SRN21 Advanced Digestion
Cost Adjustment Claim

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from Southern Water

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Glossary

Abbreviation	
AD	Anaerobic Digestion
AAD	Advanced Anaerobic Digestion
AMP	Asset Management Plan
ATC	Advanced Thermal Conversion
BAS	Biosolids Assurance Scheme
BAT	Best Available Technique
CHP	Combined Heat and Power plant
DPC	Direct Procurement for Customers
EA	Environment Agency
EPR	Environmental Permitting Regulations
FRfW	Farming Rules for Water
IoW	Isle of Wight
SE	South-East
STC	Sludge Treatment Centre
TDS	Tons of Dry Solids
WaSCs	Water and Sewerage Companies

Executive Summary

This cost adjustment claim sets out our proposed adjustment to facilitate the introduction of advanced anaerobic digestion (AAD) at our Ham Hill and Ashford sludge treatment centres, significantly improving the resilience of our biosolids operation. This is a key risk for Southern Water, as our biosolids operation is totally reliant on recycling sludge to land and we face disproportionate pressure on our limited available landbank for sludge recycling.

The introduction of AAD will improve the quality of our biosolids product and reduce the overall mass and volume of biosolids to be recycled to land. These improvements will strengthen the resilience of our biosolids operation and will mitigate the high risk we currently face to our biosolids operation of any reduction in demand for biosolids or restriction on our ability to recycle to land.

Advanced anaerobic digestion will increase demand for our biosolids, as AAD treated biosolids can be used for a wider range of crop applications under the safe sludge matrix. The drier AAD treated biosolids will improve performance for farmers and reduce the risk of run-off to surface water. AAD will also reduce the overall dry mass of our biosolids by ~18.5% and reduce volume by ~32% compared with conventional treatment, reducing the total landbank needed to recycle our biosolids product.

Table 1: Summary evidence table

Test	Brief summary of evidence to support claim
Need for cost adjustment	Atypical investment is required to upgrade the technology of our digestion facilities from AD to AAD in order to satisfy future capacity and quality requirements for the disposal of our bioresources. Ofwat's models will not adequately fund the lumpy investment that Southern Water needs at this point in time to change the technology from CAD to AAD.
Uniqueness	We have the largest proportion of conventional digestion in the industry (UK) and our treated sludge is mostly limited to applications on cereal crops and to a lesser extent oil-seed rape (due to current regulatory requirements). This limits the farms that we can recycle to. Biosolids are recycled to agricultural land, however the South-East of England has the lowest farmed area and the second lowest area of cereals (biosolids typical outlet) when adjusted for population. Advanced Anaerobic Digestion demonstrates Best Available Technique (BAT)[4] for sludge treatment and can mitigate landbank pressure, however, we currently have the lowest adoption of AAD in the industry.
Management Control	This investment has been driven by an increasing number of factors outside of management control including the threat of resilience on the supply chain through the Farming Rules for Water (FRfW)[2] requirements, the Environment Agency's (EA) Policy Paper 'Strategy for safe and sustainable sludge use'[5] and adherence to BAT requirements for biological treatment of waste. In addition, we have a relatively low proportion of farmed area, wheat area and cereal area when adjusted for population[6].
Materiality	The claim is material at £112.8m of the forecast AMP8 Bioresources business plan totex, compared to the Ofwat materiality threshold of 6% of totex (£23m).

Adjustment to allowances	This is additional expenditure required from an atypical investment that the bioresources econometric models do not account for. Because of our updated timescales for delivery, we do not expect any beneficial use from the 2 plants within AMP8 and have therefore calculated the implicit allowance to be 0.
Need for Investment	The threat to resilience of the supply chain through the FRfW requirements in terms of nutrient management and the EA's Strategy for safe and sustainable sludge use.
Best option for customers	The optioneering has demonstrated that AAD is the best option available and is supported by our customers.
Cost Efficient	We have benchmarked our scope and construction costs for the two sites and have addressed the discrepancies where required. These included removal of Growth element (included in the totex allowance) and adjustment of design/costing of a specific asset (THP).
Customer Protection	We have set out a price control deliverable to ensure customers are protected if we do not deliver.

What is the claim for?

Investment is required to convert Ashford and Ham Hill STCs in Kent from Conventional Anaerobic Digestion (CAD) to Advanced Anaerobic Digestion (AAD), including improved dewatering of digested sludge to increase the supply chain resilience of biosolids recycling by:

- Increasing farmer acceptance of biosolids product by an expected 50% (Appendix 1-a)
- Ensuring compliance with BAS pathogen (currently not achievable without secondary remediation) and updated BAS dried solids standards.
- Increased product dryness (better stackability in fields resulting in reduced slumping, smaller field footprints and reduced risk of run-off to surface water).
- Enhanced pathogen destruction allowing farmers to apply enhanced product (safe sludge matrix) to a wider range of land (e.g. grassland which covers one-third of agricultural land in the South-East of England[1])
- Reduced odour

In addition, the tightening of spreading windows and stricter criteria of applications (i.e. Farming Rules for Water[2]) will reduce the amount of agricultural land (landbank) available to recycle our Biosolids.

Beneficial use of the additional biogas produced (Combined Heat & Power) also supports our customers view that we should be recovering and producing more renewable energy and reducing our carbon footprint.

Ofwat uses benchmarking models to determine the efficient bioresources base cost allowances. According to Ofwat's April 2023 cost model consultation[3], such models rely on the relationship between historical costs (for operating and maintaining existing assets plus enhancement expenditure to accommodate sludge growth) from 2011-12 to 2021-22 and exogenous cost drivers. The econometric models provide insufficient allowance to accommodate the lumpy investment needed to change the technology from CAD to AAD for two reasons. Because the econometric models cover only 11 years of historical data, they do not include long-run capital maintenance costs longer than the asset life of CAD assets, and therefore provide insufficient allowance to fund the type of lumpy investment that Southern Water needs at this point in time to change the technology from CAD to AAD. This is compounded by the fact that the econometric models do not include enhancement expenditure to accommodate sludge quality improvement, such as transitioning

from CAD to AAD, that other companies have incurred in the past meaning that the modelled allowances do not reflect such historical lumpy costs.

Without a resilient landbank, Southern Water may be unable to beneficially recycle biosolids to agricultural land instead relying on landfill or incineration in the short term. This outcome does not align with the UKs net-zero carbon commitments, DEFRAs call "for near elimination of biodegradable waste disposal to landfill from 2028" nor Southern Waters environmental aims. Our view is that delivery of AAD in this area will help mitigate landbank risks and that this warrants a separate cost adjustment to accommodate Southern Water's specific circumstances (outlined in Section 2). We also recognise the transition to AAD and the drier product it produces is part of the adaptive pathway leading to the development of advanced thermal conversion technologies which could be utilised if biosolids recycling became unviable in the future.

Table 2: Summary of claim

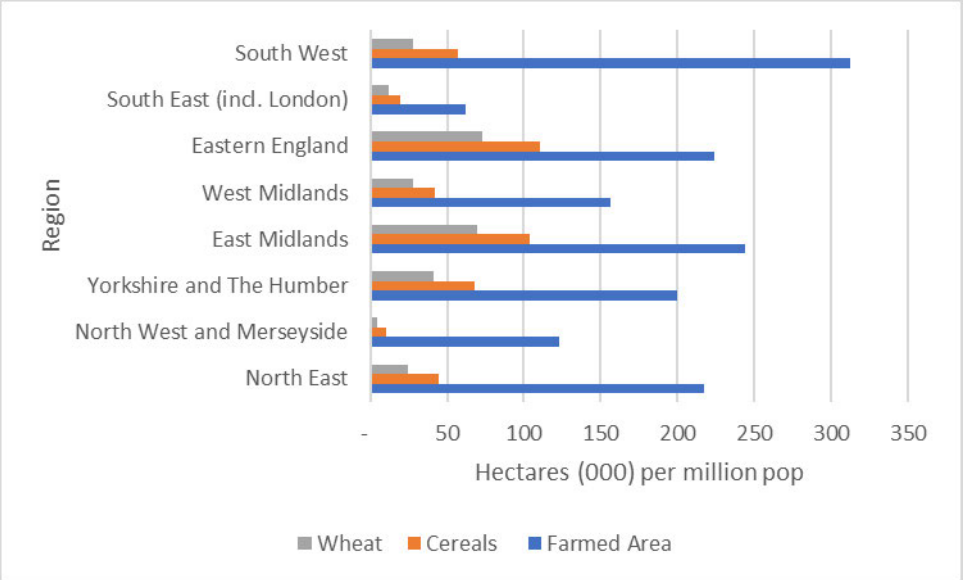
Name of claim	Advanced anaerobic digestion at Ashford and Ham Hill
Business Plan Tables where botex claim is reported	CWW18
Price control the claim relates to	Bioresources
Total gross value of claim for AMP8	£112.8m
Total implicit value of claim for AMP8	£0m (however, see Section 1.4)
Total net value of claim for AMP8	£112.8m
Materiality for relevant price controls	£23m
DPC?	No, but see text in section 4

1. Need for Adjustment

1.1. Why is Southern Water Unique?

The South-East (SE) of England (including London) is the most populous region of the UK with a population over 18 million. Significant quantities of biosolids are produced treating the wastewater produced in the SE and are typically recycled to cereal crops, particularly wheat. Adjusted for population, the SE has the smallest farmed area and the second lowest area of farmed cereals and wheat among English regions[6] as demonstrated in Figure 1.

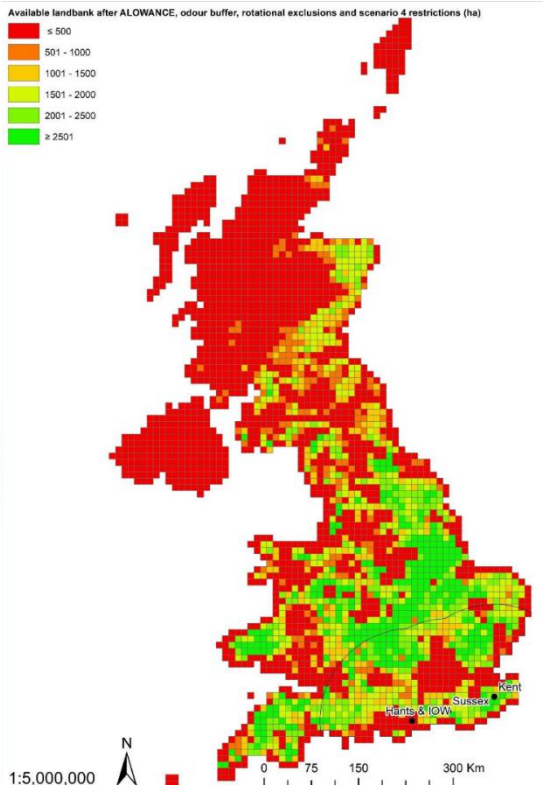
Figure 1: Farmed Areas by Region[6]



SWs region has significant coastal populations including South Hampshire, Brighton & Hove and Medway. Within these regions biosolids produced cannot easily be transported radially (because of the coast), limiting disposal to inland locations. Pressure on these locations is compounded by our proximity to Greater London, which produces vast quantities of biosolids with limited available landbank. London's biosolids are largely exported to surrounding landbank in Eastern and Southern England. Adjusted for population, our counties of Hampshire & Isle of Wight (IOW), Sussex and Kent have approximately one-third of the cereal/wheat area compared to Eastern England[6] which results in disproportionate pressure on the local landbank. Compounding this challenge is more varied topography and smaller field sizes (46% <20 Ha, 20.9% >100 Ha) compared to Eastern England (35.3% < 20 Ha, 33.6% >100 Ha)[6] further increasing recycling cost and complexity. Southern Water have considered transporting biosolids further to areas with higher quantities of landbank, however this was not deemed viable because of increased requirement for on-site storage and increased transport costs.

In addition, competition for the outlet from other organic wastes and the tightening of spreading windows / criteria of applications[2] risk a diminishing landbank. Whilst this is also true for other WaSCs, we have unique circumstances in our region and Kent in particular is a 'hotspot' of limited landbank availability. The Kent region is currently the most stressed area for our Bioresources operation from a resilience perspective and North Kent especially is one of the most stressed areas country-wide and therefore faces higher costs in the round compared with its peers (Figure 2).

