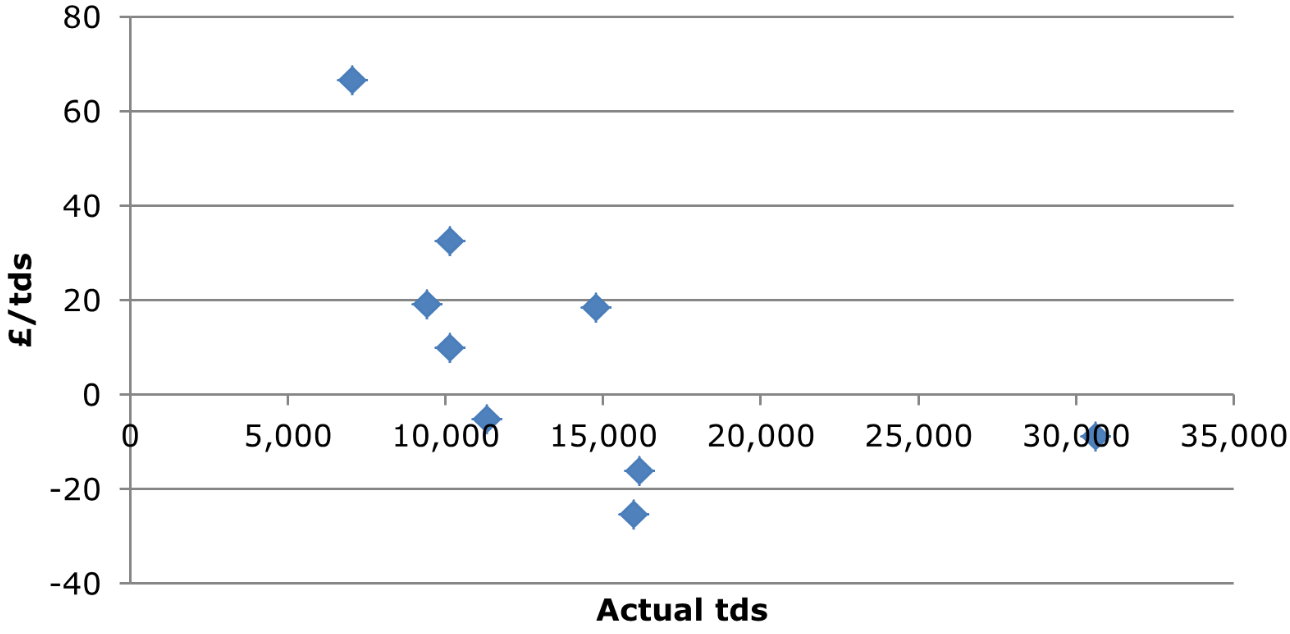


The red dot in Figure 1 represents Anglian Water. This suggests that our proportion of indigenous sludge (and therefore number of STCs) is consistent with the demographic characteristics of our region and in line with the collective consensus.

iii. Unit cost analysis based on our 10 AAD STCs

Figure 2 below shows the optimised marginal cost of treating an incremental tonne of dry solids at Anglian Water's 10 AD sites in 2016-17. It can be seen that for STCs treating less than 10,000 tds, the marginal cost incurred rises rapidly. It suggests that there is limited scope for adding incremental (smaller) STCs without seeing a significant increase in the marginal cost of operation.

Figure 2 Marginal cost of Anglian Water STCs (Source: Anglian Water)



iv. BMA scenarios

We have developed a suite of models of our sludge operations with consultants Business Modelling Associates (BMA). The models are designed to allow us to optimise our operations at a strategic level.

We have run scenarios on an unconstrained basis to determine the optimal size and location of STCs once existing STCs have reached the end of their planned life. The conclusion reached was that it would be beneficial overall to expand the capacity at existing sites and not to replace two STCs at the end of their lives, in the early 2030s. The additional transport costs which would be incurred as a result of going from ten to eight STCs would more than be offset by the economies of scale realised at the remaining STCs.

Consequently, insofar as the current number of sites is sub-optimal, the direction of travel is towards a greater and not lesser volume of sludge requiring to be transported. All other things being equal, this will tend to make us even more of an outlier than we already are. Put differently: our high levels of transport are not excessive but an integral part of the optimum solution for managing sludge in our region.

1.4.4 Best option for customers

As described above, we have found the optimum number of STCs to deliver the most efficient arrangements for treating the sludge in our region. This represents the best option for customers as it means we deliver our statutory obligation to manage sludge with the lowest overall bill impact.

