Appendix: YKY42_Appropriate Measures Enhancement Case

YKY42_ Appropriate Measures Enhancement Case

YorkshireWater

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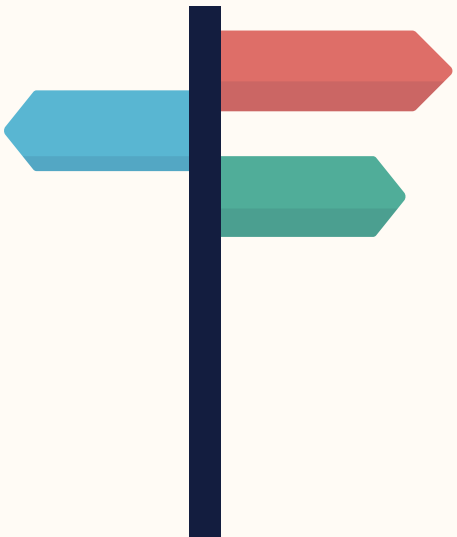
Read more about this at **WINEP Enhancement Case**

Business plan links
This icon can be clicked on to go to the main Yorkshire Water Business Plan document where more information can be found.

More detail on this subject can be found in **Chapter 8 Part 2: What our plan will deliver**



Contents

1. Appropriate Measures Enhancement Case

1.1 Driver:

Compliance with the EA's Appropriate Measures

1.1.1 Requested Investment:

Table 1.1 AMP8 Investment Requirements in Appropriate Measures

	£m	Table Line Ref.
Enhancement Expenditure Capex	107.706	CWW3.187
Enhancement Expenditure Opex	10.495	CWW3.188
Base Expenditure Capex		
DPC value		
Total	**118.201**	

1.1.2 Associated Reporting lines in Data Table:

Table 1.2 CWW3 Reporting Lines

Reporting line	Line Description
CWW3.187	**Appropriate Measures (IED) - capex**
CWW3.188	**Appropriate Measures (IED) – opex**

1.2 High Level Driver description:

The Environment Agency (EA) published the 'Biological waste treatment: appropriate measures for permitted facilities', commonly known as Appropriate Measures (AM) in September 2022. It introduces more prescriptive and tighter controls than the existing Industrial Emissions Directive (IED) requirements.

Yorkshire Water is requesting additional enhancement expenditure to deliver the activity required to comply with this guidance over and above that required to achieve IED compliance before AM was introduced.

The extensive requirements within the AM require a material change to the operation of our existing bioresources facilities, beyond what could have been foreseen in our existing plans for compliance with IED. The primary changes will require the construction of new fully enclosed odour-controlled cake storage barns for biosolids storage, as well as more extensive tank and lagoon covering.

To be clear the expenditure is specifically related to activity ***above*** the IED requirements to meet the conditions for Appropriate Measures.

1.3 Need for Investment

1.3.1 The Need for the Proposed Investment

The Environment Agency (EA) published the 'Biological waste treatment: appropriate measures for permitted facilities', commonly known as Appropriate Measures (AM) in September 2022. It introduces more prescriptive and tighter controls than the existing Industrial Emissions Directive (IED) requirements.

Water UK, on behalf of its members commissioned Atkins to produce a report to assess the compliance requirements being driven by Appropriate Measures Standards. The 'Industrial Emissions Directive Supporting Document' issued on 31st May 2023, concludes that the implementation of Appropriate Measures "goes beyond the original intent of BAT [Best Available Technique], resulting in significantly higher investment than could have been predicted when IED was instructed to the industry prior to PR19 final determinations and what the CMA considered appropriate." Furthermore, Atkins identify that "*the EA guidance is legally enforceable as it is based on legislation which is embedded in statute*."

Atkins determined that AM sets out catch-all requirements for assets and equipment using phrases such as 'you must', whereas the BAT approach is more risk-based, including the ability to be flexible and practical. BAT also includes more recognition of the constraints of existing facilities in implementing the full range of best practices, recognising the constraints of assets already in situ and the infrastructure around them.

Yorkshire Water's sites, consistent with most of the industry, tend to be old sites that have evolved over time and as a result have significant constraints, such as layout or lack of space, when retrospectively applying new higher standards.

1.3.2 The Scale and Timing of the Investment

The primary investment requirements for Yorkshire Water to be compliant with AM relate to covering of existing bioresources activities which until this point have not been required to be enclosed. We are seeking enhancement investment for these activities because they are beyond the scope of IED.

The most significant work required will be for all biosolids to be stored in fully enclosed odour-controlled barns. Other key changes are the need for covers on all tanks within the IED permitted area and covers on related lagoons.

Most of Yorkshire Water's treated biosolids are currently stored on vast concrete storage pads which cover an area of approximately 136,000m^2 (equivalent to 19 football pitches). None of our existing biosolids storage is in fully enclosed or odour-controlled barns. With no alteration to existing treatment techniques, it is calculated that the cost of covering these storage pads would be greater than £400m.

To deliver the requirement to cover all treated biosolids efficiently, we have determined that the most efficient option is to convert all our sites to lime sanitisation of the treated digestate, to reduce the storage time on site. This significantly reduces the size of the storage barns required. However, switching to lime sanitisation for the majority of our biosolids also necessitates the need to increase the storage capacity at those sites that already use this technique. Removing the option of our existing large concrete storage pads, will severely reduce our necessary flexibility of the logistics of delivery of biosolids to agricultural customers to accommodate factors such as variable weather.

The AM do not specify a timescale for delivery, however, EA published AM guidance for other wastes, state that "operators should complete these improvements [long-term and capital-intensive] as soon as practicable and within 3 years." It is therefore reasonable in our view to assume that compliance would be required prior to the end of AMP8. Furthermore, as the requirements are closely aligned to IED, AM compliance should be designed as part of IED investment plans to ensure efficient delivery.

Table 1.3 below (2022/23 £m) indicates the key activities and the totex required.

Table 1.3: Summary of Appropriate Measures Enhancement Costs and Activities

Key Activities	Totex required (£m)
Convert sites to lime sanitisation of treated biosolids	4.26
Construct fully enclosed odour controlled cake barns for biosolids storage	89.98
Tank covering	9.50
Lagoon covering	3.97
Additional Opex - lime sanitisation, odour-controlled cake barns	10.50
	118.2

The scale of investment required is material and cannot be managed through existing cost allowances. To put the investment required in context, the total capex investment allowance in the AMP7 bioresources price control was £127m, whereas the capital investment needed to meet the AM standards is £107.7m.

It is clear that this level of additional investment cannot be met from the existing capital allowances and that additional enhancement investment allowances are required to enable us to comply with the new AM obligations.

1.3.3 Interactions with Base Expenditure

As this investment is required to deal with newly introduced AM standards, all new capital work will be delivered through enhancement investment, the operating costs of the new assets, and enabling costs to facilitate their construction will also be reported as enhancement within AMP8.

This investment does not impact on the delivery of our performance commitments, and we confirm there is no overlap with base activity.