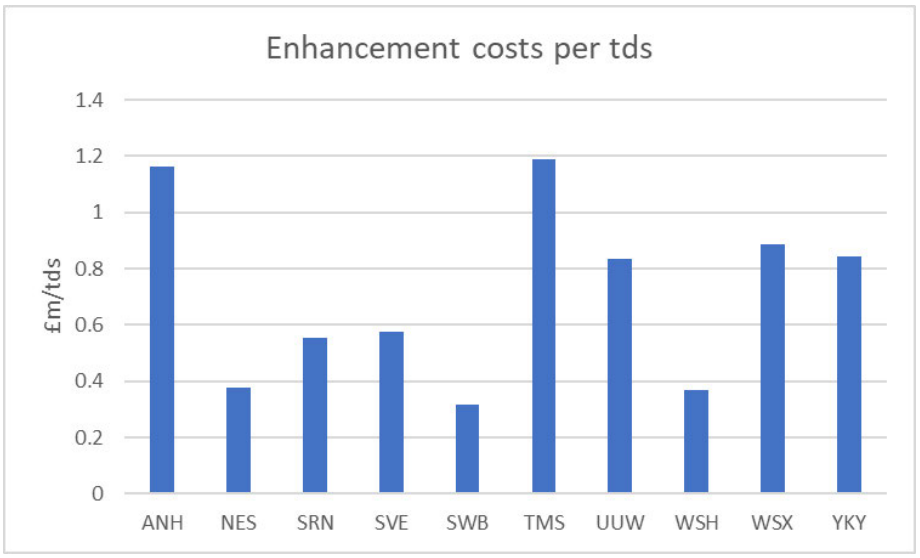
Figure 2: Agricultural land available to Southern Water with current operation (incl. impact of Farming Rules for Water).



At present, we treat 100% of our sludge through conventional anaerobic digestion (CAD). Whilst we ensure 100% of our treated Biosolids recycled to agriculture is compliant, the current performance of our STCs, in terms of pathogen reduction, is varied and double handling of the material (additional maturation, chemical use, transport) is required to ensure compliance to the microbiological standards in BAS is achieved. Implementing AAD will help ensure our product is 100% compliant and can be recycled to agriculture immediately.

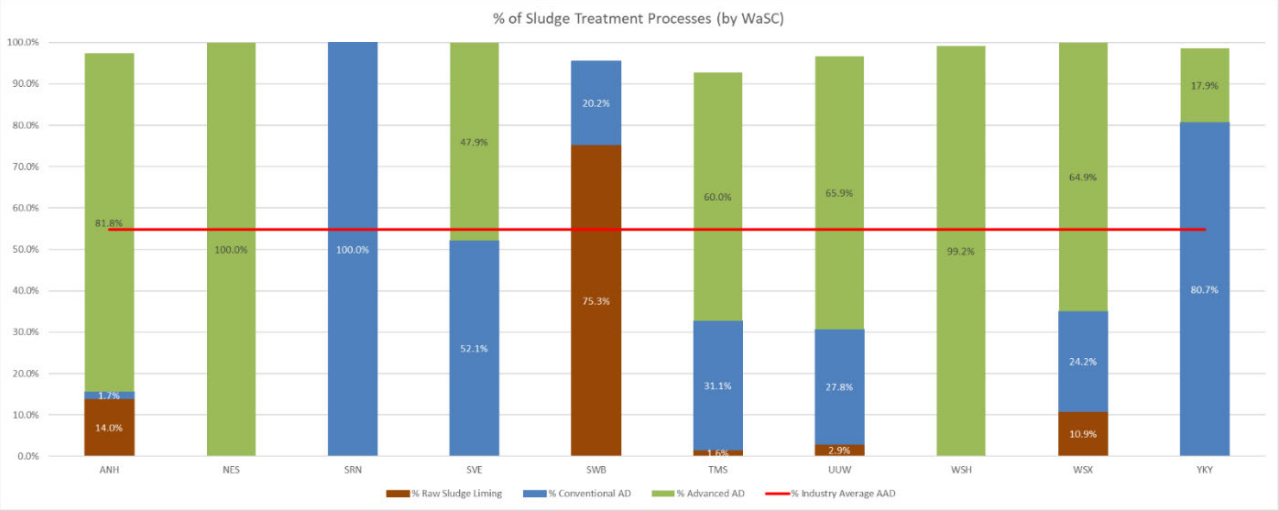
The main attractiveness of companies investing in AAD in the past, is the increased biogas production (and associated incentives - e.g. Renewable Obligation Credits, Renewable Heat Incentives, Green Gas Support Schemes), this in turn maximises efficiency and profitability of the bioresources business. At Southern Water, our focus was instead to ensure we kept our customers' bills low, therefore we endeavoured to maximise the use of our existing assets and chose a lower CapEx strategy. This is demonstrated from Figure 3 below which shows our total enhancement capex spent over the last 10 years per TDS comparative to the industry.

Figure 3: Enhancement CapEx – Industry comparison (APR 2013-2022)



The incentive schemes for biogas are either no longer available or being phased out and the outlet security for our treated sludge (landbank) is now at much higher risk (as described in section 2). These alongside the relatively mature and proven status of advanced digestion are the reasons why we recognise we now need to invest in such technology.

Figure 4: Sludge treatment process (by percentage – APR Industry Datashare 2022)



In comparison, as shown on Figure 4, only an average of 33% of the industry's raw sludge is treated through conventional AD, with AAD being the most common type of treatment (55% on average). Pressure on regional landbank can be mitigated through the adoption of advanced digestion (AAD) which significantly reduces the volume of biosolids produced and increases its quality resulting in an enhanced biosolid output. Enhanced (sometimes called Class A) biosolids benefit from increased dryness, improved farmer acceptance and can be applied to a wider range of agricultural soils. WaSCs in the South-East, including Thames Water and Anglian Water, already operate AAD processes with 60% and 81.8% of sludge treated this way respectively. Following the implementation of AAD in our Kent area, c. 30% of our sludge will be treated through this process.

Delivery of AAD in this area will mitigate these risks and this warrants a separate cost adjustment to accommodate Southern Water's specific circumstances which the econometric models used to determine efficient cost allowances for bioresources do not account for (see section 1.4).

1.2. Management Control?

This investment has been driven by an increasing number of factors outside of management control that threaten the access to the agricultural landbank outlet. For example, exceptional weather events caused by global warming is leading to more frequent intense rainfall impacting access to fields which can increase the pressure on other available land.

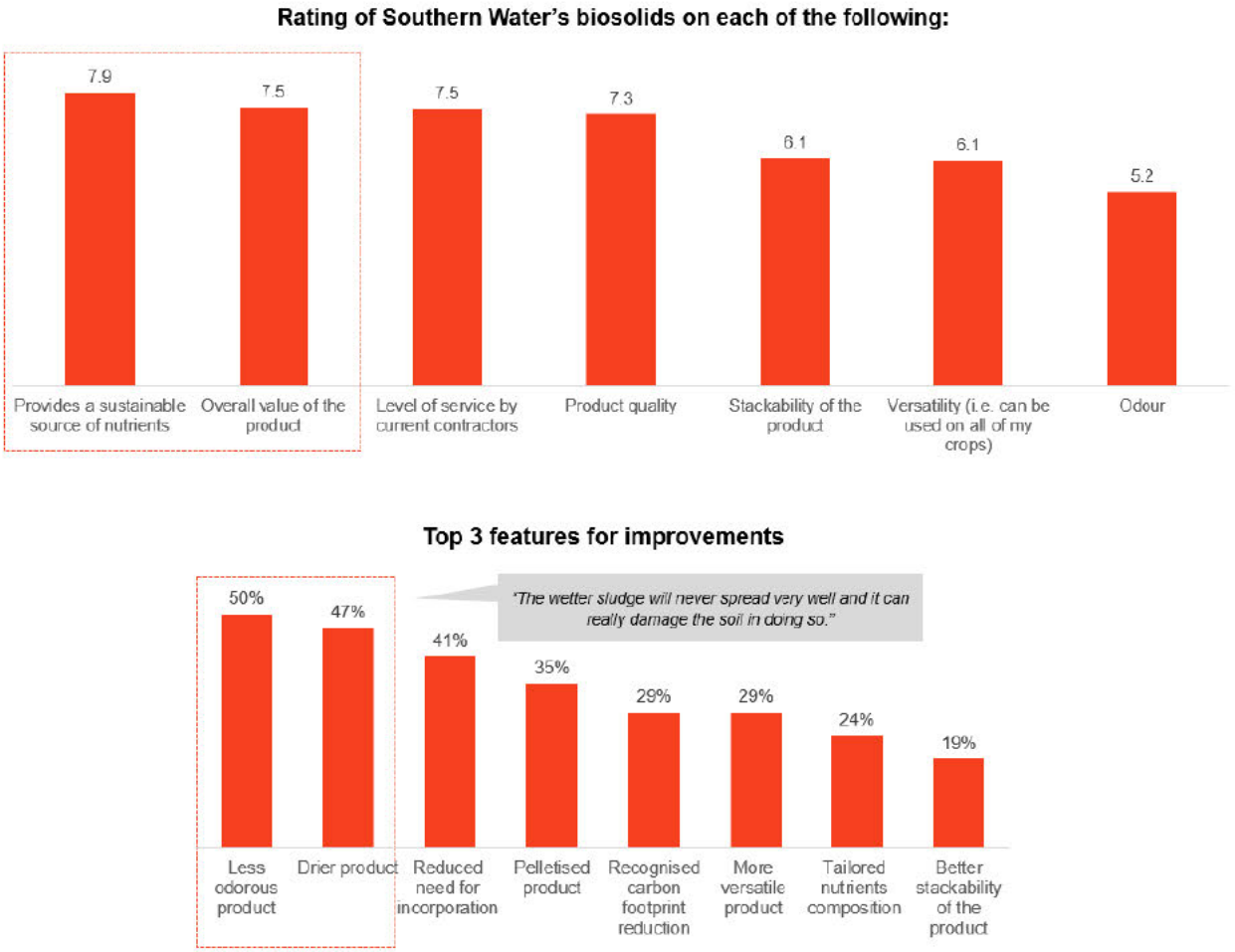
There is also the cumulative impact of changes to the regulatory environment governing biosolids treatment and its management including, for example:

- Nutrient restrictions and the ongoing Farming Rules for Water (FRfW)[2] implementation
- The Environment Agency's (EA) Policy Paper 'Strategy for safe and sustainable sludge use'[5] highlights their intention to move biosolids recycling to land activities from the Sludge (Use in Agriculture) Regulations to the Environmental Permitting Regulations (EPR) based framework.

These changes, as described further in section 2, will make recycling of our treated sludge to agriculture more challenging. This will have a greater impact on our operation as access to farmland areas in the South-East is already limited (Figure 1).

In addition, farmers are demanding enhanced product quality (greater dryness to improve stockpile stability, more consistent nutrient content, and ability to apply to great variety of crops outside ploughing periods) and to this extent, the resilience of the supply chain to agriculture is dependent on Southern Water investing in improved treatment technologies. Our customer engagement survey (discussed further in Section 2) has shown that it is primarily external factors that would prevent the future use of biosolids by farmers – this includes regulatory constraints, phosphorus levels in the soil or restrictions on certain soil types. Without further investment to improve the product quality to make it more consistent, less odorous and drier (to make spreading easier), these stakeholder concerns have the potential to impact the longevity of this option. We gathered from the farmers surveyed that the value of our biosolids is one of the top reasons for using it but they would prefer to use a product which is drier, less odourous, and easier to store, spread and cultivate (Figure 5 below and additional information in Appendix 2).

Figure 5: Rating of our biosolids currently available (rating out of 10) and areas of improvement



1.3. Materiality of claim?

We have calculated the materiality threshold for the Bioresources price control, based on an early view of our AMP8 Totex.

Table 3: Materiality Thresholds

Price control	Expected AMP8 totex	Materiality threshold (%)	Materiality amount (£m)
WWN+	£387m	6%	£23m

The claim is material. The additional costs above those provided by Ofwat's modelled base costs amount to £112.8m. This is 29% of the projected business plan Totex for Bioresources (and is above the 6% threshold). This is comprised of upgrading our 2 Bioresources sites:

- Ham Hill - £72.5m
- Ashford - £40.3m

Table 4: Materiality of Claim

Price control	Threshold (£m)	Net value of the claim (£m)	Status
BIO	£23m	£112.8m	Pass

Section 1.4 below explains how we derived the cost of the claim gross and net of implicit allowances.