As a result of our AAD strategy, which requires the transport of sludge from small, remote WRCs, we produce high quality digestate which our customers value. Evidence for the value placed on the treated product is the fact we earn ~£7/dry tonne from our digestate, a far higher figure than any other WaSC.

1.4.5 Robustness and efficiency of claim’s costs

We set out two possible approaches for estimating the value of a cost adjustment claim for sludge transport at PR19:

Using cost drivers alone

The first approach is to look at the IR17 cost drivers and estimate the extent to which companies are affected by differences in their operating circumstances.

In Table 1, below, we show the share of sludge transport costs (in absolute terms and normalised) as well as the share of non indigenous sludge. Indigenous sludge (I in Table 1) is sludge which is produced at WRCs which are co-located with STCs. Hence (1-I) is the share of sludge that has to be transported to STCs.

Table 8 Normalised costs and (1-I) share from IR17 for 2017 (Sources: IR17, Anglian Water analysis)

	Transport costs as % Biores	Transport share normalised	% sludge transported (1-I)	(1-I) normalised
ANH	27%	159.8%	71%	194%
NES	12%	72.5%	47%	128%
UU	11%	65.5%	25%	69%
SRN	16%	94.6%	29%	80%
SVT	22%	131.0%	30%	82%
SWT	19%	113.4%	30%	82%
TMS	8%	49.4%	14%	39%
WSH	23%	136.9%	49%	135%
WSX	21%	125.5%	50%	138%
YKY	12%	70.8%	20%	54%
Weighted Average	**17%**	**100.0%**	**36%**	**100%**

The starting point for the calculation was the work done in moving liquid sludge (see Figure 3). The figure for Anglian can be seen to be 81.6million m^3km/year.

In the final column of the table we show the ratio of (1-Indigenous) for each company compared to the industry average. Companies with figures below 100% transport less sludge than the industry average while those with figures above 100% transport more. The figure for Anglian is 71%; the weighed average is 36%, giving a ratio of actual to average for Anglian of 194% (see Table 1).

