Anglian Water

WASTEWATER DATA TABLES COMMENTARY

IAP Response April 2019

RESPONSIBLE BUSINESS OF THE YEAR 2017
BUSINESS IN THE COMMUNITY

THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2015

love every drop.
anglianwater

SUMMARY OF CHANGES - SEPTEMBER 2018 TO APRIL 2019

The table below summarises the changes to the input cells in the Wastewater data tables. Where appropriate table commentary has been updated.

Note: Where line numbers have changed in the data tables, we have re-numbered the commentary accordingly, even if the commentary itself has not been updated.

Data table	Lines amended	Years amended
WWS1 - Wholesale wastewater operating and capital expenditure by business unit	1, 7, 13, 21	2018/19
	13-14	2019/20
	1, 7, 8, 12, 15, 18	2020/21 to 2024/25
WWS1a - Wholesale wastewater operating and capital expenditure by business unit including operating leases reclassified under IFRS16	1, 7, 13, 21	2018/19
	13-14	2019/20
	1, 7, 8, 12, 15, 18	2020/21 to 2024/25
WWS2 - Wholesale wastewater capital and operating expenditure by purpose	9-10, 57	2020/21 to 2021/22
	25	2019/20
	9-10, 56-57	2022/23 to 2024/25
WWS2a - Wholesale wastewater cumulative capital enhancement expenditure by purpose	9-10	2020/21 to 2024/25
WWS3 - Wholesale wastewater properties and population	3-4	2018/19
WWS4 - Wholesale wastewater other (explanatory variables)	10, 12	2020/21 to 2024/25
WWS5 - Other wholesale wastewater expenditure	1	2020/21 to 2024/25
	3	2021/22 to 2024/25
WWS7 - Wholesale wastewater local authority rates	1, 12	2020/21 to 2024/25
	13	2021/22, 2022/23, 2024/25
WWS8 - Third party costs by business unit for the wholesale wastewater service	21	2020/21 to 2024/25
WWS10 - Transitional spending in the wholesale wastewater service	No change	-
WWS12 - RCV allocation in the wholesale wastewater service	No change	-
WWS13 - PR14 wholesale revenue forecast incentive mechanism for the wastewater service	15-18, 22	2018/19
	30-31	2019/20

Data table	Lines amended	Years amended
WWS15 - PR14 wholesale total expenditure outperformance sharing for the wastewater service	9	2018/19 to 2019/20
	19-22	2019/20
WWS18 - Explaining the 2019 final determination for the wastewater service	11	2020/21 to 2024/25
WWn1 - Wholesale wastewater sewage treatment operating expenditure	1-8	2018/19
	1	2020/21 to 2024/25
	7	2020/21, 2023/24 to 2024/25
WWn2 - Wholesale wastewater large sewage treatment works explanatory variables and operating expenditure	No change	-
WWn3 - Wholesale wastewater network (explanatory variables)	No change	-
WWn4 - Wholesale wastewater sewage treatment (potential explanatory variables)	1-7	2018/19 to 2024/25
WWn5 - Wholesale revenue projections for the wastewater network plus price control	2-8	2020/21 to 2024/25
	11	2020/21 to 2022/23
	26	2017/18 to 2024/25
WWn6 - Cost recovery for wastewater network plus	3, 8, 11	2020/21 to 2024/25
	11	2025/26 to 2029/30
WWn7 - Weighted average cost of capital for the wastewater network plus control	11-13	2020/21 to 2024/25
	19	2025/26 to 2029/30
WWn8 - Wholesale wastewater network plus special cost factors	No change	-
Bio1 - Wholesale wastewater sludge (explanatory variables)	No change	-
Bio2 - Wholesale wastewater sludge treatment process and disposal routes	No change	-
Bio3 - Wholesale wastewater sludge opex	4-5, 12-13	2018/19
Bio4 - Wholesale revenue projections for the wastewater bioresources price control	5, 6	2020/21 to 2024/25
	30	2017/18 to 2024/25
Bio5 - Cost recovery for bioresources	16	2023/24
Bio6 - Weighted average cost of capital for the bioresources control	11-13	2020/21 to 2024/25

Data table	Lines amended	Years amended
	19	2025/26 to 2029/30
Bio7 - Wholesale wastewater bioresources special cost factors	No change	-

WHOLESALE WASTEWATER EXPENDITURE

This commentary provides supporting information on our totex programme for AMP7. An overview of the Totex expenditure contained within the price control is detailed in the supporting table commentary for WWS1, WWS2 and WWS2a.

In this section we:

- summarise our approach to developing our enhancement expenditure (see *Efficiency and Innovation* in our Plan for full details)
- provide detailed enhancement business cases (aligning to the Ofwat IN18/11, July 2018)
- provide supplementary information to the table lines.

Our approach to asset management

In this section we summarise the key features of our approach to asset management which ensure that we develop asset management plans that deliver benefits of greatest value to customers at the lowest whole-life cost. This topic is discussed more fully in Chapter 10 of Our Plan (*Efficiency and Innovation)*.

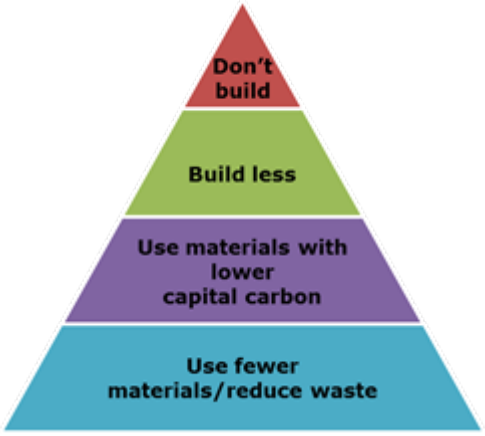
Our approach is based on continuous planning and management of assets and investments, supported by our Copperleaf C55 system, which ensures that we deliver efficient outcomes for customers. The key features of our approach are:

Step 1: We challenge need

Where possible, we use no-build solutions, reducing both capital cost and carbon. In challenging need, we assess and place a value on the consequences of asset and service failure. Our approach to challenging need includes use of:

- Deterioration and Service risk impact models: these models provide forecasts on the likely rate of decline in the performance of our assets and the associated impact. They are particularly useful in determining our maintenance plans.
- Data on the value to customers, society and the environment of service improvements arising from investment. Full details are set out in Chapter 12 of Our Plan (*Customer Engagement*).
- Data on the costs we will incur from failure to invest. Our Business Impact Matrices (BIMs) are the comprehensive set of private costs associated with specific aspects of service, such as the costs associated with particular events like sewer flooding incidents. These have been built bottom up and capture individual cost components associated with specific activities (e.g. labour costs)
- Evidence from the field: feedback on asset performance from our field-based teams, who are closest to the asset is used to inform our investment plans.

Step 2: We select the most appropriate solution



By challenging the default use of traditional, high carbon assets, we are able to reduce costs. When we do need to build new infrastructure, we make sure we minimise the materials used and ensure these are low carbon. For example, we have used innovative zero cement concrete to reduce carbon in the base slabs of our assets by 60%.