1.3.4 Activities Funded in Previous Price Reviews

Yorkshire Water received a specific mechanism for the recovery of IED compliance costs as a result of the redetermination of our price controls by the Competition and Markets Authority at PR19. Although no specific allowance was received by Yorkshire Water, a cost sharing arrangement was accepted allowing recovery of totex costs at a ratio of 75:25 (customer:company).

Yorkshire Water is already delivering work to ensure IED compliance and has and will continue to record our AMP7 costs for this purpose separately so they can be reported against the agreed totex sharing mechanism. However, the Appropriate Measures guidance have introduced more prescriptive and tighter controls than the existing IED requirements. As concluded in the Water UK IED Supporting Document, (31 May 2023), the implementation of Appropriate Measures “goes beyond the original intent of BAT, resulting in significantly higher investment than could have been predicted when IED was instructed to the industry prior to PR19 final determinations and what the CMA considered appropriate.”

Yorkshire Water therefore considers Appropriate Measures a new statutory obligation above and beyond IED alone, with insufficient time or funding available to deliver the scale of work within AMP7. Therefore, the existing totex sharing mechanism would not be applicable for the significant investment required in AMP8 and an alternate arrangement is necessary in the form of this enhancement case.

Yorkshire Water will record its costs for IED delivery separately from those exclusively required for Appropriate Measures to ensure there is no overlap and clarity of reported costs.

1.3.5 Long-Term Delivery Strategy Alignment

The costs for this enhancement case are included within the core pathway for AMP8 within the Long-Term Delivery Strategy (LTDS) in LS4.43, LS4.45 and LS4.48.

The totex expenditure on cake barns and lime sanitisation for biosolids storage has been included under LTDS data table LS4.45 (Sludge Storage – Cake pads / bays / other), expenditure on tank covering is within LS4.43 (Sludge Storage – Tanks (pre-thickening/pre-dewatering or untreated) and expenditure on lagoon covering is included under LTDS data table LS4.48 (Sludge treatment – Other).

Longer-term our expectation is that some, or all, of our sludge will be subject to additional drying of sludge to pellets, or solids destruction technologies, with the rest of our asset base adapted to the most economical way of delivering this. This will most likely involve a handful of drying or destruction centres with more of our sites geared to exporting sludge there. These centres might be spread across the Yorkshire Water region, situated at regional boundaries, and delivered with other WaSCs or dotted around the country and operated by an external third party under a gate fee.

Exactly what this looks like is difficult to establish due to the lack of clarity over the long-term plans for recycling biosolids to agriculture, in particular to what extent and where the landbank is impacted. Information on this risk is provided in section 8.8 Sludge Recycling to Land of Chapter 8 but in summary we are expecting some level of delay and uncertainty associated with:

a) The Environment Agency (EA) Sludge Strategy deployment process,

b) Restrictions on spreading that could lead to a significant shrinking of available land each year, driven by the EA's interpretation of Farming Rules for Water (FRfW) and investigations next AMP into microplastics and PFAS in sludge,

c) Changing public perception of biosolids, and therefore the approach taken by the food industry.

More detail on this subject can be found in **Chapter 8**

Read more about this at **Long Term Delivery Strategy**

The investment under this enhancement case could be either insufficient as we will not have enough biosolids storage space if any EA deployment process requires greater than 10 days storage, or abortive investment if we are forced down a solids destruction route by restrictions on the spreading of biosolids to agriculture.

1.3.6 Customer Support

We have not carried out specific customer engagement related to this enhancement case given that it is a requirement driven by the EA.

1.3.7 Factors Outside of Management Control

The investment in compliance at our bioresources sites, is a result of the introduction of the new Appropriate Measures guidance by the EA and is therefore outside of our control. The EA has final control over the standards prescribed within our permits, the guidance it applies and how it chooses to enforce the obligations.

To minimise the investment need and deliver the most efficient solution for our customers we have taken the decision to convert all digestion sites to lime sanitisation to reduce the volume of treated biosolids being stored, this decision alone saves over £300m.

In alignment with our digestion rationalisation plans for AMP8, which will involve the conversion of 3 digestion sites to thickening and dewatering only, we propose to continue using their existing cake storage pads rather than make abortive investment in lime sanitisation and enclosed biosolids cake storage. Acceptance of this approach will be subject to EA agreement,

however, Yorkshire Water is committed to ensuring investment is not wasted building redundant assets, so would seek to accelerate the rationalisation plans or challenge any request from the EA to build these assets in light of the short duration for which they would be required.

1.4 Best Option for Customers

1.4.1 Options Considered

When determining the options for delivery, our focus was on ensuring the least cost option for delivering compliance with the AM guidance. This necessitated a consideration of which assets had the most material impact of the guidance and what was required in respect of solutions.

The Atkins Water UK 'IED supporting document' reviewed the technical disparities between BAT and the AM guidance, we also undertook an internal review of the AM requirements, and consulted internally on the IED permit applications that are currently being progressed with the EA to ensure we properly understood where AM was requiring more restrictive requirements.

The analysis as indicated in the table excerpt below from the Atkins report showed that Covering / Storage to be an area where AM requirements varied significantly from the applicable BAT reference (BREF) document from the European Commission (EC). BREF for Waste Treatment was published in 2018 to support the implementation of the IED, AM was published by the EA in September 2022.

Figure 1.1: Summary of BREF for Waste Treatment / Appropriate Measures Comparison

Table 4-1 below summarises the high-level findings of the review. It demonstrates where requirements, in our expert opinion, set out by BREF and Appropriate Measures are very similar (green), where Appropriate Measures requirements go above those set out by BREF (amber) or where Appropriate Measures requirements significantly exceed those of BREF (red).

Table 4-1: Summary of BREF for Waste Treatment / Appropriate Measures Comparison

Focus Area	Sub-Areas
Covering / Storage	Volume / residence time
	Storage areas
	Covering
	Storage tank design
	Lagoons
	Handling / transfer
Primary Containment / Failure Modelling	Monitoring
	Maintenance planning
	Operational areas
Secondary Containment	Minimising risks
Emissions Control / Monitoring	General
	Bioaerosols
	Point source emissions
	Biofilters
	Pre-treatment abatement scrubbers
	Fugitive emissions
Liquor Sampling	Sample analysis
Surface Water / Liquor Drainage	Infrastructure and inspection
Anaerobic Digestate Stability	Parameter monitoring / maintenance

Source: Atkins Report (table 4-1)

Figure 1.1 above shows a table from the Atkins report and identifies many areas of increased requirements between AM and BREF. We have focussed this enhancement case on what we believe to be the most material changes from a cost perspective, although it should be noted that there is still considerable uncertainty about the other changes and the full cost implications they may entail. However, we have focussed our option assessment on the most significant asset changes, for which we have a higher confidence of the solution and therefore the cost implications in an attempt to avoid being too risk averse in our approach.

Covering of biosolids

For storage areas, which in practice for the water industry impacts biosolids cake storage, the critical difference between BAT and AM is that the AM requirements state that 'Highly putrescible wastes, including odorous and ammonia- rich wastes' [which treated biosolids are] must be stored in a contained or enclosed building.