1.4. What are the adjustments to the allowances?

The cost claim is not included in our modelled cost allowances, which do not make allowances for lumpy investments that take place at discrete points in time. Indeed, according to Ofwat's April 2023 cost model consultation, the PR24 bioresources econometric benchmarking models will rely on the relationship between historical costs (which include cost for operating and maintaining existing assets plus enhancement expenditure to accommodate sludge growth) from 2011-12 to 2021-22 and exogenous cost drivers accounting for scale, economies of scale in sludge treatment and location of sewage treatment works relative to sludge treatment centres. The econometric models provide insufficient allowance to accommodate the lumpy investment needed to change the technology from Conventional AD to Advanced AD for two reasons. First, because the econometric models include only 11 years of historical data, they do not include long-run capital maintenance costs longer than the asset life of AD assets. As such, the models do not fund lumpy investment needed at discrete points in time to change the technology, which is the case of the investments proposed in this claim. Second, the econometric models do not include enhancement expenditure to accommodate sludge quality improvement, such as transitioning from Conventional AD to Advanced AD, meaning that other companies' enhancement expenditure in transitioning to Advanced AD is not factored into the modelled allowances.

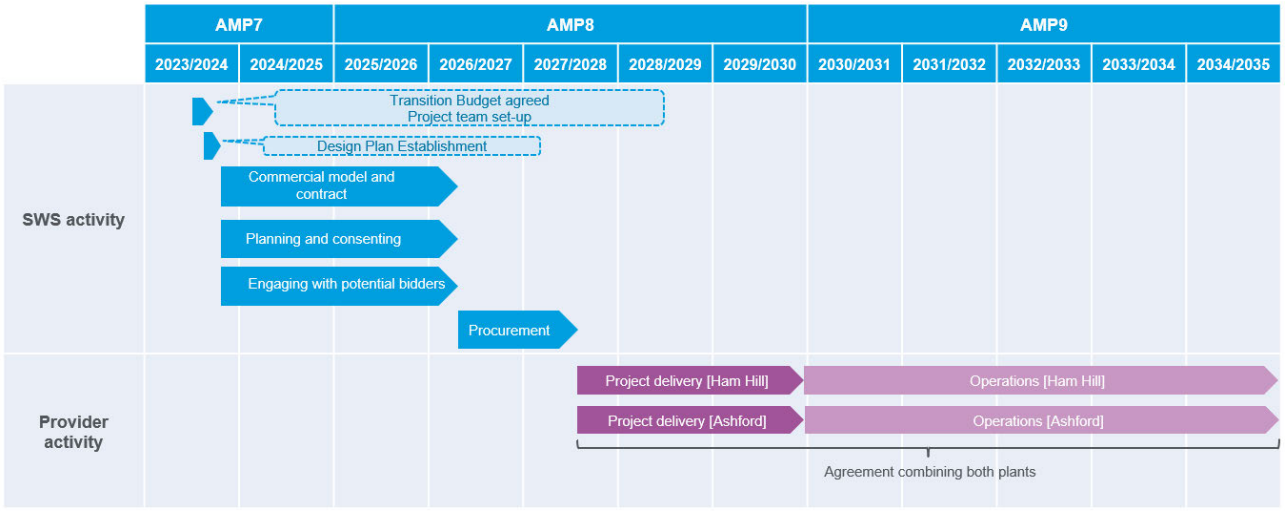
Whilst we are planning to deliver a significant technology upgrade to these sites, the existing assets will need to be retained until commissioning is complete.

The modelled bioresources efficient totex allowance will then continue beyond AMP8 as we will need to maintain the new assets. As these assets will provide additional benefit in terms of biogas and renewable energy potential, it may be deemed that the totex cost needed to operate these new assets will reduce to allow for this. However, this is already partially reflected in the efficient modelled allowance because the historical cost data used in the econometric models reflect the fact that 55% of sludge in the industry is already treated through AAD technology of which was funded through additional enhancement allowances not base expenditure.

For this claim, any implicit allowances would be related to accommodating Growth at sludge treatment centres which OFWAT is likely to provide an allowance for as part of its base econometric models and to this effect has been removed from the initial costing as per Table 8 below.

In our June 23 submission, our initial Cost Adjustment Claim accounted for an Implicit Allowance of £2.3m. This was based on an assumption that Ham Hill AAD plant would be in operation by 2028/2029, ready for beneficial use and associated reduction in capital maintenance for the consolidated sites in North Kent (Aylesford, Gravesend, Motney Hill & Queenborough). However, as discussed further in Section 4, we are considering delivering this project through our alternative financing route, which will add complexity and time, ahead of the physical build on site. The high-level timescale described below in Figure 6 built based on our in-house experience shows the work on site is unlikely to start before 2027/2028 with completion during the last year of AMP8. To this effect, no beneficial use is currently expected from this project until the beginning of AMP9. We will estimate any possible allowance related to capital maintenance for all sites in Kent that is implicit in the econometric models once we have clarity from Ofwat on the specification of the Bioresources econometric models. We anticipate this to be a minor amount (not greater than £5m) because all sites in Kent will remain in operation only until the new assets are fully commissioned. At present we assume the implicit allowance to be 0.

Figure 6: Impact of alternative funding on delivery timescales



2. Need for Investment

There is a need to ensure our biosolids is consistently acceptable by our customers (farmers) in terms of regulatory compliance, price and product quality, so that demand stays above the supply, especially in a highly competitive market from other WaSCs already producing enhanced quality biosolids and low-cost manures and slurries. Whilst we ensure 100% of our treated Biosolids recycled to agriculture is compliant, the current performance of our STCs sometimes requires us to extend treatment through additional maturation or chemical use to ensure compliance to the microbiological standards in BAS is achieved. Improving our sludge management practices by utilising advanced sludge treatment technology increases our resilience in managing the impacts of climate change (such as wet weather limiting access to outlets) and periods of supply chain disruption (e.g. during closed spreading periods as a consequence of FRfW) by reducing the volume of treated sludge produced and improving the way it can be stored (e.g. dryer product, easier to stack). This will better serve the continuous production of biosolids that are beneficially supplied to our farming customers for spreading onto their agricultural land.

The full impact of the application of the Farming Rules for Water especially could increase the cost of Biosolids disposal 5 fold as 2/3 of the Biosolids produced in the UK would require alternative outlets (Appendix 1-b)) (likely landfilling and incineration, assuming space is not a constraint), increasing our current OpEx from c. £28.2m pa to £47.7m pa.

Pre-empting this challenge as early as possible by ensuring we produce Biosolids widely accepted by farmers whilst trying to reduce volumes through implementation of a cost-effective strategy should be our focus in the coming years.

When we consulted with our customers both farmers (see Appendix 2) and bill payers (see Appendix 3–a) about AAD, their initial reactions were positive, with many feeling that the use of advanced processes and the production of higher quality material (e.g. consistent, easier to handle) was beneficial and a step forward. The farmers survey suggested that getting access to biosolids that can be used more broadly across more types of crops is a way of maximising the beneficial use of a product which would be otherwise disposed/destroyed, which also aligns with our sustainability objectives.

There is also evidence that our customers support the need for investment in that they want to see pollution stopped and in making these improvements to our product quality and complying with Farming Rules for Water[2], we are achieving a higher level of environmental protection:

- We reduce the volumes of biosolids that need to be moved to agricultural land, thereby reducing fuel consumed in haulage,
- AAD has lower fugitive emissions that conventional digestion due to greater containment within the process
- The biosolids products are more stable, reducing the risk of diffuse pollution due to run-off once stockpiled in fields.

The focus on Kent, compared to any other area is because our operation in this region is the most challenging with assets being on average older and capacity being more constrained (as described further in our SRN36 Bioresources Strategy Technical Annex). Kent is also the area where consolidation would be the most valuable, as discussed in Section 3.

In addition, regulatory compliance and future wastewater infrastructure is one of the top priorities areas that are important to our customers (See SRN14 Customer Insight). This need has been clearly defined as part of our long-term Bioresources Strategy and the scale and timing of the investment is justified.

These schemes were initially included as part of our WINEP submission for Bioresources in November 2022 but were subsequently marked as "Removed" by the Environment Agency which means they accepted the benefits of the schemes being proposed but considered they were not part of the scope of the WINEP Sludge Drivers. We believe a Cost Adjustment Claim is our best option moving forward.

3. Best Option for Customers

There is a need to ensure wider stakeholder confidence in the biosolids to land route, including continued accreditation to the industry Biosolids Assurance Scheme (BAS).

In order to ensure we have taken the best possible option for our customers we have considered a range of treatment options to meet our requirements as outlined in Table 5 below:

Table 5: Options summary

#	Option	Decision	Overview
1	Do Nothing	Discounted	The existing system of conventional digestion retains less solids destruction and therefore greater haulage to farms. The need for further processing (a mixture of liming and maturation) lowers farmer acceptance due to lower biosolids dryness; creates numerous compliance failures in terms of pathogen reduction; and does not mitigate the risk of diffuse pollution in fields due to risk of slumping stockpiles
2	Incineration	Discounted	Incineration is undeliverable for at least 10 years and does not align with our carbon strategy
3	Advanced Thermal Conversion	Discounted	The technology readiness level is not high enough yet for the industry to adopt this at the current time. ATC can be bolted onto AAD as a future further mitigation to landbank issues, should more prominent risks materialise.
4	Develop Lime stabilisation further	Discounted	Discounted due to the process increasing volumes of Biosolids post-treatment and can be highly odorous due to the release of ammonia during the treatment stage. Requires chemicals that are energy and carbon intensive in their production. Liming is not considered as a sustainable form of sludge treatment, especially moving forward with a more challenging landscape in terms of biosolids recycling.

5	Conventional Anaerobic Digestion (incl. secondary digestion)	**Considered**	Similar to current method employed but would require the addition of secondary digestion on all STCs. It doesn't provide the same level of solids reduction and stabilisation as AAD and therefore results in lower farmer acceptance and therefore greater field requirements. Higher level of carbon emissions according to the Carbon Accounting Workbook, compared to AAD.
6	Conversion to Advanced Anaerobic Digestion of 6 sites in Kent	**Considered**	Addition of AAD to provide better product quality and volume reduction. AAD also offers increased digester throughput and has better overall gas contaminant (fugitive emissions). AAD biosolids also have reduced emissions from biosolids cake due to improved solids processing. AAD to be implemented at 6 sites in Kent out of 7, the remaining one (Aylesford STC) being too close to Ham Hill to be beneficially converted to AAD.
7	Conversion to Advanced Anaerobic Digestion & Consolidation of sites	**Adopted**	Addition of AAD to provide better product quality and volume reduction. AAD also offers increased digester throughput and has better overall gas contaminant (fugitive emissions). AAD biosolids also have reduced emissions from biosolids cake due to improved solids processing. AAD to be implemented and consolidation of all sites to both Ashford and Ham Hill There is also an opportunity for our scope related to IED to be reduced as fewer AD sites would remain in operation in AMP8 (see Enhancement Business Case IED for more information).

We engaged extensively with relevant stakeholders to inform the selection of the best option for customers. This engagement was supported by Atkins' specialist bioresources team and was conducted in two phases, with an initial online questionnaire followed by a workshop. The online questionnaire was circulated to stakeholders from across the bioresources value chain. This included subject matter experts from our asset strategy, operations, carbon, energy and innovation teams. The multidisciplinary specialities of the panel engaged ensured a meaningful range of views and priorities could be captured. The questionnaire requested stakeholders to rate each technology listed above against a set of criteria (further details in our SRN36 Bioresources Strategy Technical Annex). The results showed Advanced Digestion technology being the technology rating the highest score against the agreed set of criteria and incineration rating the lowest.

Continuing our current operation ("Do Nothing" option) would impact our ability to recycle our Biosolids to agriculture more significantly. Our analysis shows that the impact of the application of the Farming Rules for Water would increase our recycling costs 5-fold, increasing overall OpEx for Kent from c. £8.2m pa to £14.6m pa (not including Carbon) according to modelling.