A big change we have made to reduce carbon and costs of our below ground infrastructure has been moving from open cut to no dig solutions. Since 2009, we have moved from using 95% open cut solutions

For our above ground (non-infra) assets we have taken a totex approach. We have prioritised reusing existing assets, using no-build solutions or building less and making use of standard products and building off site. We have also developed digital models that allow us to test possible options in a virtual environment rather than on site. All of these approaches ensure we reduce both costs and carbon in building new infrastructure.

Our alliancing model also provides the platform for long-term relationships and investment which helps to drive innovative solutions. This is described in the Chapter 5, *Efficiency and Innovation* of our Plan.

Step 3: We ensure solutions selected are cost efficient, informed by a comprehensive evidence base

The quality of any decision is constrained by the volume and quality of the evidence on which it is based. When assessing investment requirements, we have a comprehensive system for capturing the widest and most recent set of private, societal and environmental costs and benefits which allow us to determine the optimal level of investment. This consists of a number of key components:

- Costs: Since 2003 we have captured the outturn costs of completed capital projects at equipment and plant group level. We have over 38,000 projects comprising over 270,000 data points. We capture project costs at sub-systems level (e.g. civil costs of rapid gravity filters) and assess and categorise indirect costs. Both the scale and level of granularity of this database is unrivalled in the water industry, with nearly a million records.
- Delivering value to customers: Our evidence based approach means that we use the most efficient costs and latest innovations to develop our plans. So customers continually benefit from efficiency driven by totex and innovation in our cost base. Where there are new technologies we validate and challenge estimates provided by third parties. In addition we are able to develop cost estimates that are based on confirmed contract costs for a project or very similar work (e.g. schedule of rates, framework agreements, fixed price contracts) where appropriate.
- We have further enhanced our approach to ensure alliance overheads (OH) are reflected in our cost base. We assign an alliance on a project by project basis and work type which enables us to reflect the overhead incurred rather than a one size fits all approach.

Overall Cost Benefit Approach

We have undertaken cost benefit analysis across both base and enhancement totex within our plan using a common methodology, implemented through our C55 investment planning system

- Financial costs (and cost savings) are discounted using the Weighted Average Cost of Capital (WACC)
  - Assessed as the whole life cost over a 40 year planning horizon, including ongoing operating costs and renewal activities
  - These are annualised (dividing by sum of private discount rates)
  - This is the equivalent annualised costs (EAC)
- Non-financial benefits are discounted and annualised using the Social Time Preference Rate (STPR), as provided by the Treasury Green Book
  - These are customer, wider societal and environmental triangulated values obtained through our valuation workstream (as described in our Valuation Completion Report)
  - Assessed as the whole life benefit over a 40 year planning horizon

  - These are annualised (dividing by sum of social discount rates)
  - This is the equivalent annualised benefits (EAB)
- Objective function : Maximise EAB less EAC subject to meeting constraints
  - Max Equivalent Annualised Value (EAV)= Max equivalent annualised net benefit

Our approach to computing annualised costs and benefits is in line with UKWIR Approach to CBA (2010) and the Treasury Green Book. We have configured our investment planning system, C55, with the Social Time Preference Rate for all non-financial benefit values of 3.5% diminishing to 3.0% after 30 years.

Costs and income are discounted at a rate 2.3% to reflect the expected Weighted Average Cost of Capital (WACC).

Within C55 we assess our confidence in the solution proposed for each option (alternative) considered for the plan. Following the final option selection we then apply our continuing productivity and efficiency assumption to further challenge our costs to ensure they are efficient.

Investments featuring in our WRMP as well as our AMP7 plan, also go through the rigorous option selection and WRMP specified cost benefit assessment process described in our WRMP document, as well as the final options being taken through the Cost Benefit process described above

A final EAV is then calculated for the purposes of producing our marginal cost curves for incentive rate setting. The EAB used in incentive rate setting is also derived directly from investments considered in the plan.

Expenditure Profiling

In this section we describe the approach for expenditure profiling across the AMP7 period, this is based on best practice methodologies and enables us to accurately forecast the cash profile on a project by project basis.

In developing our Plans we have taken into account obligation dates and delivery timescales for all our projects. Within the enhancement area we have over 3000 individual projects that have been reviewed, challenged and validated.

The cash profiles for each project based on a standard set of cash profiles determined from historical delivery data and are a function of scale and the type of project which is automatically applied, the user can substitute the profile if required if there is a good reason to do so. There are 15 capital available and 16 operational cost profiles within C55 investment planning and optimisation system.

The capital cost profiles specify:

- the number of years the spend will occur (between a single year and 5 years)
- the percentage of the total capex to be spent in each year
- the lower and upper ranges of total capex spend that these are available.

The operational cost profiles specify:

- the year the opex spend starts
- the percentage of the total opex to occur each year.

The standard capital cost profiles are:

- 1 year 100%
- 2 year linear - Yr 1 start
- 2 year linear - Yr 2 start
- 2 years 10% 90%
- 2 years 17% 83%
- 2 years 30% 70%
- 2 years 32.6% 67.4%
- 3 year linear - Yr 1 start
- 3 years 10% 60% 30%

- 3 years 5% 55% 40%
- 4 year linear - Yr 1 start
- 4 years 5% 30% 50% 15%
- 5 years - 20% per year
- 5 years, 50%, 12.5% each year after
- 3 years 5% 10% 85%

The standard operational cost profiles are:

- 1 year, 100% starting in year 1 of capex
- 3 years linear, starting in year 2 of capex
- 3 years, 10% 60% 30%, starting in year 2 of capex
- 5 years, 20% each year, starting in year 2 of capex
- 50% for last capex year, 100% thereafter
- 4 years linear - Yr1 start
- 3 year linear, starting in year 1 of capex
- 2 years, 33% 67%
- 5 years - 20% per year
- 2 years linear, starting in year 1 of capex
- 2 years linear, starting in year 2 of capex
- 4 years linear, starting in year 2 of capex
- 1 year, 100% starting in year 2 of capex
- 100% in Year 4
- 25% for last capex year, 100% thereafter
- 0% for last capex year, 100% thereafter

This comprehensive and sophisticated set of profiles enables us to accurately profile and plan our future expenditure for each project or programme of activity.

Taking this approach there will be yearly variations in totex expenditure and is related to the type of project, delivery period, planned delivery date and obligation date. This is complex and requires us to the use the functionality of C55 our investment optimisation and planning system. The outputs are used to validate the expenditure, challenge the totex expenditure profiles and complete all the PR19 tables.

WWS1 - WHOLESALE WASTEWATER OPERATING AND CAPITAL EXPENDITURE BY BUSINESS UNIT

Changes for our IAP Response

Following Ofwat's initial assessment of plans published on 31 January 2019 we have reviewed our Plan and made two changes in the Wholesale Wastewater area. These relate to updated guidance from the Environment Agency on two specific WINEP drivers U_IMP5 and U_IMP6. We have made the following changes:

- Re-costed the U_IMP6 programme based on the revised guidance for sizing of storm tanks in relation to permitted flow as opposed to connected population
- Removed investments from both the U_IMP6 and U_IMP5 drivers that we have successfully agreed with the Environment Agency have no current negative environmental impact is recorded downstream of the water recycling centre.