As is shown in Figure 1.2 below from the Atkins report, the BREF only states that this should occur where possible. It is this absence of choice and risk assessment that requires the building of fully enclosed buildings to store our biosolids cake. Although not specifically mentioned in the AM section below, once biosolids are stored in a fully enclosed building, this also necessitates the building will need odour control units installed, both to facilitate the safe operation of vehicles inside and to maintain a safe atmosphere under DSEAR regulations, owing to the potential emission release in a contained area.

Figure 1.2: Requirements on Storage Areas as Specified by Appropriate Measures and BREF

Table 4-3: Requirements on Storage Areas as Specified by Appropriate Measures and BREF

Common Point	BREF Only Requirements	Appropriate Measures Only Requirements
Waste should be stored on an impermeable surface with enclosed drainage.	Storage on an impermeable surface with enclosed drainage is applicable to bulk storage vessels and highly putrescible wastes.	Storage on an impermeable surface with enclosed drainage is applicable to all waste storage areas.
	Where possible, highly putrescible wastes should be contained within an enclosed building with ventilation and emissions abatement, however, this can be substituted by being treated within a maximum period of 24 hours in some instances.	*'Highly putrescible wastes, including odorous and ammonia-rich wastes'* must be stored in a contained or enclosed building.
		Storage areas must adhere to CIRIA C736 recommendations. This prescribes a greater level of detail for storage area design, as outlined in Section 5.3 and Appendix A1, based on a risk-based approach.

Source: Atkins Report (table 4-3)

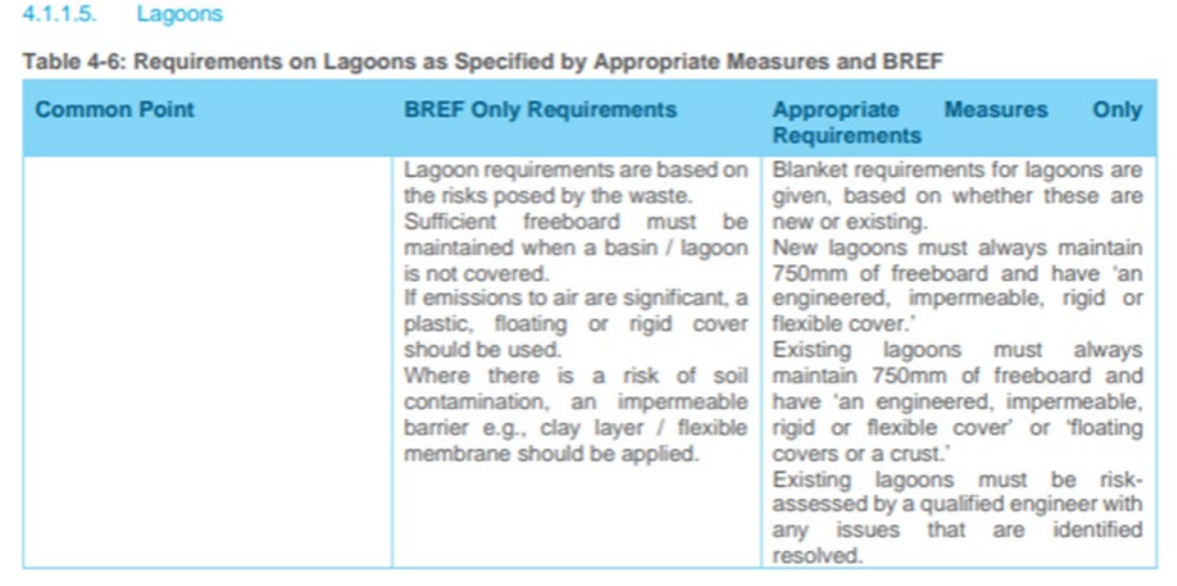
Tank Covering

In respect of covering of tanks, the Atkins report identifies; '*BREF specifies a risk-based approach to covering and that waste should be stored and treated in covered areas, depending on the risk it poses to soil / water, it also recognises that open tanks may be required in some cases. Appropriate measures goes beyond this by requiring covering for all bulk storage tanks and for transfer / management areas where these 'may produce emissions'*.'

Lagoon Covers

The treatment of lagoons is a very similar issue when comparing BREF and AM, in that the option to consider the risk possessed by the lagoon in question is irrelevant under AM and it simply becomes a must do. Figure 1.3 below from the Atkins report again highlights the discrepancy between the two standards, which lead to the requirement to invest in assets beyond those previously required for IED compliance.

Figure 1.3: Requirements on Lagoons as Specified by Appropriate Measures and BREF



4.1.1.5. Lagoons

Table 4-6: Requirements on Lagoons as Specified by Appropriate Measures and BREF

Common Point	BREF Only Requirements	Appropriate Measures Only Requirements
	Lagoon requirements are based on the risks posed by the waste. Sufficient freeboard must be maintained when a basin / lagoon is not covered. If emissions to air are significant, a plastic, floating or rigid cover should be used. Where there is a risk of soil contamination, an impermeable barrier e.g., clay layer / flexible membrane should be applied.	Blanket requirements for lagoons are given, based on whether these are new or existing. New lagoons must always maintain 750mm of freeboard and have 'an engineered, impermeable, rigid or flexible cover.' Existing lagoons must always maintain 750mm of freeboard and have 'an engineered, impermeable, rigid or flexible cover' or 'floating covers or a crust.' Existing lagoons must be risk-assessed by a qualified engineer with any issues that are identified resolved.

Source: Atkins Report (table 4-6)

Options for covering of biosolids storage

Yorkshire Water currently has 14 digestion sites, across these sites we utilised three different treatment techniques to deliver the necessary pathogen kill to ensure that the biosolids are treated in compliance with our Hazard Analysis and Critical Control Point (HACCP) plans and therefore meet the required standard for recycling to agriculture.

At three sites, Knostrop, Huddersfield and Hull we treat the digested cake with calcium oxide, commonly referred to as lime sanitisation, this has the benefit of being relatively quick with cake typically stored for 2-3 days only prior to being transferred to farmer's land.

Yorkshire Water has one Thermal Hydrolysis Plant (THP) at Esholt as this pre-digestion process involves treating the sludge at high temperatures with steam, this step in the process ensures the necessary pathogen kill is achieved.

At the majority of our digestion sites digested and dewatered cake is stored on open air concrete cake pads in windrows for a minimum of 4 weeks, which allows for secondary digestion and the eventual pathogen kill.

The primary benefit of lime sanitisation as an option is that it significantly reduces the period of time cake has to be stored on site from a minimum of 4 weeks to 2-3days, therefore reducing the size of any storage area by a factor of at least 14:1. However, Yorkshire Water doesn't currently utilise lime sanitisation on all our sites as it is more costly than storing in windrows, requiring the continued purchasing of chemical, the provision and maintenance of the necessary mixing equipment and it makes the treated biosolid cake more odorous which can make it more problematic to store both on our sites and on farmer's land.