On this basis, we have carried out a Whole Life Cost analysis for the options considered as feasible, as described in Table 6 below. Using our Decision Support tool (from Business Model Associates) and for our Kent region only:

- CapEx was calculated over 25 years of operation using bottom-up cost curves for each option and includes existing asset replacement and capital maintenance over the period. The benefit of doing this over a longer period of time is that the model contains information related to remaining life of current assets and is able to give the analysis a more representative picture
- OpEx was averaged over 25 years of operation (including energy, transport, disposal) using typical process assumptions (including availability, capacity, performance) – does not include Carbon
- Carbon was averaged over 25 years of operation, using emissions factors from the latest version available of the Carbon Accounting Workbook.
- Whole Life Cost calculation was carried out over 20 years using SWS' WLC analysis tool

Table 6: Whole Life Cost Analysis

Option	CapEx (Total across 25 y £m)	OpEx (Average across 25 y - £m/y)	Carbon (Average across 25y t CO_2/y	Whole Life Cost (Across 20 years £m)
5 – Conventional Anaerobic Digestion (incl. Secondary Digesters)	219.1	14.6	9,575	351.32
6 - Conversion to Advanced Anaerobic Digestion of 6 sites in Kent	315.0	13.6	5,968	375.49
7 - Conversion to Advanced Anaerobic Digestion & Consolidation of sites	257.6	13.8	7,461	350.98

Although the WLC is marginal between Option 5 and 7, the preferred option (Advanced Anaerobic Digestion and consolidation of sites) will meet the need to provide modern sludge treatment quality for Kent area, in a cost-effective way and to a standard which will help mitigate coming legislative requirements (e.g. Farming Rules for Water) and reduce landbank risks. The biosolids produced at the end of the process can be used on a wider range of crops (e.g., grassland) and will be more widely accepted by farmers because of its attractive properties (easier to stack, less odorous and more versatile). This coupled with the volume reduction (increased solids destruction and improved dewaterability) will enable us to reduce the risks associated with supply chain disruption.

Significant uncertainty continues to surround the future of Bioresources operations as the continued use of biosolids as a phosphate-based fertiliser for farming is in doubt due to the anticipated DEFRA and EA regulations review in 2025.

The Bioresources core pathway in the long-term delivery strategy plans for a phased reduction in the use of landbank as a disposal mechanism by 2040-2050. To this effect, the development of our long-term Bioresources strategy (SRN36) includes the assessment and potential implementation of Advanced Thermal Conversion (ATC) type of technologies (e.g. Pyrolysis, Gasification) in order to fully mitigate the risks related to the landbank. The conversion of Advanced AD is seen as a "no-regret" solution as ATC processes could be easily installed post-AAD given the beneficial interdependencies between the two concepts, from a mass & energy balance point of view[7].

However, should a partial landbank ban be introduced in 2025, an adaptive plan is in place that will accelerate our move away from landbank use. The proposed Ashford and Ham Hill Advanced Anaerobic Digestion plants will remain a key component of our plans whatever the outcome of the review. However, a partial ban on landbank use would result in a re-focussing of future enhancement spend away from additional advanced digestion sites to thermal destruction technologies. Incineration is our potentially primary disposal mechanism in the short term. However, incineration is not our preferred option and as such is not in our core pathway as we recognise the associated customer reservations and high CO_2 footprint it would lock us into for 20+ years. Incineration only becomes an option, if both pyrolysis is tested and shown not to be viable, and if DEFRA and the EA make an adverse decision in AMP8.

We undertook qualitative and quantitative approaches to our farmer engagement including in-depth interviews and surveys of our farmers to gain feedback on the quality of the product provided to them, the benefits and barriers to using it as well as their needs in order to support our proposals. The feedback is that Biosolids is an inherent part of their operation because it provides their soils with useful, cost-effective nutrients. The prospect of getting better quality product is clearly welcome (Appendix 2-c).

Surveys show that our customers are supportive of our strategy to enhance our current operation and the quality of our product (Appendix 2–c and Appendix 3–a) . However, moving to incineration in order to fully mitigate the landbank challenge is seen as taking a step backwards due to its high CO_2 emissions profile (Figure 7 and additional information in Appendix 3- b). We agree with our customers and are keen to explore and adopt more advanced type of technologies (such as Advanced Thermal Conversion).

Figure 7: Reactions from our customers about potential use of incineration to treat sludge

We believe the option selected is appropriate to the size and complexity of the risks and issues to be addressed.

4. Cost Efficient

Cost estimates and costing stages are summarised in Table 7.

Our costing team derived initial costing through the use of cost curves for specific items extracted from the specific high-level design carried out by SWS' design team. These cost curves were built upon previous projects that included similar items.

[redacted] conducted third party assurance and external benchmarking of our internally developed cost estimates, which highlighted no significant difference in the direct costs (2.5% for net direct works costs). We provide evidence of this benchmarking exercise in Appendix 4. We have also undertaken benchmarking of our scope for Ham Hill STC site by visiting another WaSCs' plant of similar size. Once again, this exercise highlighted no significant differences in the scope (as per Appendix 5).

We have therefore kept initial costing for both sites as the basis for further cost refinements as described below and summarised in Table 7:

- Firstly, following discussion with the Environment Agency about our Bioresources WINEP submission, we agreed with the Environment Agency to remove the Cake Storage element of each scheme, which we resubmitted as a WINEP enhancement scheme and was subsequently approved.
- Secondly, we adjusted the design of the THP plants for both sites which reduced costing. This is based on cost curves we received from the supplier, which we provide in Appendix 6. We note these costs are commercially sensitive.
- Thirdly, we conducted a further assessment (Appendix 7) of Biomethane Upgrade vs CHP following OFWAT's publication of the PCs for Green House Gases[8] for Ham Hill. Whilst the study showed that choosing Biomethane injection over CHP will delivers 100kTCO_2 reduction over the 20y M&E asset life of the Ham Hill example, choosing biomethane results in an

additional £1.4m annual cost compared to CHP due to the impact of the GHG PC. This prompted us to move away from Biomethane upgrade at present and use Combined Heat & Power (CHP) engines instead. We will continue reviewing any changes in relation to Biomethane Upgrade, especially from a Carbon benefit and incentives point of view. Costing for CHP engine for Ham Hill was extrapolated based on costed item from Ashford design based on sludge throughput.

- We then removed the growth element of the schemes as we expect this to be included into the modelled bioresources efficient totex allowance.
- Finally, we added indirect costs and overheads of 2.040x of direct costs, which are based on the design maturity and complexity of the schemes underpinned by an analysis of historical data benchmarked against industry comparators. Description of the tool used and rational is available in the Optioneering and Enhancement Costing Technical Annexe.

Table 7: Costing Adjustment Summary

Costing Adjustments	Type of costs	Cost Source	Ham Hill AAD (£m)	Ashford AAD (£m)
Initial costing	**Direct**	**SWS internal cost curves**	[redacted]	
Cake Covering transferred to WINEP (Approved)	Direct	SWS		
Adjustment of design & costing for THP	Direct	SWS		
Move from Biomethane Upgrade to CHP	Direct	SWS		
Growth element removed	Direct	SWS		
Final Direct Costing	**Direct**	**SWS; external benchmarks**		
Total Costs (incl. Indirect)	**Total**	**SWS; external benchmarks**	**72.5**	**40.3**

As mentioned above, we are also able to drive further value by investing in AAD and consolidating our Bioresources operation in Kent at 2x key sites (Ham Hill and Ashford), allowing us to remove the need for sludge treatment at 5 other sites.

Whilst this reduces capital expenditure thanks to the economy of scale, it could also limit investment associated with achieving BAT for the biological treatment of waste – subject to EA approval - at a smaller number of sites which is more cost effective for our customers.

We are considering delivering these projects through our alternative financing route. We would identify one or more investors who would design, build, finance, operate & maintain the assets and we would buy services from this group via an arms-length long term contract. The proposed delivery model set out in the Ham Hill & Ashford business case for alternative financing, including the delivery schedule, tender and commercial models and the associated development costs. We consider this can offer additional benefits via increased scope for innovation, reduced deliverability risk and payment profiles that better match the time when the assets will be in service.

Further work is being undertaken to explore the non-regulated capital investment options. For significant projects we could look at Alternative Funding (akin to Direct Procurement for Customers (DPC) but without the security of the return) mechanisms as well as wider PFI (Private Finance Initiatives). Funding options

also include the potential for us to Outsource through leasing of some (or all) of our STCs to a third-party which would invest, build, and operate parts (or all) of our bioresources assets in return for a gate fee over a 15+ year term. Whilst this option would shift the challenging task of designing a sustainable strategy for bioresources in the South-East to another entity, we would still retain a 'Duty of Care' and legal obligation for our waste to be managed correctly.

This is atypical expenditure and is not relevant for a symmetrical cost adjustment.

5. Customer Protection

The selection of this option and the technology chosen has a long-proven record of operation (including positive impacts on biosolids quality, efficiency and reliability), the wider industry has extensive experience in delivering the type of chosen technology across the world and this therefore protects customers from the risk of abortive spend.

Furthermore, this technology allows future bolt-on processes (for example, advanced thermal conversion technologies could be included after the AAD process) to mitigate against further landbank restrictions. This spend also aligns with our long-term adaptive strategy which aims at delivering sustainable and cost-effective solutions.

There are also secondary benefits for our customers associated with potential reduction in odour and fugitive emissions.

However, in order to protect our customers in case of non or late delivery, we are proposing a scheme specific price control deliverable (PCD) based on the capacity of the processes which will be built. Where the schemes do not progress or do not manage to build agreed capacity, the costs will be returned to our customers.

The expected timescales for implementation of both AAD schemes are described in Table 8 below:

Table 8: Delivery targets

Scheme	Value	Output	2025/26	2026/27	2027/28	2028/29	2029/30
Ham Hill AAD*	£72.5m	Built Capacity (TDS/y)					30,700
Ashford AAD*	£40.3m	Built Capacity (TDS/y)					15,400

*AAD site selections in Kent are assumed to be Ham Hill and Ashford, however this could be subject to change but the overall capacity would still apply.

For clarity:

- The conversion of Ham Hill AAD plant is expected to be completed by 31st March 2030. This CAC will allow building of a 30,700TDS/y capacity plant by the end of financial year 2029/2030
- The following conversion of Ashford AAD is expected to be completed by 31st of March 2030. This CAC will allow building of a 15,400TDS/y capacity plant by the end of financial year 2029/2030

If we deliver either of the schemes late, we expect to pay a penalty of £0.041k per TDS for every month the scheme is delivered late (this will be dependent on the delivery route of the scheme). This is based upon the total scheme value and the total months in an AMP period.

Any non-delivery of capacity across both sites will be returned to customers at the rate of £1.36k per unit TDS capacity below the 46,100 level.

An assurance exercise will be completed ahead of AMP9 to assess the completion dates of both schemes.

The details of the PCD are set out in Table 9 below:

Table 9: PCD Summary

Component	Output based on Capacity
Output	46,100 TDS capacity by 2029/2030
Total cost	£112.8m
Unit cost	£2.45k per TDS capacity
Penalty rate	£2.45k per unit as no cost sharing is assumed
Scheme Delivery Date	31st of March 2030 (Ham Hill) 31st of March 2030 (Ashford)
Gated dates	Assurance of the scheme will be delivered on time at 31st March 2028/29
Late penalty	£0.041k per TDS capacity for every month late.
Measurement	Performance reported in APR
Conditions	If a higher amount of throughput is constructed, there will be no adjustment
Assurance	Third party assurer will assure conditions have been met

NOTE: The late penalty is derived from £112.8m (total net claim cost)/60(months late)/46,100(total capacity in TDS)

6. Conclusion

To summarise, the adoption of two advanced anaerobic digestion facilities at Ham Hill and Ashford STCs will enable SWS to treat sludge to a high-quality product for agricultural recycling.

The investment has been driven by an increasing number of factors outside of management control including the threat of resilience on the supply chain through the FRfW requirements, the EA's strategy for safe and sustainable sludge use and adherence to BAT requirements for the biological treatment of waste. In addition, we have a relatively low proportion of farmed area, wheat area and cereal area when adjusted for population.

Our customers want to see pollution stopped and in making these improvements to our sludge treatment centres we will be achieving a higher level of environmental protection. In addition, regulatory compliance and future wastewater infrastructure is one of the top priorities areas that are important to our customers. Feedback from our customers (including our farmers, the end users of our biosolids) is supportive of recycling treated biosolids to agriculture. It is primarily external factors that would prevent the future use of biosolids by farmers – this includes regulatory constraints, phosphorus levels in the soil or restrictions on certain soil types. Without further investment, these stakeholder concerns have the potential to impact the long-term viability of this recycling option.

Consolidating our STCs into these 2 large AAD facilities at Ham Hill and Ashford will strengthen our operation and mitigate immediate threats as it reduces the amount of biosolids produced and opens up additional farmland for spreading. The Biosolids obtained is a more stable product, less likely to cause public nuisance which makes it more desirable and well received by farmers. The processes involved are highly contained systems to avoid fugitive emissions.