In addition to the changes described above, we have restated our tables following a request from Ofwat to show developer requested diversions spend gross of grants and contributions. This is explained further in Section B, below.

More detail on the changes made can be found in our updated enhancement business cases in the commentary for WWS2.

We have not updated all of the table commentary for WWS1, but have provided updated graphs to reflect the new position by price control as shown below. We have not updated the Bioresources graph as this is unchanged. We have also provided an update for AMP6 total expenditure forecasts.

Our totex approach

When considering the component parts of our totex expenditure in our Plan, we have given particular focus to botex and enhancement expenditure. Clearly botex is made up of opex and capital maintenance and we have, in some areas, made significant transfers from capital maintenance to opex reflecting either how we expect the money to be accounted for (for example the trend to cloud computing in Information Services technology), or to reflect more effective use of totex solutions to deliver our outcomes.

Whilst it is not a sub-total in the tables, it can be clearly seen in most price controls individually, and certainly collectively, that we have tightly controlled our total botex spend, including stretching efficiency challenges, whilst having some significant, but offsetting, movements from capital maintenance to opex.

Our large enhancement programme, driven by the requirements of the WINEP and WRMP programmes also result in significant cost increases in opex, either as a more effective way to meet outcomes, or as the more traditional operating cost impact of our planned capital schemes, where a capital solution remains the most appropriate totex solution.

Wastewater Network Plus

This table commentary includes a detailed explanation of our proposed totex expenditure for the Wastewater network plus price control.

We set out:

- a brief summary of the assets and services included within each Price Control
- a longer-term outlook
- our AMP7 Totex expediture plan

Summary of the assets and service within the Wastewater Network Plus Price Control

Assets

- 45,236km of Sewers
- 31,200km of Transferred Sewers
- 6,210 Pumping Stations
- 1,138 Wastewater Treatment Sites
- 9 Balancing Lakes

Services

The wastewater network plus price control comprises five principle service areas to enable us to serve our customers:

1. **Sewage Collection** – planning and delivery of activities to maintain the service we give to customers, removal of wastewater from the edge of customers premises
2. **Water Recycling Treatment** – the effective treatment of wastewater to meet existing environmental standards through operation and maintenance of the assets
3. **Improving Environmental Quality** – enhancing the environment of the region through improvements to our plants to meet future standards
4. **Enabling Sustainable Growth** - proactive investment to ensure our assets enable sustainable growth
5. **Community Flood Management** – planning and delivery of enhancements to reduce the impact of all flood waters on our customers

To deliver the five service areas we manage service, risk and performance. The scope of this includes day to day planned and reactive activities.

Longer term outlook

Our long term strategy is set out in our Strategic Direction Statement (Annex 1a to our Plan) and Chapter 8 *Flourishing Environment*.

The expenditure needed over the next 25-years to balance the supply and demand for water recycling services is described in our Water Recycling Long-Term Plan (WRLTP). The plan considers risk from growth, climate change, urban creep and customer behaviours. It promotes sustainable solutions for maintaining reliable and affordable levels of service.

How customers have shaped our Plan

Our Plan has been driven by our customers' priorities. We will deliver the most stretching performance in areas that matter most to them and improve performance across the board. Our customer engagement and how it has shaped our Plan is set out in Chapter 5 (*How customers have shaped our Plan)* and Chapter 12 *(Customer Engagement*).

AMP7 Expenditure

Our expenditure requirements align to the Wastewater network plus RAG 4.07 reporting guideline boundaries.

The overall Totex Plan for this price control is £2,806.5m. Totex Expenditure is post continuing efficiency, 2017-18 price base, net of grants and contributions.

The totex expenditure within this price control is summarised in the following charts:

Figure 1 WWN+ collection totex expenditure

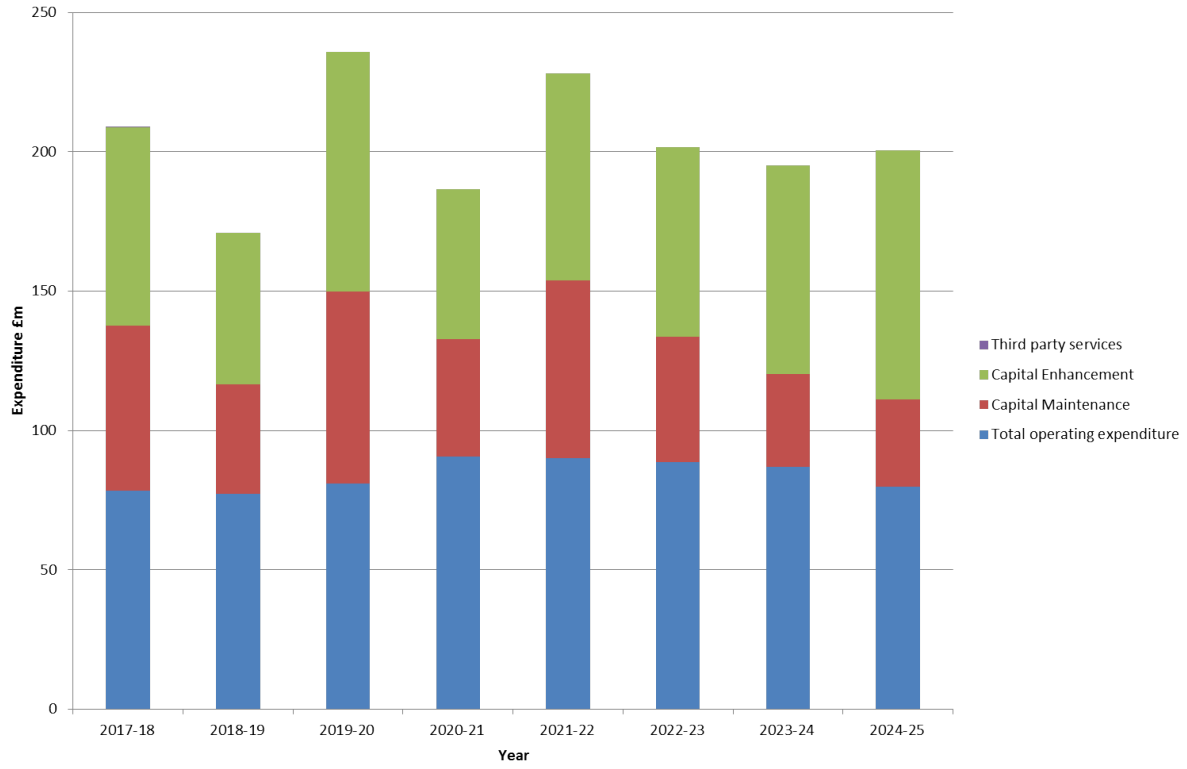
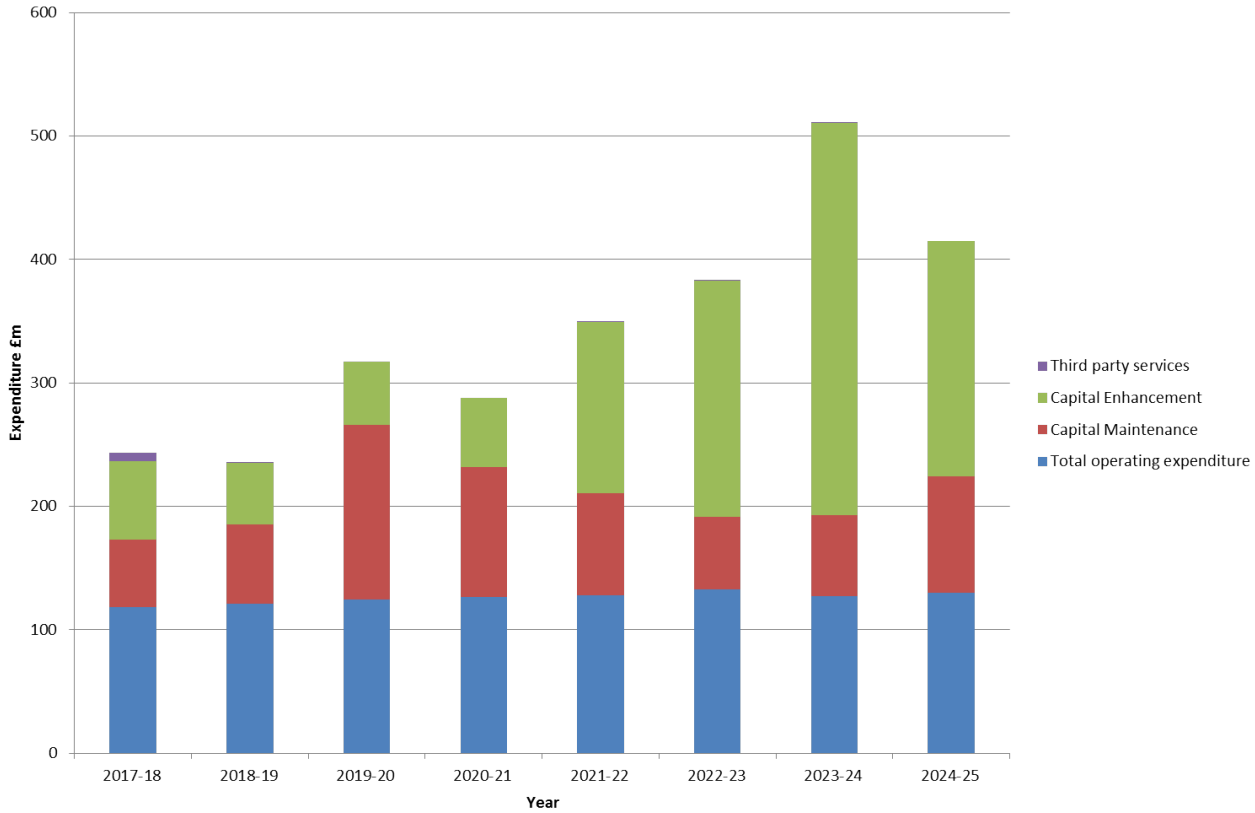


Figure 2 WWN+ treatment expenditure



Maintaining service to customers

Sewerage Collection Pipes (£169m) and Sewerage Collection Pumping Stations (£93.4m)

We have produced a balanced plan of activities that enable us to meet the needs of the customers through the assets we manage.

We have accounted for the day to day operation of these assets including Planned Preventative Maintenance (PPM) to minimise the number of blockages that can cause a service interruption, and a customer and community awareness programme to minimise the amount of Fats Oils and Greases (FOG) entering the system. This is an effective way to maintain service.

Our plans include reacting to customer needs such as the replacement of manhole covers in highways. With over 800,000 manholes on our system we have allowed for a reactive programme of replacement. Other areas include the removal of domestic interceptors where we are regularly called out by customers to remove blockages, this is reviewed on a case by case basis. Both of these areas can cause a nuisance and distress to our customers.

With over 75,000km of sewers, emergencies can happen. Our Plan includes ensuring service is maintained in the event of this happening. To try and minimise these event we have enhanced the amount of Close Circuit Television (CCTV) we plan to undertake. Through multi criteria decision analytics we have enhanced our capability. The outputs are included in our Plan, to give us enhanced knowledge and ability to pin point proactive sewer rehabilitation.

In AMP6 we have gained a further 1,270 transferred pumping assets and have made them safe and serviceable. In AMP7 we have provision for the replacement of pumps on a reactive basis, as we have determined they are relatively short lived assets.

Building on our proactive approach we have incorporated surveys and renovation of these transferred assets. We are planning to focus on hot spots determined through spatial analysis in 13 catchments. This is mainly on pitch fibre pipes laid in the 1970s which cause problems for us and our customers.

We are not promoting a step change in sewer rehabilitation for AMP7 as there is little evidence this is required. We plan to continue rehabilitation of our rising mains. Whilst few in number compared with sewers, they have a disproportionate impact on our asset health performance. Included within our Plan is the refurbishment of seven vacuum sewerage systems. These are particular to our region given its flat topography, which makes conventional gravity sewers both uneconomical and ineffective.

We have around 20% of England and Wales' stock of sewerage pumping stations. Our pumping stations have annual assessments to ensure they are serviceable and able to meet service requirements.

During AMP6 we also carried out a proactive survey programme of our water recycling centre final effluent sea outfall pipework. During AMP7 there is a programme of rehabilitation for these pipes, combined with surveys of all other sea outfall pipework, with subsequent repairs (unless urgent) planned for delivery in AMP8 and beyond.

Other areas in our Plan include the removal of misconnections to our surface water network from foul networks and inspection and remedial work to reduce pollutions and protect the environment. We have identified that the mechanical and electrical elements of 19 Combined Sewer Overflows will require replacement. 13 overflows will require investment in AMP7 to ensure that we do not cause harm to the environment.

We have included for the on-going inspection and refurbishment of our balancing lakes and tanks based on historical expenditure. Some of these structures fall under the Reservoir Act and we have allowed for inspections and refurbishment of these assets.

The future requirements for maintenance of our hydraulic models and sewerage management plans have been included following an extensive model build and plan development programme in AMP6.

Water Recycling (Wastewater) Treatment - £268m

The outcome in this area is to achieve sustainable environmental compliance at all our works. Whilst the future has a number of challenges, we have not identified any specific additional items of expenditure. The bulk of this activitys fall on our regionally based operational teams.

We have undertaken detailed studies on the Wastewater Treatment Centres which have a high risk of potential failure in the future. These draw out the asset, maintenance and scientific knowledge from subject matter experts. This has resulted in a planned programme of activities for AMP7, validated using our predictive service impact models to ensure the balance is correct and there is no bias in the outputs.