Where space isn't a restriction, the most cost-efficient option and method with the least environmental impact is to store in windrows on open air pads. As a result, the majority of Yorkshire Water's treated biosolids cake is stored in this way to achieve its HACCP compliance before being recycled to agriculture. The current size of Yorkshire Water's biosolids storage pads is over 136,000m^2, equivalent to more than 19 football pitches.

Biosolids storage optioneering

For our proposed costs, our estimates utilise models aligned with models from our Unit Cost Database (UCD), with estimates developed using historic cost information on individual components of an overall solution. A simple cost assessment tool was developed, which used our UCD cost data as its source, for use in the creation of the WINEP SUiAR enhancement

case. For consistency we used the same tool for testing different scenarios and identifying our best estimates for preferred options.

Option 1, enclose our existing biosolids cake storage with no changes to existing treatment methods.

Given the enormous area that would be required to be covered and enclosed this was always likely to be a very high cost, but we verified this assumption using the tool and identified an estimated cost of £436.991m, prior to considering oncosts or inflation. This allowed a baseline cost for other options to be considered against, but does not represent an affordable scale of investment, nor an environmentally sound solution given the amount of materials that would be required to build such large buildings, or the ongoing electricity requirements to run very large odour control systems to ventilate such large buildings.

Option 2, convert all sites to lime sanitisation and build fully enclosed storage barns with 18 days storage capacity.

The WINEP SUiAR Enhancement case optioneering had determined that the optimum storage size for our barn sites would be 18 days, so we utilised the same metric in our options. The ready reckoner tool was used to estimate the required fully enclosed odour-controlled barn cost. To estimate the cost of converting sites to lime sanitisation, our solution manager obtained the costs of building lime sanitisation at our most recently completed site (Huddersfield) and pro-rated these costs for the equivalent throughputs of our other sites. The initial cost prior to considering oncosts or inflation was £84.433m.

Option 3, build driers to dry digestated cake and reduce the necessary storage volume further.

Yorkshire Water has not built any driers in recent years, so it was not felt that the UCD would contain sufficient or reliable data so a previous high level cost estimate for building a drier at our Knostrop site was used as a benchmark. This previous estimate suggested at cost of c.£57m to build a drier to deal with Knostrop's sludge volumes, given that would only be sufficient to dry a small proportion of our sludge, and storage of the dried sludge would still be required this option was considered highly likely to be cost prohibitive. Further considerations were the high energy demand and therefore high ongoing opex, as well as the uncertainty of a market for the dried cake, as farmers would not be able to spread in the same way as the existing biosolids. Considering these factors this option was ruled out.

Option 4, build incinerators removing the need for treated cake storage

Few sludge incinerators have been built, so limited cost information is available. However, it has been estimated that it would cost £2-300m to build the necessary incineration capacity. Ultimately this option is not feasible as the land selection, planning permission, environmental permitting, technology selection and detailed design is complex, lengthy and would come at a significant cost, so is not considered deliverable within AMP8. Therefore, as the AM guidance is considered to require compliance within the AMP8 timeframe this option was not considered further.

For biosolids storage Option 2 was considered the only viable option and was used for further cost assessment.

Options for covering of tanks

All existing tanks in the scope of the IED permitted area will need covering, so there is no alternate option.

Options for covering of lagoons

The AM guidance limits choice as all lagoons require covers. In determining our preferred options for costing a distinction was made between our only lagoon (at Blackburn Meadows site) currently within an IED permit boundary which is still in use, and a small number of other lagoons and below ground tanks that could potentially be considered in scope by the EA.

For the lagoon at Blackburn Meadows, a full cover and Odour Control Unit were assumed to be needed, for the other sites the lowest cost option identifiable to Yorkshire Water was considered to be floating balls so this solution was used for pricing.

1.4.2 Carbon impact and best value

There is not expected to be any carbon benefit from the work, there will be an as yet undetermined embedded carbon impact from the necessary construction works principally the use of concrete and steel, amongst other building materials. Designs are not yet known, but as all work is being carried out to deliver statutory obligations that would not otherwise be required, all materials used and ongoing chemical and energy consumption are a negative carbon impact compared to the 'do nothing' baseline.

1.4.3 Impact Quantification

The driver for this investment is delivering statutory obligations there are no expected service benefits from this work, nor are any performance commitment deliverables being affected.

The investment required to create covered storage, tank covers, and lagoon covers deliver no improvements in sludge quality or efficiency of our processes. The sole benefit of the asset changes is to reduce the risk of pollution, primarily odour risk from site activities.

1.4.4 Third Party Funding

There is no planned third-party funding for this case.

1.4.5 Customer Views

We have not carried out specific customer engagement related to the solutions within this enhancement case given that it is a requirement driven by the EA.

1.4.6 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

1.5 Cost Efficiency

Within this section, detail is provided specific to the expenditure forecasting methodologies used for the capex cost components, fully enclosed cake barns, conversion to lime sanitisation, covering of tanks and lagoons.

Following on from this the operating cost forecast methodology in relation to the new assets created is detailed.

1.5.1 Option Costs

Costings method for fully enclosed cake barns and conversion to lime sanitisation

To calculate the most accurate cost forecast possible for building fully enclosed cake barns data from our Unit Cost Database (UCD) was used to create a 'ready reckoner tool' which allowed us to cost multiple options and scenarios by inputting the required metrics. This tool was created for

use in determining the most appropriate solution and efficient cost for Yorkshire Water's WINEP SUiAR Enhancement case, we used it to develop this case for consistency and accuracy.

To determine the necessary input metrics; the forecast sludge production volume in 2030 and the number of days storage required, the relevant subject matter experts were consulted within Yorkshire Water (YW).

In respect of the required number of days storage, two factors were considered, firstly following consultation with our Recycling Manager - the logistics and increased risks of having all our cake lime sanitised the shortest duration which would be manageable to store the cake was considered. This had to take on board allowing for some flexibility owing to customer uncertainty, as simple impacts like wet weather can prevent farmers from being able to receive cake, so we have to store it longer. Secondly, we had to consider the wider regulatory challenges to the land bank, for this we referred to the optioneering that had already taken place to formulate the optimum storage period for our existing lime sanitised sites as part of the WINEP SUiAR Enhancement case workings. The WINEP work had identified the optimum balance between cost and resilience for Knostrop, Huddersfield, Hull and Esholt where YW currently has partially enclosed storage was 18.7 days storage per site.