We believe the technology can also be efficiently integrated with additional bolt-on processes (e.g. thermal destruction technologies), this enables us to stay adaptive should the landbank risks materialise further at later stage. This need and opportunity have been clearly identified and defined as part of our long-term Bioresources Strategy.

We have set out an appropriate price control deliverable in order to fully protect our customers and ensure they will not be disadvantaged from this cost adjustment claim.

A summary of the costs included and not included in this claim is available in Table 10 below:

Table 10: Costs Summary

Costs included in this Claim (£m)		Costs not included in this Claim (£m)	
Conversion of Ham Hill STC to AAD	Total Cost = 72.5	Cake storage WINEP	Net Direct Cost = 11.3
Conversion of Ham Hill STC to AAD	Total Cost = 40.3	Growth	Net Direct Cost = 10.1
TOTAL	Total Cost = 112.8	TOTAL	Net Direct Cost = 21.4

List of References

1 DEFRA (2023). Agricultural facts: South East Region. https://www.gov.uk/government/statistics/agricultural-facts-england-regional-profiles/agricultural-facts-south-east-region

2 DEFRA (2018). Farming rules for water – getting full value from fertilisers and soil. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/695598/farming-rules-for-water-policy-paper-v2.pdf

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4 European Commission (2018). Best Available Techniques (BAT) Reference Document for Waste Treatment. https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC113018_WT_Bref.pdf

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6 DEFRA (2022). Structure of the agricultural industry in England and the UK at June. https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june

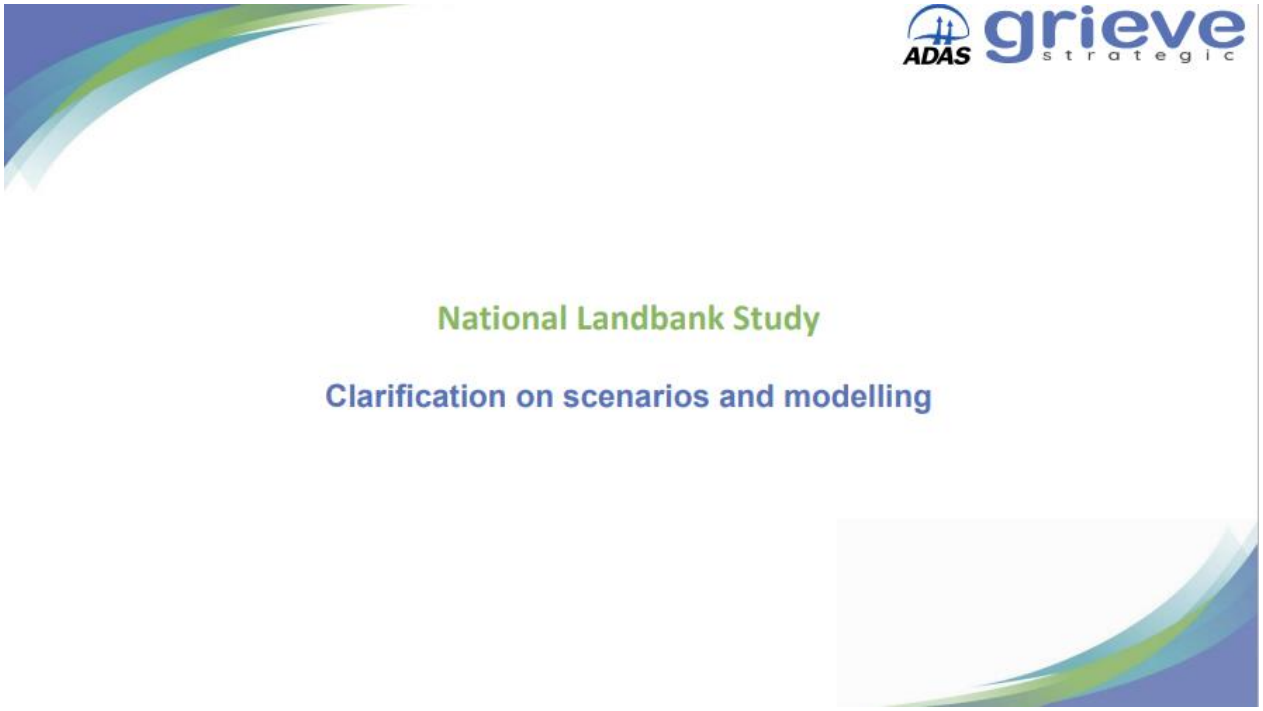
7 Mills, N. (2015). Unlocking the full energy potential of sewage sludge. EngD. University of Surrey https://openresearch.surrey.ac.uk/esploro/outputs/doctoral/Unlocking-the-full-energy-potential-of-sewage-sludge/99515301502346

8 OFWAT PR24 operational greenhouse gas emissions performance commitment (wastewater) https://www.ofwat.gov.uk/publication/pr24-operational-greenhouse-gas-emissions-performance-commitment-wastewater/

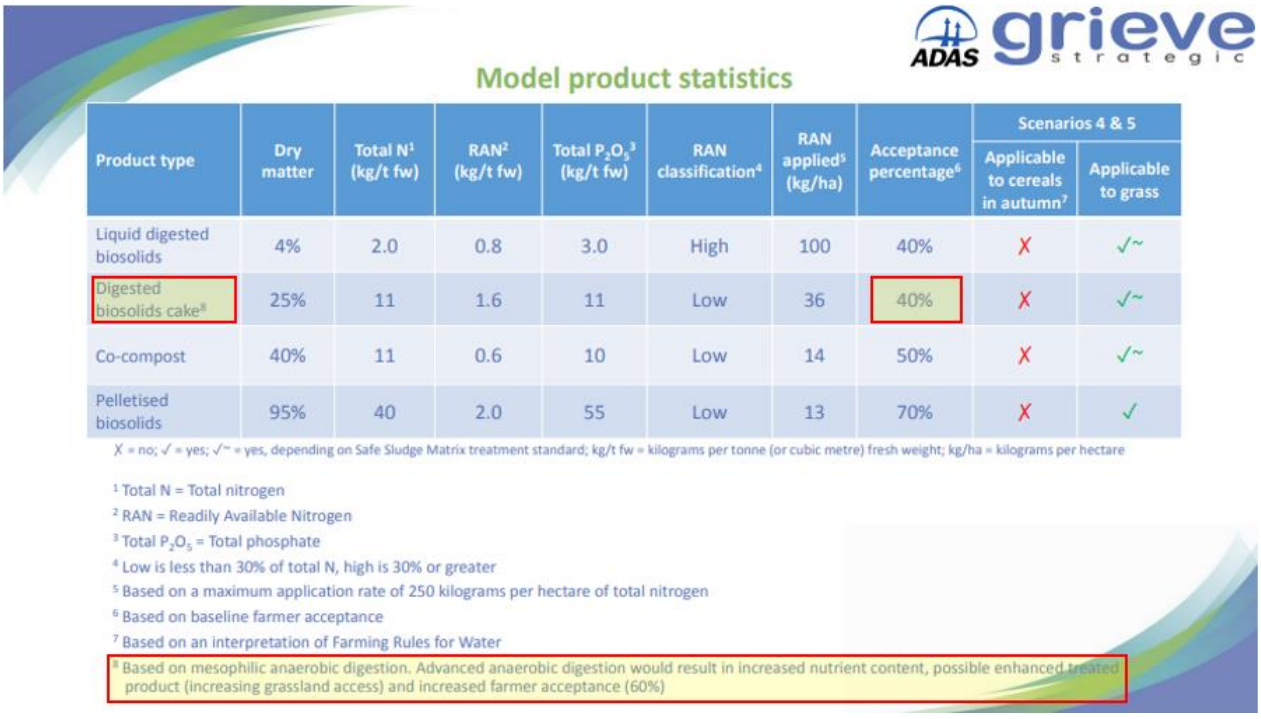
List of Appendix

SRN21 Appendix 1	ADAS & Grieve Strategic (2022) - National Landbank Study Clarification on scenarios and modelling
SRN21 Appendix 2	YONDER for Southern Water (2022). The future of Southern Water's sludge – farmer survey
SRN21 Appendix 3	[redacted] for SWS (2022) Water Future 2030 – Potential Changes to Sludge Regulations
SRN21 Appendix 4	[redacted] Costing Benchmarking report
SRN21 Appendix 5	Additional Internal Scope Benchmarking (Other WaSC's AAD plant)
SRN21 Appendix 6	Indicative cost for THP ([redacted]) **Commercially Sensitive**
SRN21 Appendix 7	Assessment of Biomethane Upgrade vs Combined Heat & Power engine options

Appendix 1 - National Landbank Study Clarification on scenarios and modelling (ADAS & Grieve Strategic - 2022)



a. *Farmers Acceptance of various quality of Biosolids*

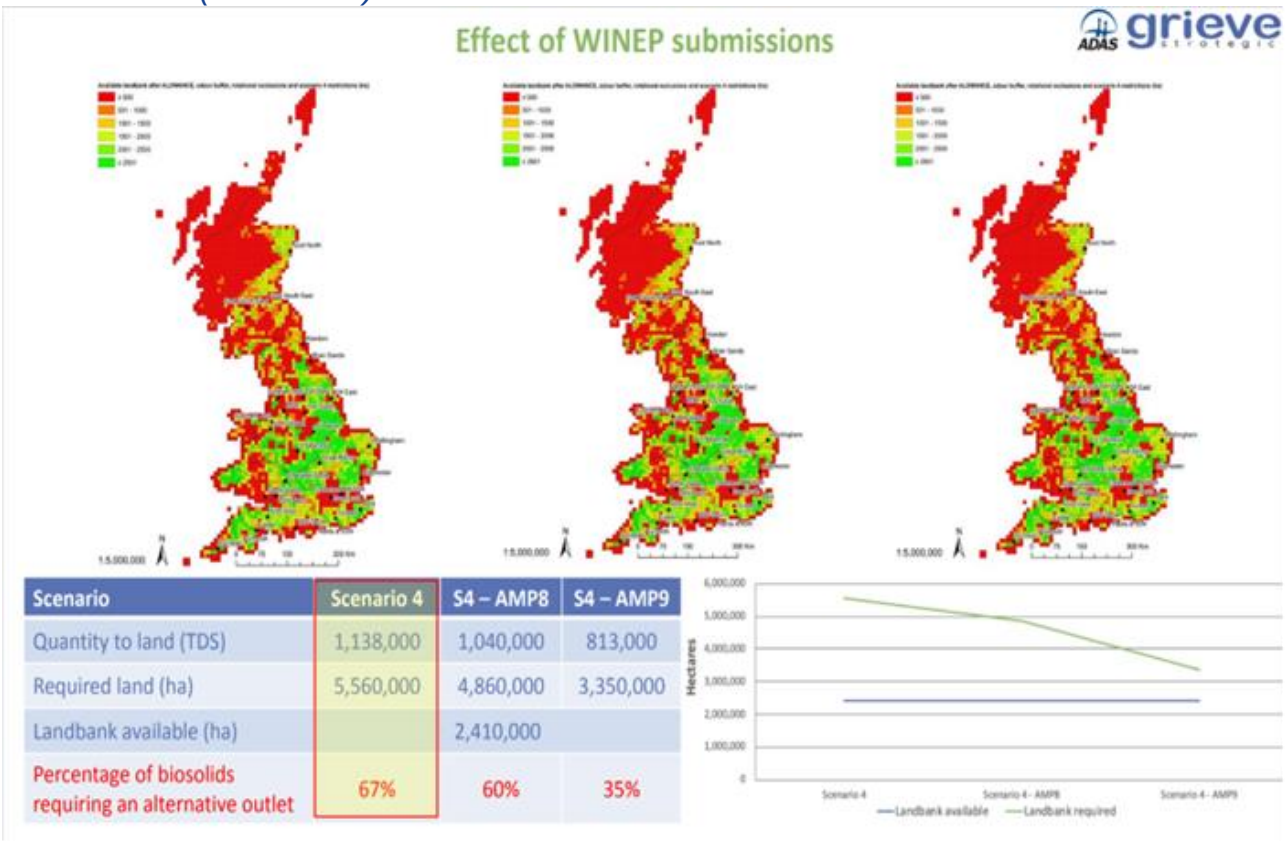


Product type	Dry matter	Total N[1] (kg/t fw)	RAN[2] (kg/t fw)	Total P_2O_5[3] (kg/t fw)	RAN classification[4]	RAN applied[5] (kg/ha)	Acceptance percentage[6]	Scenarios 4 & 5	
								Applicable to cereals in autumn[7]	Applicable to grass
Liquid digested biosolids	4%	2.0	0.8	3.0	High	100	40%	✗	✓~
Digested biosolids cake[8]	25%	11	1.6	11	Low	36	40%	✗	✓~
Co-compost	40%	11	0.6	10	Low	14	50%	✗	✓~
Pelletised biosolids	95%	40	2.0	55	Low	13	70%	✗	✓