We have a planned maintenance programme which achieves 80% planned maintenance on our above ground assets. This is a challenging target to maintain and we will require greater knowledge and planning of asset interventions. We propose to develop dynamic and digital asset plans, enabling improved understanding of current and future risks of wastewater treatment centres to support investments that underpin our asset management activities.

Whilst we would like all activities to be 100 per cent planned we have allowed for reactive work such as emergencies. Whilst this is minimal, it needs to be accounted for.

One of the more challenging parts of this plan to develop was the management of septicity and odour, as though the problem usually manifests itself at the water recycling centre, the root cause of the issue is often earlier in the process – either in the sewage network or pumping station. Our plans include for total catchment based solutions that maximise benefits to customers.

To meet the challenges of AMP7 we plan to build upon our award winning energy programme and continually optimise our sites for performance. Our Licence to Operate qualification has equipped our workforce for the challenges we face as a business which give a firm foundation to work from.

Enhancing service to customers

To meet the needs of our customers and our regulators our Plan includes investment proposals for:

- 10 First Time Sewerage (S101a Schemes)
- our first ever multi-catchment surface water removal programme and an extended partnership funding programme
- 16km of Trunk Sewers
- 182 phosphorous removal plants
- 1,180 WINEP flow monitoring investments
- 127 schemes to increase storm tank capacities
- 100 increase flow measurement, and
- 200 CSO flow monitors.

Our WINEP obligations and strategies are covered in chapter 8 Flourishing environment and WWS2 Table Commentary. Our plans to ensure enable sustainable growth are set out in Chapter 7 Resilient Water Supplies and WWS2 table commentary.

The commentary to table WWS2 sets out in detail our proposed enhancement expenditure and business cases for each line where we are proposing investment in AMP7. These cases relate to the following areas:

Growth - £433 million

- New development and housing growth - infra
- Growth at Water Recycling centres
- Addressing flow in the sewerage system

Improving Environmental Quality and service

- Phosphorus Removal WINEP obligations
- Addressing flow at Water Recycling Centres

- No deterioration environmental drivers
- Chemical investigations programme
- Bathing Waters
- First time sewerage (s101a)
- Odour investment
- Medium Combustion Plant Directive (MCPD)
- Water Resources environmental measure

Improving resilience - £71 million

- Sewer flooding
- Pluvial and Fluvial flooding

Bioresources

This table commentary includes a detailed explanation of our proposed totex expenditure for the Bioresources price control.

We set out:

- a brief summary of the assets and services included within the price control
- a longer-term outlook
- our AMP7 totex expenditure plan

Summary of the assets and service within the Wastewater Network Plus Price Control

Assets

- 12 Strategic Dewatering hub sites
- 10 Dewatering sites (indigenous only)
- 10 Regional advanced digestion sites with a installed design capacity of 174.2ttds in 2020
- 23 Combined Heat & Power (CHP) Generation Units currently delivering 98 MWh per year of renewable electricity
- 47 Sludge Tankers & bulk tippers
- 22 Bulk final product Transport Vehicles
- 7 Biosolids Product Spreaders
- a range of other items of mobile plant (loaders, trailers, skips, generators etc)
- 410 Farmer customer managed, approx. 140 customer orders per annum
- 227,300 hectares of landbank available

Our Plan allows for the recycling of up to 174,200 tonnes of dry solids of sludge. This is treated and recycled to agriculture as a beneficial product. This is an increase from predicted 2020 levels of 156,400 tonnes of dry solids.

Services

The Bioresources price control comprises five principle service areas:

1. **Sludge Collection and Transport** – management of a fleet of vehicles to transport raw sludge from our 1141 Water Recycling Centres and treated product around our region.
2. **Sludge Dewatering** – day to day operation and maintenance of equipment to enable the economic transportation of raw sludges to our sludge treatment centres.
3. **Sludge Treatment** – the operation and maintenance of complex advanced technology assets to meet the stringent requirements of the safe disposal of sludge.
4. **Energy Generation** – maintaining and delivering over 124GWh/y of electricity from renewable methane gas from 2020
5. **Recycling of our treated biosolids product** and management of the agricultural land bank.

Longer term outlook

Our long term strategy is set out in our Strategic Direction Statement (Annex 1a to our Plan), Chapter 11 *The role of markets, incentives and behaviours*, and Annex. 11 *Anglian Water Bioresources Strategy 2020-2045*.

How customers have shaped our Plan

Our Plan has been driven by our customers' priorities. We will deliver the most stretching performance in areas that matter most to them and improve performance across the board. Our customer engagement and how it has shaped our Plan is set out in Chapter 5 (*How customers have shaped our Plan)* and Chapter 12 *(Customer Engagement*).

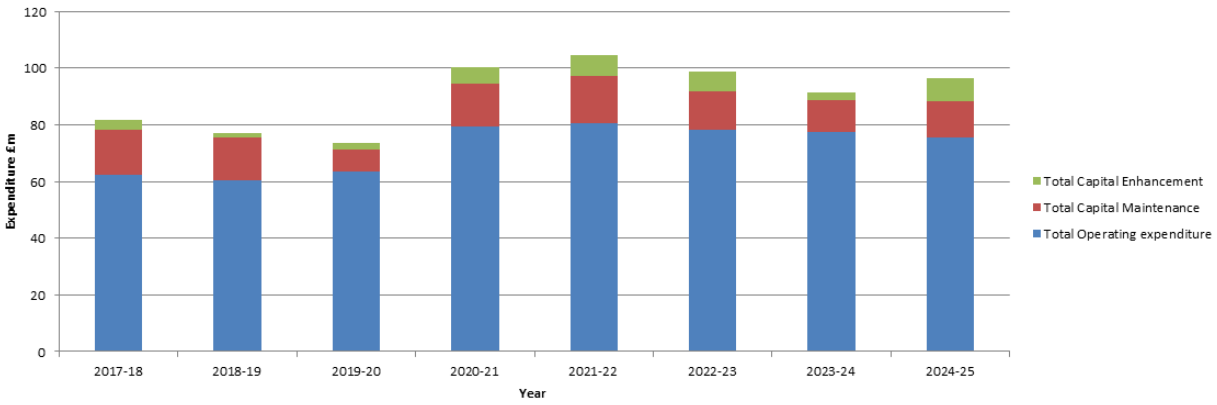
AMP7 Expenditure

Our expenditure requirements align to the Bioresources RAG 4.07 reporting guideline boundaries and include Sludge Thickening (>10% Dry Solids), Sludge Transport, Sludge Treatment and end product recycling.

The overall totex Plan for this price control is £491.1m. Totex Expenditure is post continuing efficiency, 2017-18 price base, net of grants and contributions.

The totex expenditure within this price control is summarised in the following charts:

Figure 3 Bioresources Totex Expenditure



Maintaining service for customers

Raw Sludge Dewatering

All of our Strategic Dewatering Hubs have been surveyed to develop a risk based asset management plan. These items of plant are generally in aggressive environments, have high speed reciprocating elements and therefore can be subject to rapid deterioration. This deterioration is mitigated by maintenance plans that are monitored and managed.