It was considered that 18.7 days storage at each site, whilst a substantially more restrictive operation than the current storage arrangements on open pads, would allow for the recycling of treated biosolids cake to agriculture to be carried out at all sites under the existing SUiAR regulations. When considering the new problems it would create, in terms of a lack of resilience to weather, customer changes, treatment outages, increased odour and the increased likelihood of having to use expensive third-party disposal routes in case of failure, it was considered that 18.7 days would be very challenging but struck the necessary balance between challenge and value for money for customers. (i.e., YW wouldn't have invested in an overabundance of storage that wasn't needed)

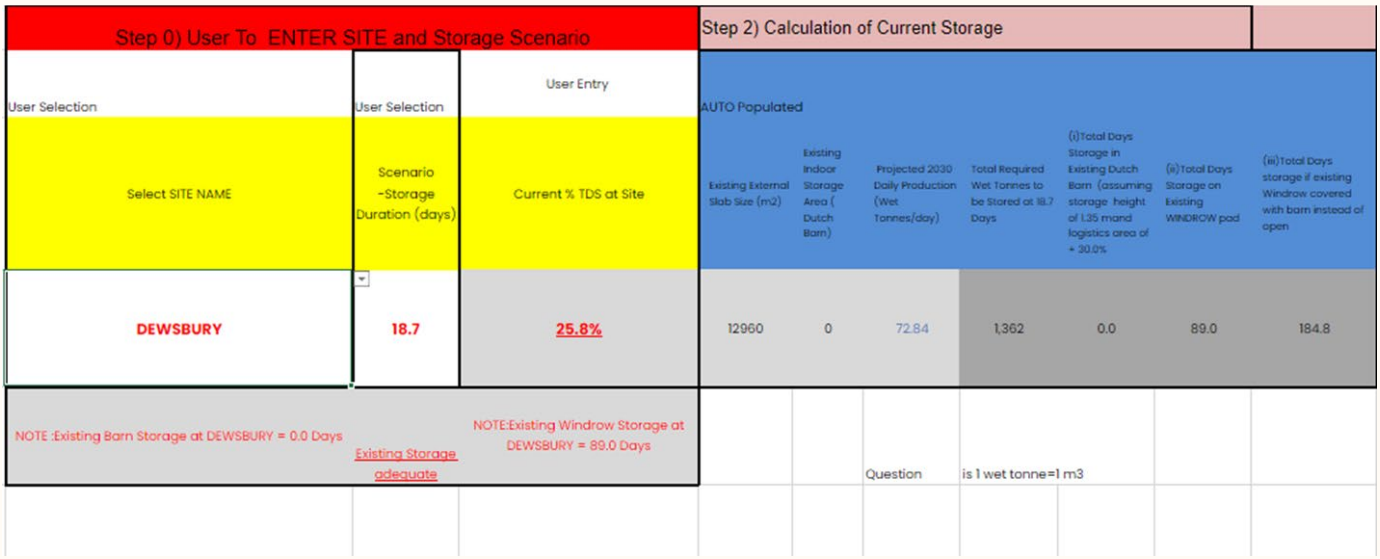
Forecast sludge throughput volumes for each site were provided by our Technical Optimisation team who calculated the data for all PR24 calculations based the most up to date forecasts available, considering our AMP8 plans for digester site rationalisation. Which include the plans to close Caldervale, Lundwood and Aldwarke digestion plants within the AMP8 period.

Once the number of days and the projected 2030 sludge production was confirmed, we entered the data into the ready reckoner tool for each site to calculate the required barn costs. Option 2b in the ready reckoner determines the cost for a new fully enclosed barn with odour control. As none of our sites had fully enclosed or odour-controlled barns this was the most suitable option to use for forecasting.

Read more about this at
WINEP Enhancement Case

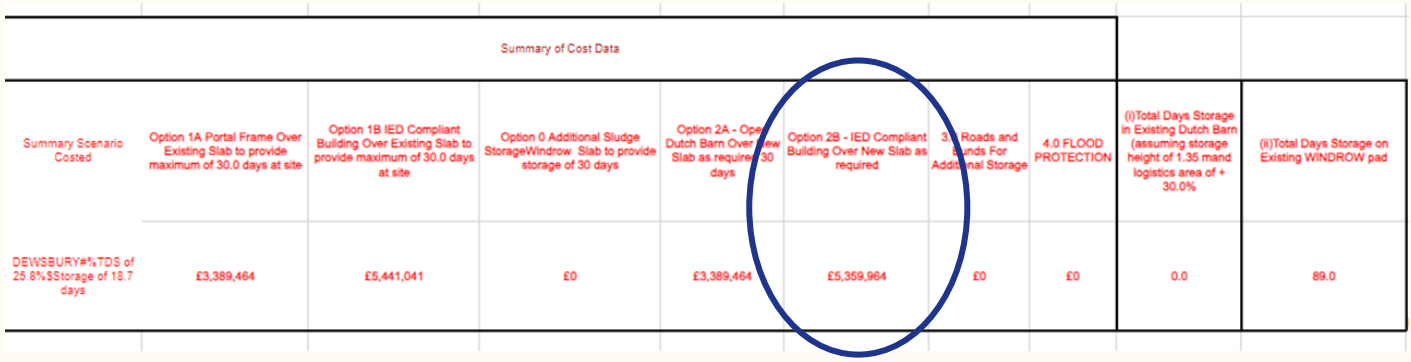
Excerpts are shown below from the tool, showing the example of the Dewsbury site.

Figure 1.4: Site selection, storage duration selection and the fixed site metrics used in the calculation.



Step 0) User To ENTER SITE and Storage Scenario			Step 2) Calculation of Current Storage						
User Selection	User Selection	User Entry	AUTO Populated						
Select SITE NAME	Scenario -Storage Duration (days)	Current % TDS at Site	Existing External Slab Size (m2)	Existing Indoor Storage Area (Dutch Barn)	Projected 2030 Daily Production (Wet Tonnes/day)	Total Required Wet Tonnes to be Stored at 18.7 Days	(i)Total Days Storage in Existing Dutch Barn (assuming storage height of 1.35 mand logistics area of + 30.0%	(ii)Total Days Storage on Existing WINDROW pad	(iii)Total Days storage if existing Windrow covered with barn instead of open
DEWSBURY	18.7	25.8%	12960	0	72.84	1,362	0.0	89.0	184.8
NOTE :Existing Barn Storage at DEWSBURY = 0.0 Days	Existing Storage adequate	NOTE:Existing Windrow Storage at DEWSBURY = 89.0 Days			Question	is 1 wet tonne=1 m3			

Figure 1.5: Summary option cost data, Option 2B is the relevant option for a fully enclosed odour-controlled barn.



Summary of Cost Data									
Summary Scenario Costed	Option 1A Portal Frame Over Existing Slab to provide maximum of 30.0 days at site	Option 1B IED Compliant Building Over Existing Slab to provide maximum of 30.0 days at site	Option 0 Additional Sludge StorageWindrow Slab to provide storage of 30 days	Option 2A - Open Dutch Barn Over New Slab as required 30 days	Option 2B - IED Compliant Building Over New Slab as required	3.0 Roads and Hards For Additional Storage	4.0 FLOOD PROTECTION	(i)Total Days Storage in Existing Dutch Barn (assuming storage height of 1.35 mand logistics area of + 30.0%	(ii)Total Days Storage on Existing WINDROW pad
DEWSBURY#%TDS of 25.8%$Storage of 18.7 days	£3,389,464	£5,441,041	£0	£3,389,464	£5,359,964	£0	£0	0.0	89.0

Figure 1.6: Detailed metrics the costing tool determines for the given option, which are used to calculate the forecast cost using the UCD data.