✗ = no; ✓ = yes; ✓~ = yes, depending on Safe Sludge Matrix treatment standard; kg/t fw = kilograms per tonne (or cubic metre) fresh weight; kg/ha = kilograms per hectare

[1] Total N = Total nitrogen
[2] RAN = Readily Available Nitrogen
[3] Total P_2O_5 = Total phosphate
[4] Low is less than 30% of total N, high is 30% or greater
[5] Based on a maximum application rate of 250 kilograms per hectare of total nitrogen
[6] Based on baseline farmer acceptance
[7] Based on an interpretation of Farming Rules for Water
[8] Based on mesophilic anaerobic digestion. Advanced anaerobic digestion would result in increased nutrient content, possible enhanced treated product (increasing grassland access) and increased farmer acceptance (60%)

b. *Impact of application of Farming Rules for Water on landbank available in the UK (Scenario 4)*



Scenario	Scenario 4	S4 – AMP8	S4 – AMP9
Quantity to land (TDS)	1,138,000	1,040,000	813,000
Required land (ha)	5,560,000	4,860,000	3,350,000
Landbank available (ha)		2,410,000	
Percentage of biosolids requiring an alternative outlet	67%	60%	35%

Appendix 2 – The future of Southern Water's sludge – farmer survey (Yonder for SWS - 2022)

SOUTHERN WATER

The future of Southern Water's sludge

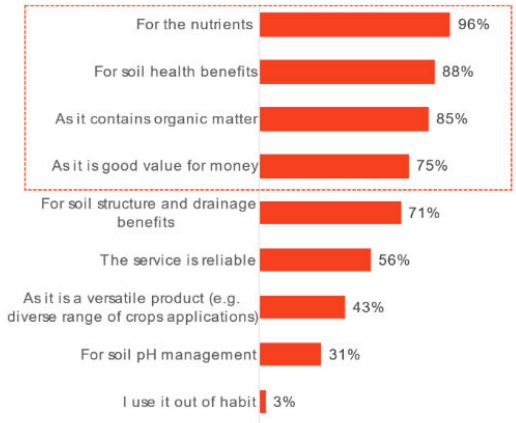
.YONDER

Qualitative & Quantitative research debrief

a. *Biosolids seen as a value material*

The main advantages of biosolids are the nutritional benefits to soil health, alongside being good value

REASONS TO USE BIOSOLIDS - PROMPTED



REASONS TO USE BIOSOLIDS – SPONTANEOUS COMMENTS

Improves soil health/ organic benefits

"Good source of organic fertiliser/improves soil health, greater than its technical nutrient value"

Phosphate and nitrogen:

"Biosolids supply important key nutrients including phosphate and nitrogen. It also is very important as a soil conditioner and enhancer to maintain and improve my soil organic matter"

Good value

"Because it's cheap organic/nutritional content. Also, a belief that a society ought to be returning its waste to the soil"

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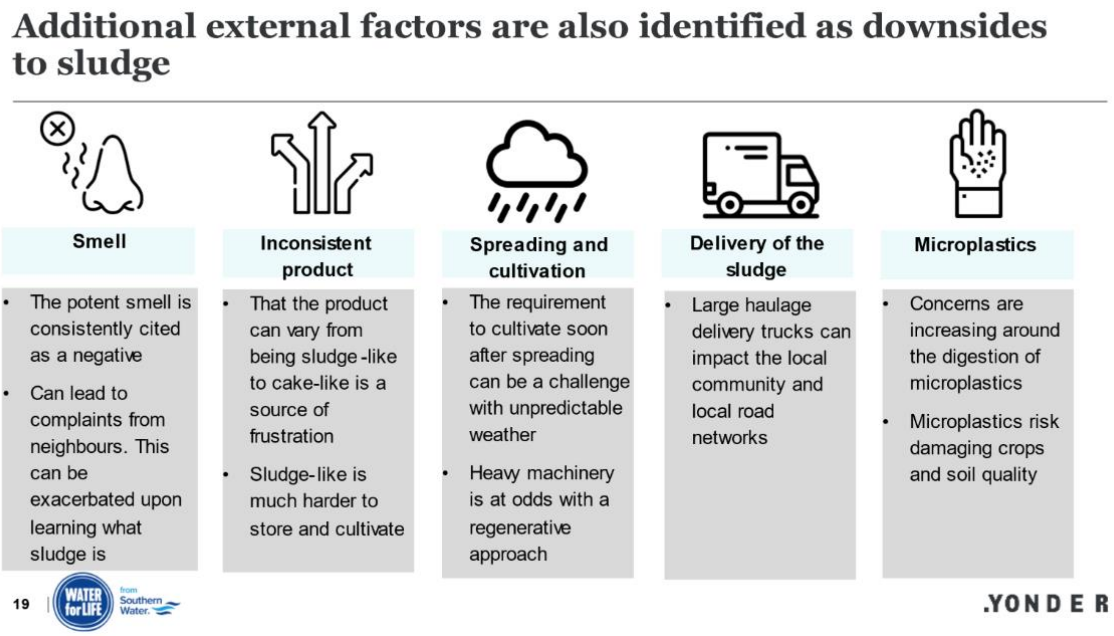
Q7. Why do you use biosolids ("treated sludge / treated cake") on your land? / Q8. Below are some reasons others have provide biosolids ("treated sludge / treated cake") on their land. Which of the following are reasons that you use biosolids? All respondents (68)

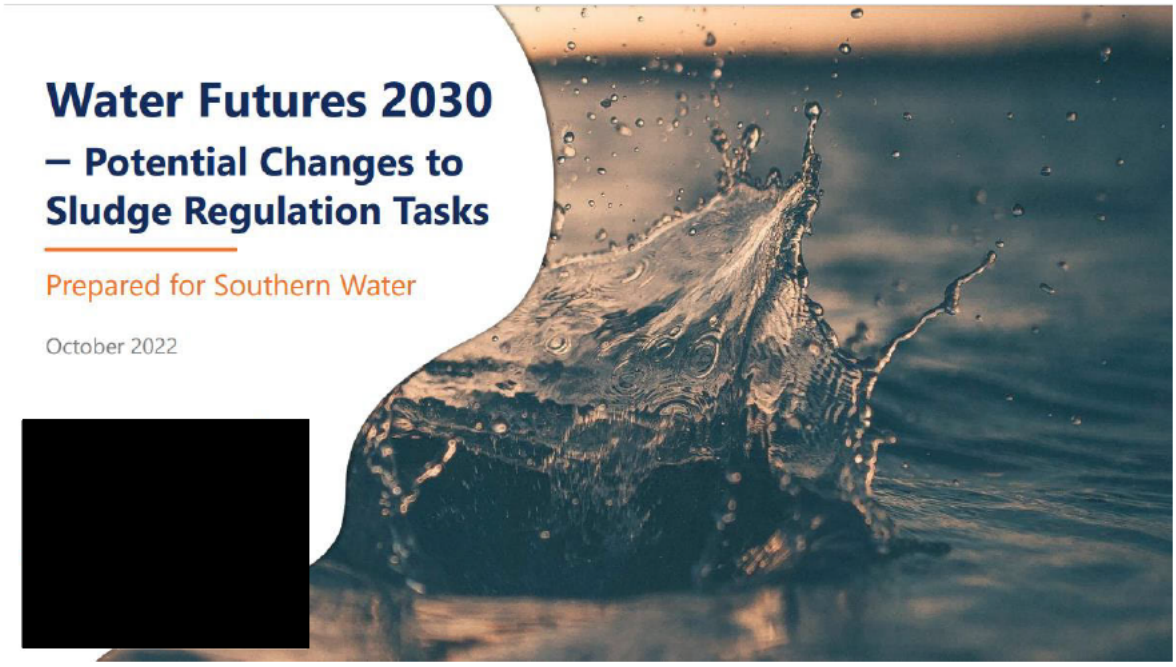
d for using .YONDER

b. *Limitations of current Biosolids from SWS*



c. *Benefits expected from Advanced Digested cake*

Appendix 3 – Water Future 2030 – Potential Changes to Sludge Regulations ([redacted] for SWS - 2022)



a. *Positive feedback on AAD from customers (bill payers)*

Advanced Digestion feels like the next logical step, however, there are concerns over timescales and in turn, future proofing

Impressions of Advanced Digestion

Advanced Digestion
- Wastewater is treated to a high standard with lots of regulations and criteria we need to meet. An end product called 'sludge' or 'cake' is provided to farmers and spread on their crops.
- There is a process called **'advanced digestion'** which is essentially a more advanced type of treatment.
- This means that the end product (sludge) is of higher quality.
- It can then be spread on more and different types of crops – so is more versatile and better used by farmers.
- Southern Water are currently planning to propose to introduce advanced digestion across their sites.
- It is likely to take between 10-15 years to complete – partially due to the spreading the cost but also the resource needed to upgrade sites.
- The current proposal being worked up is to focus on Kent in 2025-2030, and then across to Sussex and Hampshire after this.
- Southern Water have been working with Farmers – who are supportive of the plans.

- ✓ Initial reactions are positive, with many feeling that anything more advanced or that produces a higher quality product is beneficial
- ✓ Being able to use this more broadly across more types of crops feels like we are making the most of what we have already got, again fitting well with sustainability
- ✓ It is assumed that this would have potential to replace current, harmful fertilisers and chemicals and as such, feels like a logical step to take

As such, overall customers are supportive of Advanced Digestion, however …

- !! Timescales do raise some concern, especially considering farmers are supportive – *if it is so good, we need to be doing this as soon as possible!*
- !! Although the need to plan resources and keep costs low is understood, there are worries that the technology may be out of date by the time it is implemented - *could it be a waste of time and money? And who is paying for this – farmers, customers?*

I think it is a good thing, making better use of what is probably, technically a waste product. Hopefully over the course of the expected 15 year timescale, technology will also improve/adapt to assist.

Seems like a good idea and if this is good for the environment, then I can't see why they wouldn't put this in place. I understand the need to do this slowly but it does feel like a long, long time.

My concern is who pays. The farmers should be paying a contribution here and not customers as it is they who directly benefit. The lead time of 15 -20 years seems very long though, and could be costly, is it worth the wait?

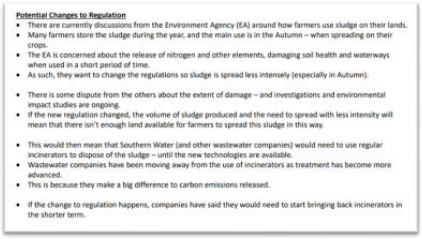
This sounds great I would be supportive of this. I would want to know though whether this means there are other more harmful products/ chemicals that can be used less?

4

b. *Customers views on Incineration as a potential answer to mitigate impact of FRfW in the short-term*

Customers initially feel that changes in regulations are a positive step, however, the need for incinerators brings this into doubt

Reaction to Potential Changes to Regulation



Potential Changes to Regulation

- There are currently discussions from the Environment Agency (EA) around how farmers use sludge on their lands.
- Many farmers store the sludge during the year, and the main use is in the Autumn – when spreading on their crops.
- The EA is concerned about the release of nitrogen and other elements, damaging soil health and waterways when used in a short period of time.
- As such, they want to change the regulations so sludge is spread less intensely (especially in Autumn).
- There is some dispute from the others about the extent of damage – and investigations and environmental impact studies are ongoing.
- If the new regulation changed, the volume of sludge produced and the need to spread with less intensity will mean that there isn't enough land available for farmers to spread this sludge in this way.
- This would then mean that Southern Water (and other wastewater companies) would need to use regular incinerators to dispose of the sludge – until the new technologies are available.
- Wastewater companies have been moving away from the use of incinerators as treatment has become more advanced.
- This is because they make a big difference to carbon emissions released.
- If the change to regulation happens, companies have said they would need to start bringing back incinerators in the shorter term.

- ✓ Initially the situation makes sense, it feels positive that if there are concerns over damage then this should be investigated and other plans put on hold ....
- !! ... However, the need to bring back incinerators makes customers question this
- !! It feels like a huge backwards step especially in an era of climate change and looking for more sustainable solutions. Almost a knee jerk / over reaction, surely the current damage cannot be that significant?
- !! Customers want to see proof of the damage currently being caused and how this compares to the damage that would be caused by bringing back incinerators, to understand if this step is justified
- !! There is disbelief that the damage from nitrates can be as bad as the damage to the environment from incinerators

My initial reaction to this is that it sounds counter-productive and leads to a backwards step which feels unnecessary. Bringing back incinerators seems like a big backwards step.