Figure 3 Tanker volume work done in 2016-17

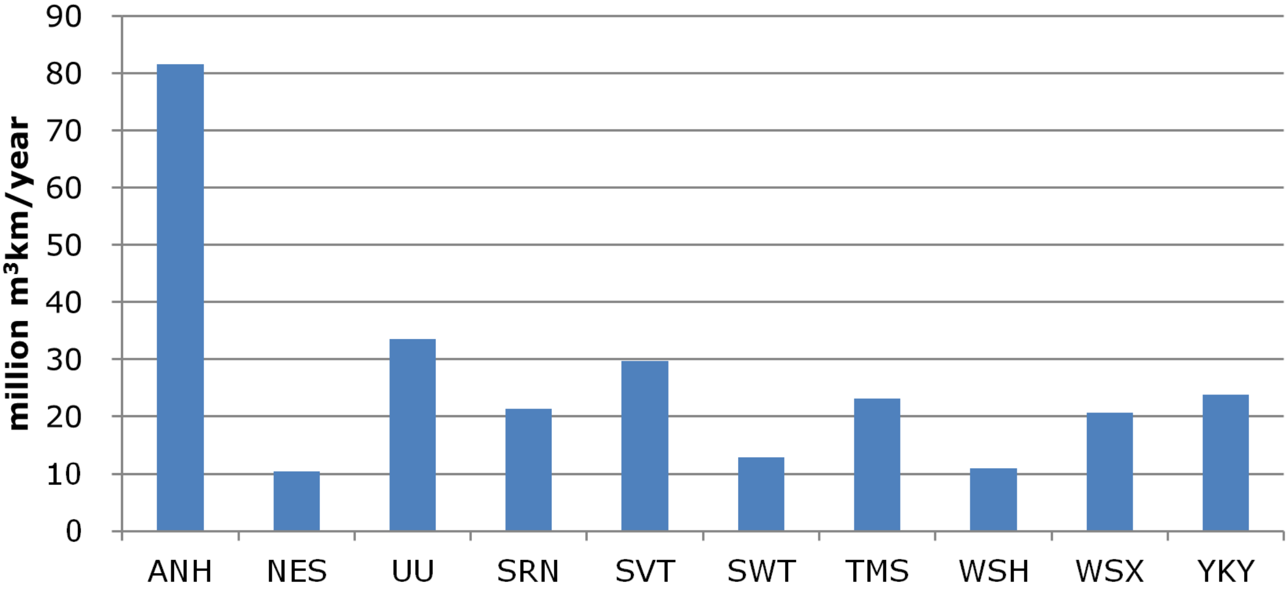
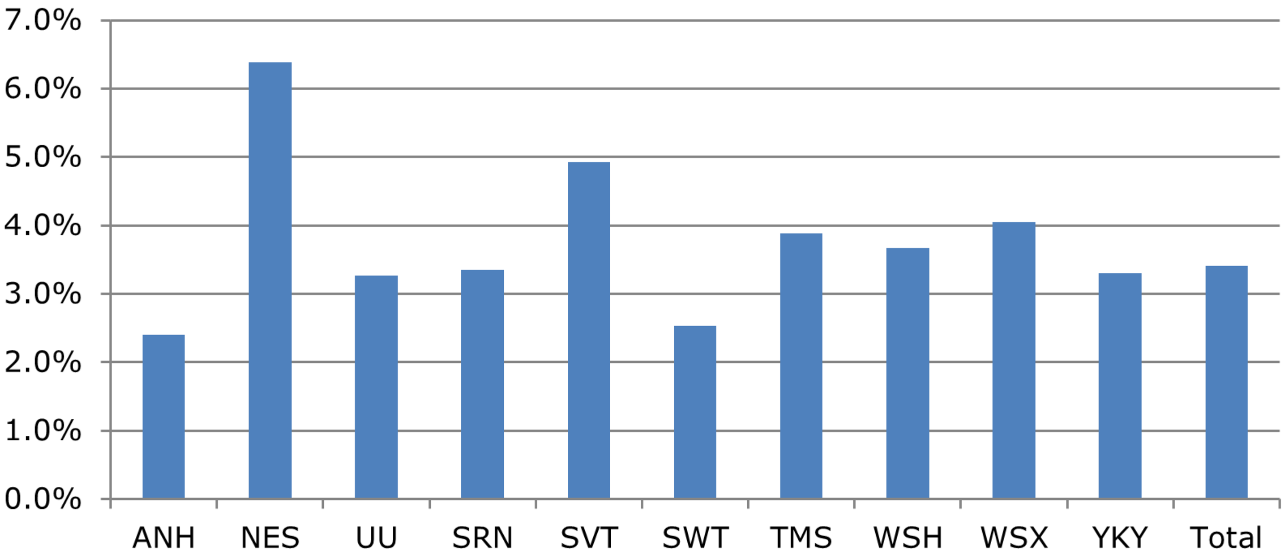


Figure 3 shows that in 2016-17 our total work done by tanker was 81.6 million m^3km.That implies that if our level of indigenous sludge conformed to the industry average, then the figure for Anglian would be 42.1 million m^3km/year (81.6 / 1.94).

The figures shown in Figure 3 refer to liquid volumes. For the purpose of the calculation, they need to be adjusted for the ratio of our dry solids (DS) in liquid to the average of all companies. Not to do so would potentially reward companies who deliberately refrained from dewatering so as to reduce costs. We can infer this from the ratio of the two measures for total measure of inter-siting 'work done' by tanker - by tds and by volume. These figures are set out in Figure 4.

Figure 4 Inferred dry solids in liquid sludge 2016-17 (Sources: IR17; Anglian Water analysis)



Our inferred figure is 2.4% which matches internal company estimates. This compares to a weighted average figure of 3.4% for all companies. The explanation for this low figure is that detailed studies have shown that we cannot cost justify active thickening at any WRCs below Band 5. Because we have such a large number of small (especially Band 1-3) works, we are destined always to have a low DS percentage.

Table 9 Inferred and normalised DS (Sources: IR17, Anglian Water analysis)

	Inferred % DS from IR17	Normalised inferred DS
ANH	2.4%	70%
NES	6.4%	187%
UU	3.3%	96%
SRN	3.4%	98%
SVT	4.9%	144%
SWT	2.5%	74%
TMS	3.9%	114%
WSH	3.7%	108%
YKY	3.3%	97%
Weighted average	**3.4%**	**100%**

From Table 2, if you further correct the ‘work done’ figure in line with the ratio of DS, the 42.1 million m^{3}km/year figure falls to 29.6 million m^{3}km/year (42.1 x 0.70). By making this adjustment, we are absorbing the cost of having to move unthickened sludge, even though we have shown that sludge thickening is uneconomic in our operating environment. This figure of 29.6 million m^{3}km/year thus represents the expected transport work done by a hypothetical company serving a region with average levels of indigenous sludge and average sludge thickness.