DEWSBURY	18.7		TITLE	Option 2B - IED Compliant Building Over Extended Slab					0	
DEWSBURY	18.7	2B	10a	Option 2B Digestate sealed building (Zy1045 inlcudes slab!)	*Quality*	*Digestate Storage*	*Add*	area	m2	1,311.6
DEWSBURY	18.7	2B	11	Option 2B Digestate Building Ventilation System	*Quality*	*Digestate Storage*	*Add*	airflow	m3/hr	20985.9
DEWSBURY	18.7	2B	12	Option 2B Odour Control System	*Quality*	*Digestate Storage*	*Add*	Power (KW)	m3/h	24.6 Power (KW)

Table 1.4 below summarises the output of the costing tool exercise, noting that no costs have been projected for Aldwarke, Caldervale or Lundwood on the assumption that the EA will agree that covered biosolids cake storage is not required in AMP8 at these sites as YW will convert them to sludge thickening and dewatering sites only by 2030.

Table 1.4: Output of costing tool exercise for Option 2b and 'oncost' application

Site	Option 2b Barn Cost (£m)
Knostrop	25.23
Hull	20.35
Huddersfield	10.54
Esholt	15.34
Blackburn Meadows	11.63
Dewsbury	6.49
Old Whittington	3.12
Woodhouse Mill	2.65
Sandall	2.77
Aldwarke	-
Caldervale	-
Lundwood	-
Total	**98.11**

To ensure that YW did not duplicate funding requests, the WINEP SUiAR Enhancement Case was reviewed to consider possible overlaps in funding requests. There was an obvious overlap with the proposal to 'Extend covered sludge barn storage to 18 days at 4 sites', WINEP action ID 08YW100075, as this case had also determined the need to extend barn storage to 18 days at the 4 referenced sites (Knostrop, Hull, Huddersfield and Esholt). As none of the other WINEP actions involve the construction of covered storage none of the others were determined a duplicate request.

To remove the overlap in funding requirements, the relevant WINEP SUiAR values including forecast on-costs were deducted from this request. Leaving a total net barn cost of £85.73m, as shown in the table below.

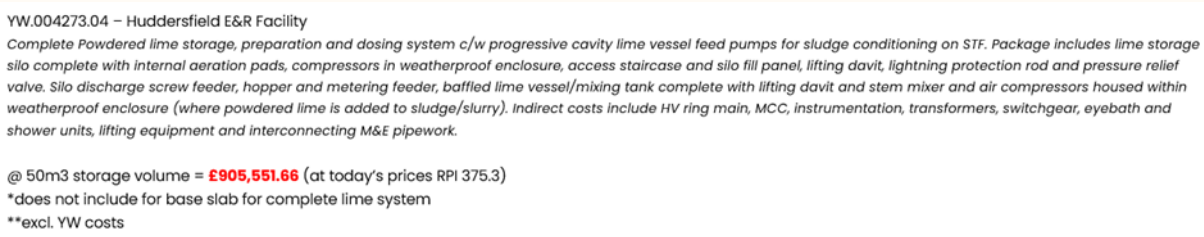
Table 1.5: Removal of Overlap with SUIAR enhancement costs

Site	Option 2b Barn Cost (£m)	WINEP SUiAR Enhancement Cost (£m)	Net Barn Cost (£m)
Knostrop	25.23	-3.74	21.49
Hull	20.35	-2.28	18.06
Huddersfield	10.54	-4.39	6.16
Esholt	15.34	-1.98	13.36
Blackburn Meadows	11.63		11.63
Dewsbury	6.49		6.49
Old Whittington	3.12		3.12
Woodhouse Mill	2.65		2.65
Sandall	2.77		2.77
Aldwarke	-		
Caldervale	-		
Lundwood	-		
Total	**98.11**	**-12.38**	**85.73**

For the lime sanitisation cost forecasts the most recent lime sanitisation installation cost data was obtained from the UCD, which relate to YW's Huddersfield digestion plant commissioned in May 2021. This was used as a baseline cost for lime dosing installation, with costs for other sites calculated from this baseline by comparing sludge throughput and the relative dosing unit size required compared to Huddersfield. The costs were then calculated from the Huddersfield baseline proportionate to the dosing unit size.

Detail of what is included in the Huddersfield lime dosing UCD cost baseline is shown below.

Figure 1.7: Huddersfield Lime Dosing Cost Baseline


YW.004273.04 – Huddersfield E&R Facility

Complete Powdered lime storage, preparation and dosing system c/w progressive cavity lime vessel feed pumps for sludge conditioning on STF. Package includes lime storage silo complete with internal aeration pads, compressors in weatherproof enclosure, access staircase and silo fill panel, lifting davit, lightning protection rod and pressure relief valve. Silo discharge screw feeder, hopper and metering feeder, baffled lime vessel/mixing tank complete with lifting davit and stem mixer and air compressors housed within weatherproof enclosure (where powdered lime is added to sludge/slurry). Indirect costs include HV ring main, MCC, instrumentation, transformers, switchgear, eyebath and shower units, lifting equipment and interconnecting M&E pipework.

@ 50m3 storage volume = **£905,551.66** (at today's prices RPI 375.3)
*does not include for base slab for complete lime system
**excl. YW costs

Table 1.6 below details the forecast lime sanitisation conversion costs for the relevant sites. No costs are included for Knostrop, Huddersfield or Hull as they already have lime sanitisation, Esholt was also excluded as the site has THP which negates the need for lime sanitisation. Caldervale, Lundwood and Aldwarke, were again excluded on the basis that the digestion plant will be closed prior to the end of AMP8.

Table 1.6: Lime Sanitisation Conversion Costs

Site Name	*Dosing Unit Storage Volume	Cost per site (£m)
Huddersfield	50	
Blackburn Meadows	74.8	1.797
Dewsbury	41.7	1.002
Old Whittington	19.7	0.472
Woodhouse Mill	15.9	0.382
Sandall	16.8	0.404
		4.057

Costing method for tank covering

Work being undertaken by YW in AMP7 to deliver compliance with the IED includes the covering of some tanks on our IED permitted facilities. As all YW's IED permits are yet to be issued, the team delivering the projects have assessed from the dialogue we have had from the EA on the subject where it is likely tank covers will be required for IED compliance, and where using a risk-based approach they will not be required.

Under the AM guidance, there is no longer the option to use a risk-based approach therefore all tanks now need covering. To determine the cost, YW has compared the difference in cost between covering all tanks, and the most likely IED compliance scenario being delivered in AMP7.

The project manager for the IED compliance projects maintains a forecast of all aspects of the project and the current likely, best case and worst-case estimates. The difference between the worst case and current likely case estimates have been calculated to determine the AM cost of tank covering as the worst case assumes all tanks will require covers.

An example summary view of the estimates by site is shown in below.