The options we have considered include more maintenance, refurbishment, or in a worst case replacement where this makes economic sense.

Sludge Transportation

We are making a cost adjustment claim for sludge transport as set out in table commentary to Bio7. The claim is because we need to spend more on operating expenses (opex) to move our raw sludge than our peers.

Enhancing service for customers

To meet our customers' needs, our Plan includes proposals for investment to:

- extend our plants at Whitlingham and Pyewipe to cater for growth, increased capacity to cater for the additional sludges from our water recycling plants as a result of higher environmental quality regulations and
- during AMP7 we are planning 20 upgrades to meet the requirement of the Medium Combustion Plant Directive (MCPD)

The commentary to table WWS2 sets out in detail our proposed enhancement expenditure and supporting evidence for each line of the table where we are proposing investment in AMP7. The relevant business cases are:

- Bioresources investment
- Security of Network and Information systems (NIS) compliance.

AMP6 Total expenditure forecasts

We have updated our totex forecast for 2018/19 and 2019/20, reflecting our latest view of opex and capex. Whilst for 2018/19 we have a reasonable view of the split of our costs between price controls, we do not do the actual split until after year end when we prepare our financial statements for the Annual Performance Report. For 2018/19 we forecast our Wastewater Totex expenditure to have decreased by £43.4 million, made up of an increase of £1.8 million in operating costs and a decrease of £45.2 million in capital expenditure. This reflects a timing of expenditure issue which is effectively deferred to 2019/20. We have also reflected higher Grants and contributions receipts in 2018/19 of £1.7 million due to increased developer activity and assumed these result in higher capex in 2019/20. Overall there is no change to the cumulative net Totex forecast over the two years.

SECTION A: OPERATING EXPENDITURE

Operating expenditure

Included within Block A is both Base Operational Cost (Botex element) and Enhancement Operating Costs as detailed in table WWS2, lines 48 to 83. The allocation between the two elements is detailed in the following table. The figures have been updated to reflect the minor impact of our revised Sewage Treatment enhancement expenditure plan in our IAP response (WWS2).

Operating expenditure (£m)	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Base Operating Costs (Botex element)	287.5	287.0	284.1	271.4	261.9	1,391.9
Enhancement Operating Costs (table WWS2 Block B)	9.7	11.7	15.6	20.4	23.8	81.1
Total (table WWS1 Block A)	**297.1**	**298.7**	**299.7**	**291.8**	**285.6**	**1,472.9**

Base Operating Expenditure

Base Operating expenditure for AMP7 has been assessed using our planned outturn for 2019/20 as a start point. The 2019/20 outturn agrees to our Plan which has been approved at Board level and reflects our best estimate of reported operating costs. The allocation of costs to individual rows is based on the apportionment of actual costs reported in 2017/18, amended for any specific changes where the existing apportionment would be inappropriate. The figures in the tables below are pre Real Price Effect inflation and therefore will not agree to numbers in the data tables, but are provided to give further insight into our changes in operating costs.

Sewage collection

We are forecasting an increase in other operating expenditure in AMP7 when compared to our 2019/20 run-rate. The key drivers for the increases are:

- Capex to opex decisions - these include the transfer of on-premise IT to a cloud based solution. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost. This represents £16.7 million out of the total increase of £32.4 million. The remainder reflects our assessment of as yet unidentified totex transfer decisions that will be made during the AMP.
- Other opex changes include £6.1 million of expenditure on our customer experience programme, future tech of £2.4 million and additional maintenance of £1 milion.
- Enhancement operating costs - the majority of the increase (approximately £17 million) is as a result of pluvial and fluvial flood protection, with approximately £4 million on flooding risk reduction. The remainder is spread over a number of smaller programme areas. More detail on enhancement operating costs is in our commentary on section WWS2.

We have set ambitious efficiency targets during the AMP and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of Our Plan *(Efficiency and Innovation)*.

Annual increase / (decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to Opex decisions	7.0	6.4	6.5	6.4	6.1	32.4
Other Opex changes	2.4	1.8	2.1	1.8	1.5	9.6
Enhancement operating costs	5.8	5.3	5.5	5.3	1.2	23.1
Efficiency and productivity improvements	(2.4)	(2.2)	(4.6)	(6.8)	(10.3)	(26.3)
Total annual increase / (decrease)	**12.8**	**11.3**	**9.5**	**6.6**	**(1.4)**	**38.8**

Sewage treatment

We are forecasting an increase in other operating expenditure in AMP7 when compared to our 2019/20 run-rate. The key drivers for the increases are:

- Capex to opex decisions - these include the transfer of on-premise IT to a cloud based solution. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost. This represents £39.2 million out of the total increase of £96.5 million. The remainder reflects our assessment of as yet unidentified totex transfer decisions that will be made during the AMP.
- Other opex changes include future technology of £3.7 million and additional maintenance of £1.1 million.
- Enhancement operating costs - the majority of the increase (approximately £39 million) is as a result of WINEP / NEP requirements for Phosphorus removal at activated sludge works and filter bed works. Approximately £8 million is for sewage treatment works growth and approximately £6 million on WINEP schemes to increase flows and storage. The remainder is spread over a number of smaller programme areas. The figures have been updated to reflect the minor impact of our revised enhancement expenditure plan in our IAP response and more detail on enhancement operating costs is in our commentary on section WWS2.
- Enhancement operating costs - the majority of the increase (approximately £39 million) is as a result of WINEP / NEP requirements for Phosphorus removal at activated sludge works and filter bed works. Approximately £8 million is for sewage treatment works growth and approximately £6 million on WINEP schemes to increase flows and storage. The remainder is spread over a number of smaller programme areas. The figures have been updated to reflect the minor impact of our revised enhancement expenditure plan in our IAP response and more detail on enhancement operating costs is in our commentary on section WWS2.

We have set ambitious efficiency targets during the AMP and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of Our Plan *(Efficiency and Innovation)*.

Annual increase / (decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to Opex decisions	21.8	18.8	24.1	16.1	15.7	96.5
Other Opex changes	0.8	1.4	1.0	0.9	0.7	4.8
Enhancement operating costs	3.7	6.5	10.6	16.3	24.4	61.5
Efficiency and productivity improvements	(4.0)	(3.6)	(7.5)	(11.1)	(16.7)	(42.9)
Total annual increase / (decrease)	**22.3**	**23.1**	**28.2**	**22.2**	**24.1**	**119.9**

Bioresources

We are forecasting an increase in other operating expenditure in AMP7 when compared to our 2019/20 run-rate. The key drivers for the increases are:

Capex to opex decisions - these include the transfer of on-premise IT to a cloud based solution at a total cost of £11.4 million over the AMP. These costs would have previously been capitalised but in AMP7 will be accounted for as an operating cost. The remainder reflects our assessment of as yet unidentified totex transfer decisions that will be made during the AMP.