The additional work done as a result of our geography and demographics can then be calculated like this: Correcting the raw figure of 81.6 million m3km/year for DS gives a figure of 58.1million m^{3}km/year. This compares with the 29.6 million m^{3}km/year calculated above. This gives a difference of 28.5 million m^{3}km/year, representing the extent to which our transport work done varies from an industry average.

The question then that needs to be answered is how much does 1m^{3}km cost? 1m3 of dirty water weighs 1T, so the question is how much does it cost to move 1tonne by 1 kilometre? Internal estimates put the figure at 30p, implying £(0.3 x 28.5) million = £8.6m pa (in current prices) additional cost. This equates to £42.75m for the five years of a price control period.

The fundamental idea behind this approach is that while Indigenous is exogenous, thickening (and hence DS) is endogenous.

Using botex and cost drivers

This approach is similar to i) but takes as its starting point the reported sludge transport botex.

Within IR17, the sludge transport botex for Anglian in 2016-17 was £20.7m in 2012-13 prices.

So starting with the £20.7m figure, the first step is to correct for DS, following the approach and data above: this reduces the figure to £14.5m (20.7 x 0.70). In other words, this is the botex we would incur for sludge transport if we moved sludge at the industry average for thickness.

By comparison to the (weighted) average WaSC, the amount of work we do to move liquid sludge represents 194% of the industry average. In other words, if we matched the industry average, we would be doing only 52% (100/194) of the transport work we actually engage in. That means that the excess work we do annually as a consequence of our geographic and demographic factors is 48% of the (corrected) total. That equates to £(14.5 x 0.48)m "£7.0m (in 12-13 prices), or £8.1m in 17-18 prices. This equates to £40.4m for AMP7.

Conclusions

We have developed two approaches to computing our cost adjustment for sludge transport, both of which give similar figures which are material. Triangulating between the two approaches gives a figure of £41.6m. This is the figure we have used for the cost adjustment.

We can apply the same methodologies as used above to evaluate the impact of the sludge transport factor for any company. There are, in all, four companies (including Anglian) which would benefit from either of these approaches. These are set out in Table 3 below.

Table 10 Sludge Transport Cost adjustment beneficiaries (Sources: IR17, Anglian Water analysis)

	AMP7 benefit		
£m 17-18 price base	**Approach 1**	**Approach 2**	**Triangulated**
ANH	42.7	40.4	41.6
NES	6.3	9.9	8.1
WSH	4.5	9.6	7.1
WSX	10.1	18.3	14.2
Total	**63.7**	**78.2**	**70.9**

Contrariwise, there are six companies which do not benefit. In Table 4, the aggregate cost adjustment cost is spread across these six companies pro rata to the tds produced by those companies. The figures for these six companies are shown in Table 4.

Table 11 Sludge Transport Cost adjustment contributors (Sources: IR17, Anglian Water analysis)

	AMP7 cost		
£m 17-18 price base	**Approach 1**	**Approach 2**	**Triangulated**
NWT	-10.9	-13.3	-12.1
SRN	-6.9	-8.4	-7.6
SVT	-13.5	-16.6	-15.0
SWT	-2.3	-2.8	-2.6
TMS	-22.0	-27.0	-24.5
YKY	-8.2	-10.0	-9.1
Total	**-63.7**	**-78.2**	**-70.9**

1.4.6 Customer protection

We interpret customer protection to mean keeping bills as low as possible. We have sought to demonstrate in section 3 how we have developed the most efficient possible arrangements for sludge management in our sparsely populated region, thus minimising the bill impact for our customers.

Above, we demonstrate the impact of applying the same approach to the other nine WaSCs.

1.4.7 Affordability

By optimising our sludge transport operations, as we have demonstrated above, we ensure that we minimise the impact of sludge transport on affordability.

1.4.8 Board assurance

External assurance of this cost adjustment claim has been undertaken by Jacobs.

Our Board has reviewed the assurance provided by Jacobs and has endorsed our cost adjustment claims in the attached Board Resolution which is shown in Appendix 2.

love every drop
anglianwater

Anglian Water Services Limited
Lancaster House
Lancaster Way
Ermine Business Park
Huntingdon
Cambridgeshire
PE29 6XU

www.anglianwater.co.uk

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