Table 1.7: Summary Cost Estimates

	Caldervale			Dewsbury		
Row Labels	Sum of Current Likely Estimate	Sum of Best Case Estimate	Sum of Worse Case Estimate	Sum of Current Likely Estimate	Sum of Best Case Estimate	Sum of Worse Case Estimate
Tank Covering	£1,940,500	£290,500	£2,906,000	£1,390,500	£278,000	£1,781,000
Grand Total	**£4,409,804**	**£1,826,777**	**£5,790,304**	**£4,693,968**	**£2,158,859**	**£5,489,468**

To determine the cost of tank covering several assumptions have been used based on quotations, YW's UCD and engineering expertise. These are detailed below:

- To install a new fixed roof on an existing tank, £80k has been allowed per installation based upon a quote received by YW in 2022 for a typical roof on an 11.5m diameter tank at Aldwarke.
- Utilising YW's UCD models for a typical sized Odour Control Unit (OCU) with a single stage carbon filter, £200k has been used as an estimate. Where tanks are located in pairs, it is assumed a single OCU would be constructed.
- Based on YW's UCD model for typical 7m2 fixed cover, £30k has been estimated for typical wet well covers.
- Where methane extraction is likely to be required, £500k per tank has been allowed. Limited data is available, but assumes a cover, pipework, valves, and gas boosters to convey the gas to the biogas system.
- Detailed designs have not been completed, but it is likely that not all existing tanks will be structurally suitable for installation of a cover, therefore, to allow for

the likely need to build entirely new tanks in some instances a 25% uplift has been applied to all tank covering costs to allow for this possibility.

These assumptions have been applied on a site-specific basis, relevant to the current tank arrangements and summarised in Table 1.8 below.

Table 1.8: Tank Covering Costs Summary

Site Name	Cost per site (£m)
Knostrop	1.41
Hull*	-
Huddersfield*	1.089
Esholt	1.864
BBM	0.775
Dewsbury	0.473
Old Whit	0.473
Woodhouse Mill	0.004
Sandall	0.896
Aldwarke	0.351
Caldervale	1.168
Lundwood	0.548
	9.051

*All tanks at Hull are already covered as an odour sensitive site. Huddersfield IED permit already in place, costs included for covering of all uncovered tanks (9 in total)

Costing method for lagoon covering

YW has a small number of lagoons on its digestion sites, only one of these, at Blackburn Meadows (BBM) is intended to be included as a permitted lagoon within its IED site boundary as it still receives drainage run off from an adjacent cake storage pad. At three other sites, Esholt, Woodhouse Mill and Sandall YW has below ground tanks or lagoons that we do not believe should require covering, however, owing to the lack of confirmed permits there is a risk covers may be required.

To reflect the expected different approach likely to be taken to the covering of these lagoons and below ground tanks, we have costed their solutions differently taking account of the relative risk.

Limited cost data is available to YW for calculating the cost of lagoon covering as it is not an activity previously undertaken by the organisation, however, reasonable steps to establish the cost have been taken.

At BBM it is assumed a full cover and OCU would be required, this is consistent with the AM guidance mandating the application of a cover, and the recently issued IED permit for the site the improvement conditions of which suggest the EA believe the lagoon to present an odour risk.

For BBM our UCD cost model data for covering of a tank has been used, applied to the surface area of the lagoon. Additionally, an estimated cost of providing an OCU for the covered lagoon has been done assuming 3 air changes per hour would be required for a volume equivalent to the surface area of the lagoon, with an average cover height of 1m. To calculate the OCU cost, the ready reckoner tool created for cake barn calculations was used to give an estimate.

Table 1.9: Blackburn Meadows Cost Summary

Site	Lagoon surface area (m^2)	Total Cost (£m)
BBM	1,723	3.629

For the three other sites YW has identified the lowest cost covering solution, which is considered by YW to be the application of floating balls to provide a cover. Again, we have calculated the surface area of the below ground tank or lagoon but have utilised a combination of the floating ball calculator provided on Euro-Matic website (www.euro-matic.co.uk/ball-calculator) and a previous quote pro-rated to calculate an estimated cost for covering with floating balls.

Table 1.10: Lagoon Covering Cost Estimate for additional 3 sites

Site	Lagoon surface area (m^2)	No. of floating balls	Total Cost (£m)
Esholt	917	106,278	0.049
Woodhouse Mill	1,262	146,256	0.067
Sandall	744	86,220	0.04
			0.156

1.5.1.1 Summary capex detail

See table below for total capex requested across the three spend categories. These tables also show the application of an indexation adjustment that has been applied to all YW's enhancement cases to convert our cost model data from RPI April 2022 base to CPHI average 2022/23 which requires an uplift of 1.0496.

Table 1.11: Total Capex Required

Enclosed cake storage	Lime sanitisation	Tank covering	Lagoon covering	Total (£m)
89.979	**4.258**	**9.499**	**3.972**	**107.708**

1.5.1.2 Opex requirements calculation

As detailed design has not been completed, the operating expenditure impact of the capital works has been estimated using experience of similar plant equipment, known rates and key metrics established in the ready reckoner tool in relation to the cake barns. The primary focus has been on the opex related to the change in operation to lime sanitisation at all sites, and the operation and maintenance of the new odour-controlled cake barns.

The follow inputs and assumptions were used:

- The KW rating of the OCU fan motors was established from the ready reckoner tool, in the same method as the capex costings for the cake barns. Part of the detailed workings quantifies the required air flow and fan motor sizes.

- The cost per KWh used for calculations was £0.20 per KWh, which is materially less than YW's 2022/23 outturn forecast cost of £0.267 per KWh. When compared to the open wholesale market, and taking account of non-commodity costs, the monthly electricity price has exceeded this baseline for 20 of the last 25 months. (Source: Nord Pool N2EX day ahead auction prices)

- Maintenance costs for the lime dosing equipment and OCUs has been estimated at 3% of the capital costs of the installed equipment. OCU cost taken from the ready reckoner tool, lime dosing equipment from the UCD data for Huddersfield and pro-rated as described in the capex section above. (Pre-inflation adjustment figures were used for consistency)

- For the cost of lime (calcium oxide), the current known target lime dose in kg per tonnes of dry solid (tds) was used, the current weighted average cost per Kg YW pays for lime, along with the projected treatment volumes at each site, including additional volumes at sites that were increasing capacity as part of rationalisation to calculate the full year impact at each site by the 2029/2030.

- OCU carbon media was assumed to need replacing bi-annually. Therefore, costs were only included for sites that the OCU are anticipated to be in service for more than 1yr. Estimated costs were approximated from previous known carbon media replacement costs for similar sized units.

- Cake handling is expected to be required on weekends once all sites are converted to lime sanitisation, therefore the increased cost of employing our cake handling contractor was calculated using their existing contract rates. For the largest sites (Knostrop, Hull, BBM, Huddersfield & Esholt) 7-day working is assumed, for the smaller sites (Dewsbury, Sandall, Woodhouse Mill, Old Whittington) only one additional weekend working day, i.e., 6-day working, was assumed.