- Other opex changes include future tech of £2.8 million and additional health and safety costs of £1.6 milion.
- Enhancement operating costs increase slightly over the AMP due to sludge enhancement and odour management. More detail on enhancement operating costs is in our commentary on section WWS2.
- We have set ambitious efficiency targets during the AMP and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of Our Plan *(Efficiency and Innovation)*.

- Enhancement operating costs increase slightly over the AMP due to sludge enhancement and odour management. More detail on enhancement operating costs is in our commentary on section WWS2.
- We have set ambitious efficiency targets during the AMP and their impact on forecast costs are set out below. This topic is discussed more fully in Chapter 10 of Our Plan *(Efficiency and Innovation)*.

Annual increase / (decrease) from AMP6 run-rate £m	2020/21	2021/22	2022/23	2023/24	2024/25	Total AMP7
Capex to Opex decisions	3.5	4.3	3.2	2.2	2.0	15.2
Other Opex changes	0.9	0.8	0.8	1.0	0.9	4.4
Enhancement operating costs	0.2	0.3	0.4	0.6	0.9	2.4
Efficiency and productivity improvements	(1.9)	(2.7)	(5.2)	(6.7)	(9.7)	(26.2)
Total annual increase / (decrease)	**2.7**	**2.7**	**(0.8)**	**(2.9)**	**(5.9)**	**(4.2)**

Please note that the validation checks build into WWS1 for bioresources are incorrect as they are comparing all three bioresources columns in WWS1 (including sludge transport) where Bio3 includes only sludge disposal and sludge treatment expenditure. Bio3 also includes atypicals which are excluded from line 9 (total operating expenditure excluding third party services) in WWS1, although this only impacts year 2017/18.

Enhancement Operating Expenditure

Using an investment business case approach developed on a bottom up basis and taking the outputs from our C55 System (see lines 12 to 20 for explanation), we have identified areas where we plan a change in our operating costs during AMP7, and applied the incremental change to costs in the relevant year. The figures include operational costs that will be on-going operational costs into AMP8 as a result of capital schemes, as well as in-period one-off totex solutions to improve outcomes.

The change in enhancement operational cost have been developed using a build up of specific requirements for each investment rather than a broad brush allowance methodology. Each investment has a full audit trail and is specific to each investment option (or alternative). These costs are used for developing whole life costs so the best value alternative is selected using prioritisation and optimisation techniques which are available in the C55 system. The operational costs are used in all Cost Benefit Analysis which is a component of the business case approach. The allocation of operational cost has been validated by our Capital Accounting team to ensure IFRS rules are met.

Lines 5 to 6: Renewals expensed

Renewals expensed are based on the expected 2019/20 out-turn, as the level of reactive work is not expected to change over the next AMP. The reduction in costs over the AMP reflects our efficiency assumptions.

Line 9: Total operating expenditure (excluding third party services)

Bio3 captures Sludge treatment and Sludge disposal, where as the flagged range in WWS1 includes Sludge Transport as well. We also believe the flag references the wrong lines in Bio3. We believe it should flag lines 6 and 14 (total before depreciation). For example the sum of WWS1 line 9, sludge treatment and sludge disposal in 2018/19 sums to £35.359m. The sum of Bio3 lines 6 and 14, total 2018/19 sum to £35.359m.

Line 10: Third party services

Third party service costs consist predominantly of the costs for treatment works used by Thames Water. Our AMP7 costs are based on our 2019/20 forecast out-turn which reflects our underlying run-rate.

SECTION B: CAPITAL EXPENDITURE

Lines 12 and 18: Wastewater diversions expenditure

The £2.4 million of expenditure forecast on wastewater diversions in AMP7 has been included in full as third-party expenditure on line 18 in accordance with RAG 4.07. This expenditure was previously recorded on line 12.

Net totex remains unchanged as a result of these changes to reporting of diversions.

Lines 12 to 21: Capital expenditure

Expenditure has been allocated using our business investment codes (BICs) on a proportional basis.

Allocation of expenditure and boundaries align to the RAG accounting guidelines.

Capital expenditure in table WWS1 is stated on the basis that IFRS 16 (Leases) has been adopted by the company from 1 April 2019. Table WWS1A shows capital expenditure on the basis that IFRS 16 had not been adopted.

Lines 12 and 13: Maintaining the long term capability of assets - infra and non-infra

Our overall approach to the development of our botex plan is described in Chapter 10 of our Business plan. Capital maintenance profiles are often more stable than enhancement because of the nature of on-going maintenance. However, we have coded some specific activities to capital maintenance that are required to complete at specific times in the AMP. This can cause uneven spend profiles particularly within individual sub-components of price controls.

Line 13: Maintaining the long term capability of assets - non-infra

Our non-infra expenditure profile for AMP7 is deliberately front end loaded as part of our drive to tackle pollution incidents in our region. The main reason for the difference in expenditure between the peak in 2021/22 and a drop to 2023/24 is the profile of pumping station maintenance we have included to allow us to improve performance on pollutions early hence maximising environmental benefit. The effect of bringing most of this forward also helps to offset the large enhancement programme that is back end loaded due to the time required to complete large projects. Details of the enhancement cases are set out in commentary to table WWS2.

Lines 14 and 15: Other capital expenditure - infra and non-infra

Enhancement capex profiles will often vary by year and by price control depending on the timing of the investment need. This is driven by obligation dates agreed with regulators as well as duration of projects and availability of delivery resource. Our plan has been optimised using our investment

planning tool C55 to achieve the best profile of expenditure to reduce variability of bills and balance resource requirement in our supply chain whilst ensuring we hit all our obligation dates. For some lines this results in uneven spend profiles. Details of the obligations that we are required to achieve are available on request. More detail on the individual enhancement cases are available in our table commentary to WWS2.

Line 16: Infrastructure network reinforcement

Network reinforcement is driven by growth forecasts. The growth forecasts we have used as the basis for our profiles is contained in App28. This is not constant in each year of the forecast, but where possible we have smoothed the profile of investments.

Line 18: Third party services

The reasons for the provision for third party services is explained more in the table commentary for WWS8.

2017/18 third party services capital expenditure of £6.8 million is in relation to capital expenditure for the fulfillment of third party agreements at Doddinghurst and Chalton.

Line 20: Grants and contributions (excluding atypical expenditure)

This table has been assessed in line with the requirements under RAG 4.07. The data in this line is taken from App 28 Lines 24 to 29. We are not anticipating any grants being received. The contribution is expected to be received from developers and predominately follows the new charging regime that came into being in April 2018. The revenue is based on a per house contribution and therefore are aligned to the increased housing numbers predicted to occur from 2020.

The following table identifies the grants and contributions by specific areas for Wastewater.