The regulations shouldn't be brought in until the new technologies are widely available, but I suppose it would depend on how much of an impact on soil the sludge has at the moment. I'm not sure it would be worth bringing back incinerator usage until the new technologies are available.

This feels frustrating because to protect soil health and waterways, water companies will incinerate waste thereby polluting the air, which I would imagine is another area of responsibility of the EA. I guess the question is which is the lesser of the two evils?

I would want to see definitive proof from the EA that additional nitrates are an issue in the autumn before going back to incinerators. There needs to be a balance of risks: how bad is the release of nitrogen compared to bringing back incinerators and damaging the atmosphere?

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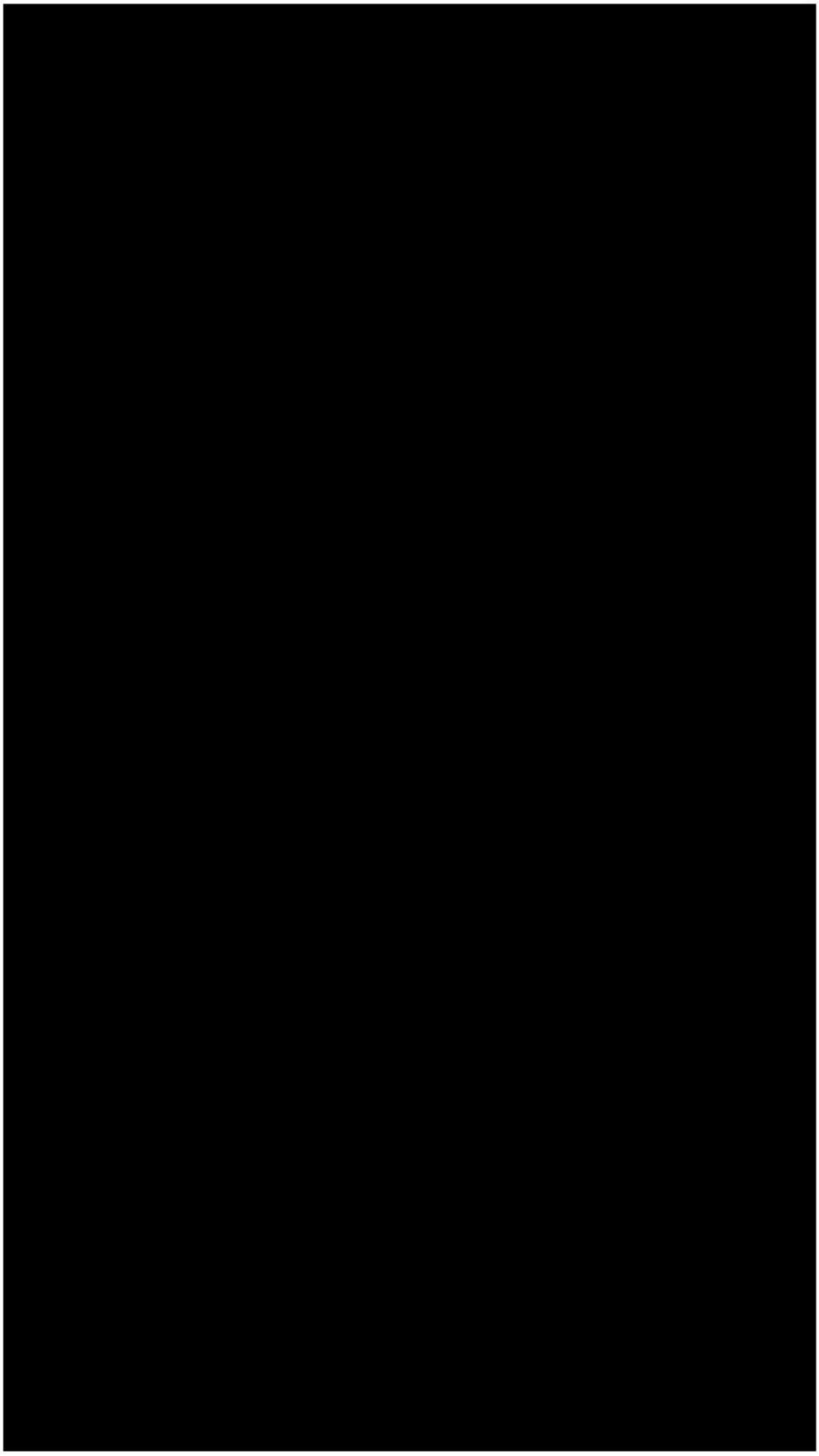
Appendix 4 - [redacted] Costing Benchmarking report

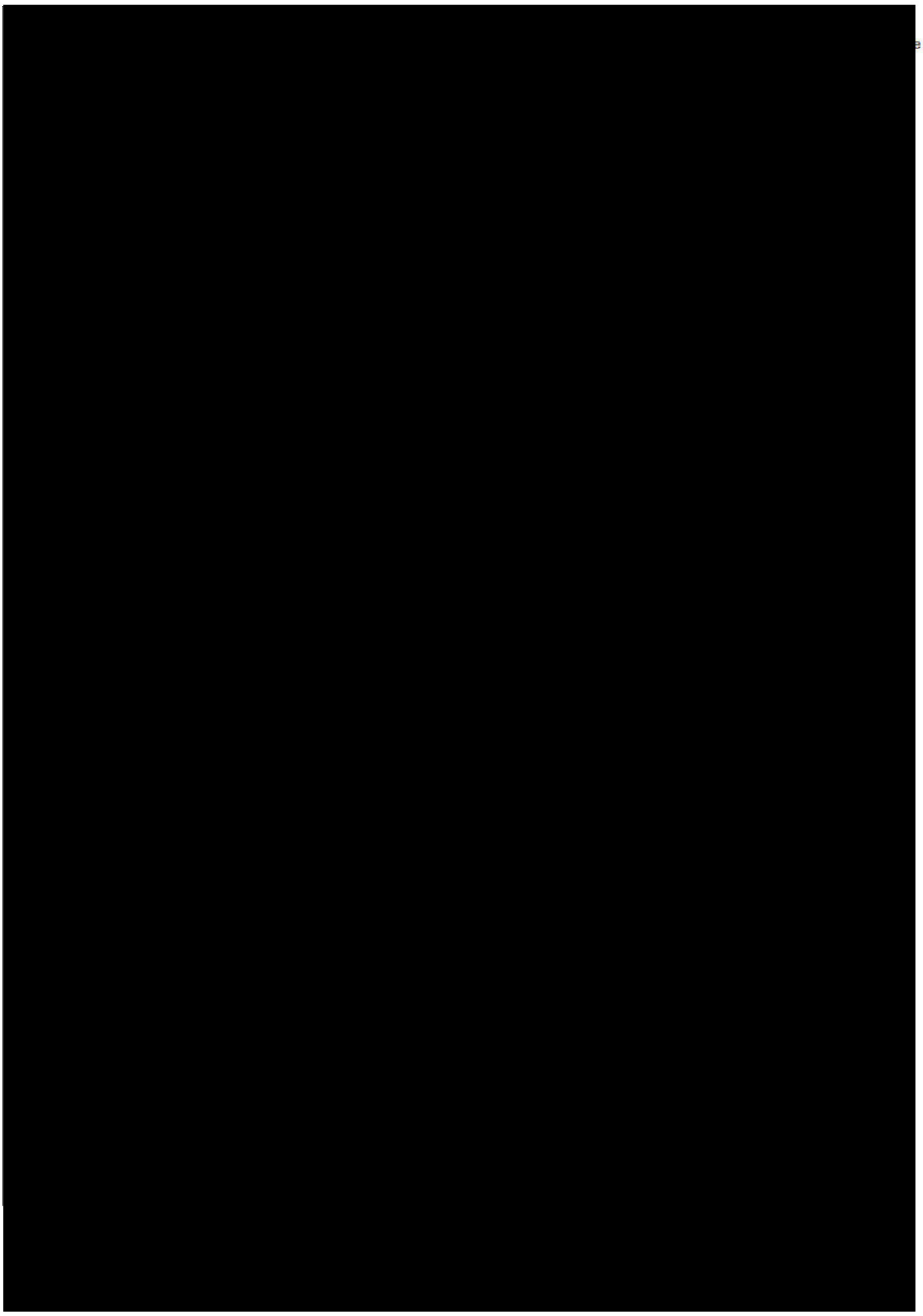
[redacted]

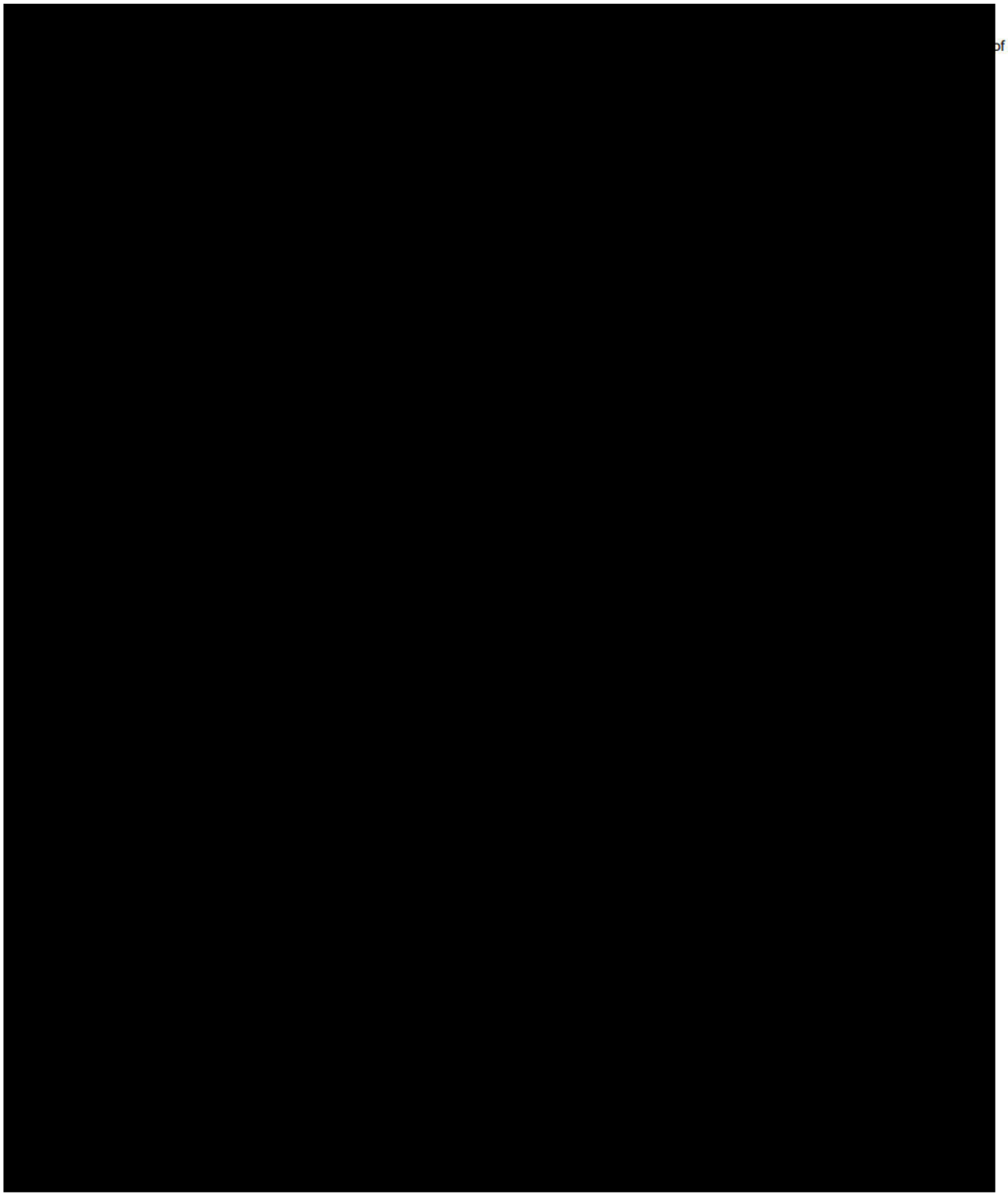
PR24 Bioresource Estimate Benchmarking

January 2023

WATER for LIFE from Southern Water







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Appendix 5 - Additional Internal Scope Benchmarking (Other WaSC's AAD plant) – Notes from visit of Site A