- For all sites, a small sum was assumed to be required for permit variation fees and consultancy cost for support in preparing the necessary changes in the first two years of AMP8. (£9k per site for two years, total £18k per site)

- In order to facilitate the conversion of our existing digestion sites to lime sanitisation as well as the construction of all new fully enclosed treated biosolids cake storage we have assumed that this will cause interruptions to normal treatment operations necessitating the disposal of a small proportion of our cake externally with third parties. We have allowed for the external treatment of the equivalent of 24 days treated biosolids production externally for the first two years, reducing to 18days in year 3 and 12 days in year 4 of AMP8. Daily throughput measured in wet tonnes per day post digestion is forecast to be 1,051.27 tonnes, based on typical costs to export cake externally which currently range between £65-£85 per wet tonne, we have assumed £75 per wet tonne disposal cost in our workings.

Once the full year effect of the operating cost changes has been calculated using the assumptions above, completion dates for the capital works were estimated and the appropriate opex costs were pro-rated based on the expected time in commissioning and operation within AMP8. The full opex impact will not be realised until AMP9, owing to the expected late completion dates of several sites within AMP8.

Below quantifies the assumptions above to forecast the 2029/30 full year opex increase as a result of the new capital works required by this enhancement case.

Table 1.12 below shows the annual breakdown of the operating expenditure forecast by site, with cake storage related opex pro-rated based upon the forecast completion date.

Table 1.12: Annual Opex Breakdown

Site / spend type	Estimated cake barn completion dates	Based on completion date no. of yrs in operation	2029/30 cake storage full year opex increase	2025/26	2026/27	2027/28	2028/29	2029/30
Knostrop	Jun-28	1.75	530,767	-	-	-	360,575	530,767
Hull	Jan-29	1.17	424,885	-	-	-	70,814	424,885
Huddersfield	Jan-30	0.17	192,314	-	-	-	-	32,052
Esholt	May-27	2.88	288,228	-	-	252,199	288,228	288,228
BBM	Mar-27	3.00	413,064	-	-	373,064	373,064	413,064
Dewsbury	Jun-29	0.75	155,113	-	-	-	-	116,335
Old Whit	Jun-29	0.75	95,408	-	-	-	-	71,556
Woodhouse Mill	Jun-29	0.75	75,258	-	-	-	-	56,444
Sandall	Jun-29	0.75	100,577	-	-	-	-	75,432
Aldwarke	n/a	-	-	-	-	-	-	-
Caldervale	n/a	-	-	-	-	-	-	-
Lundwood	n/a	-	-	-	-	-	-	-
3rd party biosolids				1,892,283	1,892,283	1,419,212	946,142	-
Permit fees and consultancy				108,000	108,000	-	-	-
			2,275,615	2,000,283	2,000,283	2,044,476	2,038,823	2,008,764

To simplify the financial projection for the purposes of the submission each yearly sum has been rounded to the nearest one hundred thousand pounds.

Table 1.13 below summarises the final opex expenditure forecast including the indexation adjustment that has been applied to all YW's enhancement cases to convert our cost model data from RPI April 2022 base to CPHI average 2022/23 which requires an uplift of 1.0496.

Table 1.13: Total Opex Value in CWW3

2025/26	2026/27	2027/28	2028/29	2029/30	Total (£m)
2.099	2.099	2.099	2.099	2.099	10.495

1.5.2 Efficient Cost Estimates

Our estimates utilise models aligned with models from our Unit Cost Database, with estimates developed using historic cost information on individual components of an overall solution. Further information on the efficiencies embedded within our modelling approach is provided in section 7.3 of the Introduction to Enhancement Cases appendix.

1.5.3 Need for enhancement model adjustment

Without a view of the Ofwat approach to setting cost allowances to each driver, anticipating any model adjustment requirements is challenging.

For this driver we anticipate that the range of interventions (wide ranging and company specific) will make identification of appropriate cost drivers difficult and therefore we anticipate that Ofwat will not produce a cost model and would assess this expenditure through a deep dive approach.

1.6 External Assurance

For information on Assurance please see section 7.4 in the Introduction to Enhancement Cases appendix.

1.7 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

We reviewed our forecast enhancement totex and found we met the 1% materiality threshold for PCDWW38. We propose to protect customers from the under or non-delivery of our programme to meet the EA's Appropriate Measures guidance.

We also considered whether additional customer protection mechanisms were in existence or should be introduced to complement the PCD. There is no third-party funding.

1.7.1 Price Control Deliverable

We set out our PCD parameters and payment rates in the following tables.

Table 1.14: PCD Delivery Expectation

PCD Delivery Expectation	
Description	The company will improve the treatment of biosolids by building 18,915 square metres of fully enclosed storage barns to control odour. Biosolids are typically spread and dried as a cake on concrete storage pads for a minimum of 4 weeks before they can be re-used, for example, in agriculture.
Output measurement and reporting	Area of fully enclosed cake storage, reported to zero decimal places. The company will report in parallel with the APR.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on Scheme	The company will implement solutions that meet Environment Agency's (EA) guidance on 'Biological waste treatment: appropriate measures for permitted facilities'.

We propose only the investment for enclosed cake storage is protected through the PCD given it is the material cost item within this enhancement case. We have considered the area of enclosed storage rather than number of sites as there is uncertainty in exact sizing and number of sites. We have carefully considered our delivery profile and set it to reflect the complexity in delivery and the need to maintain operations during construction. There are substantial complications to consider when designing the cake storage barns, with some sites having severely constrained space available, such that potential land purchase and planning permissions need to be factored into the delivery schedule.

1.7.1.1 Forecast deliverables

Table 1.15: Forecast Deliverables

Deliverable	Unit	Forecast Deliverables				
		2025/26	**2026/27**	**2027/28**	**2028/29**	**2029/30**
Enclosed storage area	m^2 (cumul)	0	2,352	5,260	13,978	18,915

1.7.1.2 PCD payment rate

We propose an average cost PCD payment rate.

Table 1.16: PCD Payment Rate

Deliverable	Unit payment (£m)
£ per m²	= Capex for storage ÷ no. of deliverables = £89.979m ÷ 18,915 = £4,757

1.7.1.3 Annualised Outcome Delivery Incentives

There is no performance commitment and associated ODI impact for this enhancement totex.

1.7.1.4 Annualised time delivery incentive

We consider a time delivery incentive is appropriate as the enhancement spend related to enclosed cake storage areas is material and there is no ODI protection for customers.

Table 1.17: Time Incentive Payment Rate

Deliverable	Unit payment (£)
£ per m²	Scale of time delay incentive = £89.979m enhancement x 3.5% = £3.149m Incentive per area per year = £3.149m ÷ 18,915 ÷ 5 years = £33.29

Given the uncertainty in the exact storage area that will be required for each site (owing to the sludge growth from AMP7 investment having not completed), potential land purchase needs, design and planning permission considerations, we propose the delay incentive only applies where actual area of enclosed storage is more than a 10% variation from the forecast area in each year.

1.7.2 Third Party Funding or Delivery Arrangements

This is not applicable for this case as no third party funding or DPC is proposed.