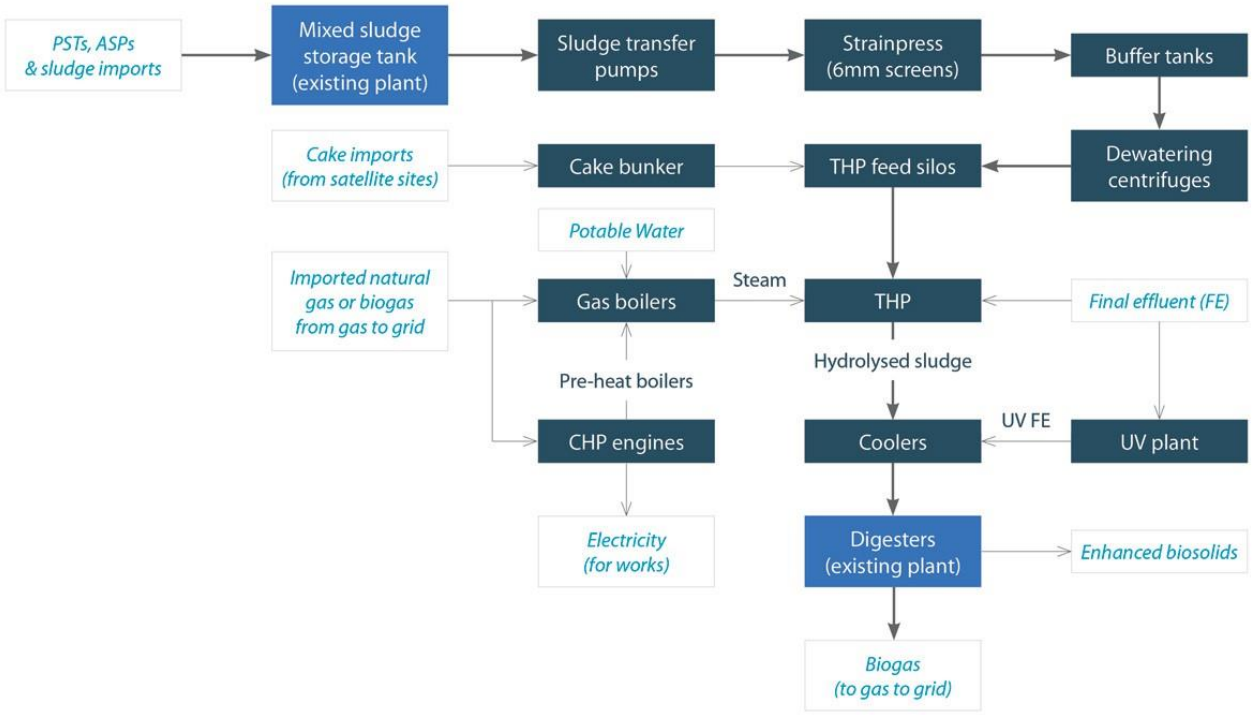
In April 2023, a small team from Southern Water visited Site A operated by another WaSC. Site A is a newly commissioned AAD site with similar capacity as SWS' Ham Hill expected AAD plant.

The WaSC operating Site A has a longstanding experience with these types of processes so the purpose of the visit was to compare scope and capacity of key assets to ensure SWS' design was aligned with the rest of the industry.

No reliable costing could be obtained from conversation with Site A personnel hence no benchmarking of costing could be carried out.

a. *Process diagram Site A*

The diagram below is a typical flow sheet for the type of processes operated and aligns with design for Ham Hill.



b. *Scope benchmarking*

The table below compares Site A scope as per visit notes from SWS design team. This was then cross referenced with SWS' design for Ham Hill site. Items in Green are of similar scope and size as items seen at Site A. Items in Amber are for processes included in designs for both sites but scope is slightly different, which could be attributed to specific sites requirements (e.g. Odour Control Unit). Items in red have been highlighted as not currently being part of Ham Hill scope but are considered as small items.

Item #	Site A scope from Site Visit Notes	SWS ref items
1	THP plant was built on disused trickling filters (may have been some issues with disposal of excavated material) at the existing site.	Ref 2, 11, 19, 36, 68,70, 71, 72, 73, 74, 75, 76, 82
2	2No. 800m3 balancing tanks were existing. The scheme starts from the outlet of these tanks with new transfer pumps/pipework to new THP area.	Existing asset (Site A)
3	45 Tonne cake reception plant. Basic hopper lid open to atmosphere. No building for cake vehicles to reverse into (which is clearly different to many of our sites where this is required). No odour issues recorded.	Ref XX, 25, 26, 27, 31, 65, 66, 67
4	2No. cake silos for imported cake (Stortec)	Ham Hill design includes cake bunker and pump up to blending tank
5	2 No. THP feed sludge balancing tanks 1290m3 each. Compressors for air mixing to de-stratify	Ref 35, 54 (but SWS' is smaller at 347m3 each), 69
6	3No. Hydro Strainpresses on elevated steelwork platform	Ref 9,32, 59
7	3No. Alfa-Laval centrifuges on elevated steelwork platform. Achieving around 20% DS (dilution downstream)	Ref 34 (but SWS' includes 2 no, total capacity similar), 78-81
8	Polymer storage (30 Ton Silo) and make-up system rated for 4m3/hr. 3No. dosing pump sets for each centrifuge. Provided by Richard Alan.	Ref 43
9	1No. Small Odour Control Unit (Fans rated for 4815m3/hr)	Odour plant included for Ham Hill expected to be larger than the one at Site A
10	2No. CHP Engines (Clarke energy) were existing but moved to location near to steam boiler house.	Existing asset (Site A)
11	2No. steam raising boilers (Cannon Bono Energia)	Ref 22, 24 37
12	No real treatment for boiler feed water. Some softening and chemicals added. Operator mentioned RO plant for feed water.	Considered as not needed for Ham Hill
13	1No. centralised main MCC kiosk for all MCC's for plant (including Cambi provided panels).	Assumed included in scope of other items
14	1No. gas holder	Ref 15, 42 (but SWS' include 2 no, total capacity similar)
15	1No. flare stack for unused biogas	Ref 45

16	Separate kiosk provided for gas to grid plant control etc	Ref 88-94
17	Gas conditioning system (for Gas to Grid) with propane storage vessels.	Ref 88-94 – Subseqently replaced with CHP engine
18	Anti-foam dosing for plant (IBC's in small kiosk and dosing pumps/pipework)	Considered as not needed for Ham Hill
19	Final dewatering centrifuges were existing but some upgrades to the conveying system to the open cake bays	Existing asset (Site A)
20	Cake bays were existing and used for storing raw sludge cake in addition to hydrolysed sludge	Existing asset (Site A)
21	FE usage includes 2No. boll filters (160l)	Could be included in Ham Hill scope (TBC)
22	2No. UV reactors (Trojan) 4.9kVA	Could be included in Ham Hill scope (TBC)
23	4No. booster pumps (Grundfos) 37kW	Could be included in Ham Hill scope (TBC)

The table below lists items which are part of Ham Hill's current design but were not listed as part of Site A's scope. These items are quite specific to Ham Hill's current design, layout & capacity and are therefore required in addition to the above.

Scope specific to Ham Hill	
Access road (360m)	Demolition of existing Water Reclamation Works
DEMOLITION OF SLUDGE DRYING BEDS	6 no. digesters (3333 m3 each)
Bunding for 6no. Digesters	5no. Bucher press, model HPS 12007.
2 unscreened blended sludge tanks	Gas Flare
2 blending tanks	Poly dosing (post-digestion)
Cover for unscreened blending storage tanks, assumed dia. 4.4m.	Digested cake conveyance
Cover for cake import silo, assumed dia. 4m.	Generator
Cover for post-screening blending tanks, assumed dia. 6m.	M&E associated with above items
Post digestion storage tanks	
Anammox Liquor treatment plant	

Appendix 6 – Indicative cost for THP (CAMBI)

Commercially Sensitive

Appendix 7 – Assessment of Biomethane Upgrade vs Combined Heat & Power engine options

"Ofwat Operational greenhouse gas emissions performance commitment."

Proposed amendment to definition to ensure greater GHG benefit of choosing Biomethane over CHP is recognised and rewarded.

Neil Liddell -Young

19/05/2023

Exec. Summary

- SWS Bioresources PR24 plan includes 2 large projects that will replace 7 existing "Conventional" AD plants with 2 new much la rger "THP" AD plants
- The existing plants are equipped with CHP and the new plants will be of sufficient size to be equipped with biomethane upgrad ing and injection or CHP
- We have modelled the GHG savings and net revenue impact for both options considering Ofwat's "Operational greenhouse gas emis sions performance commitment" v3 published in March 2023 and the further changes outlined in the April 2023 consultation response.
- Choosing Biomethane injection over CHP will delivers 100kTCO2 reduction over the 20 year M&E asset life of the Ham Hill proje ct because electricity grid decarbonises quicker than the gas grid.
- BUT choosing biomethane results in an additional £1.4m annual revenue cost compared to CHP due to the impact of the GHG PC. I t cannot therefore be chosen.
- The GHG PC allows WASC's to forgo the value of biomethane RGGO's for their exported biomethane and claim the GHG PC incentive associated with reduction in emissions.
- BUT this cannot be achieved because there is currently no method of retiring RGGO's associated with new biomethane plants in AMP 8 without losing the subsidy.
- Slide 4 explains in detail why there is no method of retiring today and that the future is uncertain. In summary:
  - RHI scheme which allows retirement of RGGO's is closed to new applicants.
  - GGSS scheme only supports new build AD and most WASC AD assets are not life expired.
  - RTFC Market is open but RGGO cannot be separated from RTFC's.
  - Looking forward to AMP 8, Government recognise in its recently published "Independent Review of Net Zero", that biomethane wi ll continue to play an important role in achieving the government's Net Zero obligation. DESNZ are working to develop a future policy framework to follow the GGSS and have requested views as part of the GGSS mid scheme review consultation which closed on 18th May 2023.
- We proposed that performance commitment is amended to create a system that can work independently of the biomethane subsidy s cheme.
- We propose an option to purchase RGGO's from the market up to the value of biomethane exported. Currently RGGO's can only be ret ired from own production.
- The minor amendment balances the net revenue for Biomethane and CHP and will result in the GHG PC objective being achieved.

PR24 operational greenhouse gas emissions performance commitment (wastewater) Ofwat

We have modelled the GHG emissions and "Energy" net revenue impact of CHP against Biomethane on our Ham Hill THP project

- Changing from "Conventional" to "THP" AD creates a net increase in heat demand for the same quantity of sludge but It also pr ovides a net increase in biogas production.
- One large site has sufficient biogas to fall within biomethane upgrading plant design range.
- Net GHG and Revenue are calculated using the new Operational GHG Performance commitment definition assuming £200/tCO2e tariff .
- Net revenue is dependent on the biomethane financial support option that it is accredited to.
- Options 2 and 4 show CHP and best GHG saving fuel configuration for biomethane respectively

	Option	Biogas Utilisation	Natural Gas Utilisation	CHP Electrical Output	CHP Heat Recovery
Transfer Sludge from 4 AD sites to Ham Hill and Build New THP AD Plant	2	100% CHP	Steam Boiler to supplement heat demand	Embedded demand and surplus exported.	Hot water and steam to satisfy THP demand
	4	Steam Boiler then Biomethane Export	n/a	n/a	n/a

Proposed Amendment to Operational GHG PC

- Biomethane delivers 100 kTCO2e more GHG savings than CHP
- BUT CHP is the compelling choice whilst only the RTFC scheme is available to biomethane making the PC counter productive.
- Government recognise in its recently published "Independent Review of Net Zero", that biomethane will continue to play an imp ortant role in achieving the government's Net Zero obligation.
- DESNZ are working to develop a future policy framework to follow the GGSS from 2025 and have requested views as part of the G GSS mid scheme review consultation which closed on 18 th May 2023.
- In view of the uncertainty that retirement of RGGO's will be available in a future framework it is proposed that the performa nce commitment is amended.
- Currently only RGGO's derived from their own production may be retired.
- We propose an amendment to allow purchasing and retiring RGGO's from the **market** up to the value of biomethane that we export.
- This minor amendment ensures the PC support for biomethane over CHP is identical regardless of the rules of the subsidy schem e.