RAG Accounting Definitions - Wastewater	2020/21	2021/22	2022/23	2023/24	2024/25	Total
Infrastructure Charge Receipts - Section 146	21.232	22.391	21.909	25.217	28.991	119.741
Requisitioned Sewers - Section 100	0.000	0.000	0.000	0.000	0.000	0.000
Other Contributions (Price Control)	4.027	4.442	4.564	4.534	4.274	21.841
Diversions (s185)	0.450	0.497	0.510	0.507	0.478	2.441
Other Contributions (non-price control)	1.413	1.559	1.602	1.591	1.500	7.665
Total	**27.123**	**28.888**	**28.585**	**31.849**	**35.243**	**151.688**

SECTION C: TOTEX

Lines 20 to 21: Grants and contributions - operating expenditure / capital expenditure

As per the updated data table structure issued in January 2019, we have split grants and contributions by operating and capital expenditure.

Line 20: Grants and contributions - operating expenditure

We are not forecasting any contributions towards operating expenditure.

Line 21: Grants and contributions - capital expenditure

It should be noted that all grants and contributions are included in line 21 (capital expenditure) as we are not forecasting any contribution towards operational expenditure. The forecast for 2018/19 has also been updated to reflect better information as we are further through the report year.

This table has been assessed in line with the requirements under RAG 4.07. The data in this line is taken from App 28, lines 24 to 29. The contribution is expected to be received from developers and predominately follows the new charging regime that came into being in April 2018. The revenue is based on a per house contribution and therefore are aligned to the increased housing numbers predicted to occur from 2020.

The £2.4 million of expenditure forecast on wastewater diversions in AMP7 (detailed in App 28, line 27) has been included in full as third-party expenditure on line 18 in accordance with RAG 4.07. This expenditure was previously recorded on line 12.

Net totex remains unchanged as a result of these changes to reporting of diversions.

The following table identifies the grants and contributions by specific areas for Wastewater.

RAG Accounting Definitions - Wastewater	2020/21	2021/22	2022/23	2023/24	2024/25	Total
Infrastructure Charge Receipts - Section 146	21.232	22.391	21.909	25.217	28.991	119.741
Requisitioned Sewers - Section 100	0.000	0.000	0.000	0.000	0.000	0.000
Other Contributions (Price Control)	4.027	4.442	4.564	4.534	4.274	21.841
Diversions (s185)	0.450	0.497	0.510	0.507	0.478	2.441
Other Contributions (non-price control)	1.413	1.559	1.602	1.591	1.500	7.665
Total	**27.123**	**28.888**	**28.585**	**31.849**	**35.243**	**151.688**

SECTION D: CASH EXPENDITURE

Line 22: Pension deficit recovery payments

Deficit recovery payments are allocated to price control and service based on on the allocation principles that have previously been used.

The value of deficit payments is known and has been agreed between the company and the pension trustees. The agreed deficit payments are reflected in the table.

Line 24: Totex including cash items

This is the sum of lines 21 to 23.

SECTION E: ATYPICAL EXPENDITURE

Lines 25 to 28: Atypical expenditure

Our atypical expenditure in 2017/18 is as reported in our annual report and accounts. We are not forecasting any atypical items from 2018/19 onwards.

SECTION F: TOTAL EXPENDITURE

Line 36: Wastewater totex including cash items and atypical expenditure

This is the sum of lines 24 and 35.

WWS1A - WHOLESALE WASTEWATER OPERATING AND CAPITAL EXPENDITURE BY BUSINESS UNIT INCLUDING OPERATING LEASES RECLASSIFIED UNDER IFRS16

Table WWS1a shows wastewater operating, capital, cash and atypical expenditure profiles before the impacts of the adoption of IFRS16, the new lease accounting standard, are taken into consideration. Table WWS1 shows the same expenditure profiles adjusted for IFRS16, which is expected to be adopted by the Company in the year ended 31 March 2020.

For full commentary on these expenditure profiles, please see the commentary for WWS1.

The adoption of IFRS16 has the impact of decreasing operating expenditure between 2019/20 and 2024/25 by a total of £7.1 million and increasing capital expenditure by £20.8 million over the same period.

The full impact of IFRS16 adoption is as detailed in table App33 and the associated commentary.

For commentary on sections A to E of this table please see the corresponding commentary in table WWS1.

WWS2 - WHOLESALE WASTEWATER CAPITAL AND OPERATING EXPENDITURE BY PURPOSE

Lines 1 to 46: Enhancement expenditure by purpose - capital

The information presented in this block reconciles with table WWS2a.

Lines 48 to 93: Enhancement expenditure by purpose - operational

The expenditure includes for the full year effect of the operational costs for schemes which are delivered at the end of AMP6 along with the additional operational costs for projects delivered in AMP7. The planned operational costs include for on-going operational costs associated with new assets and schemes, and for one off costs under IFRS accounting standards.

The enhancement business cases for lines completed in this table are presented earlier. Each enhancement business case is cross referenced to the expenditure allocation by table line.

The information presented in this block is excluded from table WWS2a as operational costs are not reported.

ENHANCEMENT EXPENDITURE - SUPPORTING INFORMATION (BUSINESS CASES)

In this section we provide detailed enhancement business cases to support our planned enhancement expenditure. These are cross referenced to the table lines.

We have developed a comprehensive set of enhancement business cases covering the all of our Enhancement Expenditure. These business cases align to Ofwat IN18/11 information letter published in July 2018.

Deep Dive Business Cases

Where through the IAP assessment, Ofwat has assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September Plan. We therefore focus attention solely upon those areas where Ofwat are not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment). We provide additional evidence below to address each point of feedback on our enhancement business cases.

We provide additional evidence below to address each point of feedback and enable Ofwat to make the appropriate allowances in cost thresholds. We have retained the information provided in our September 2018 Plan for completeness.

Within this section we have not included commentary of the enhancement modelling approach which is contained within Chapter 5 of our IAP response. We have cross referenced the models for completeness.

The totex enhancement expenditure for the Wastewater Service is summarised in the following table and provides the index to the enhancement business cases contained within this section. We have ordered them into deep and shallow dives according to value.

Enhancement Expenditure Summary - Deep dives

Business Case	Our Plan Totex (£m) [1]	Ofwat IAP Assessment £m	Summary of new information provided	Page number
Addressing Flow at Water Recycling Centres	259.747	213.734	Updated and adjusted required investment based on EA agreed deferrals and revised guidance on sizing. Further details of the options considered.	29

Business Case	Our Plan Totex (£m) [1]	Ofwat IAP Assessment £m	Summary of new information provided	Page number
Bioresources	23.396	0.000	Impact of P-removal and population growth on sludge volumes. Details of the size and categories of our generators and how this links to our capital maintenance programme. Further details of how options have been considered Details of actions we have taken to facilitate the development of sludge markets Further details on how we enabling greater STC utilisation and mitigating the risks associated with this	43
Medium Combustion Plant Directive (MCPD)	7.768	0.000	Details of the size and categories of our generators and how this links to our capital maintenance programme. Results of the tests of our generator fleet performance against MCPD limits. Further justification of the business need for enhancement expenditure	68

1 includes adjustments made post September Plan

Enhancement Expenditure Summary - Shallow dives

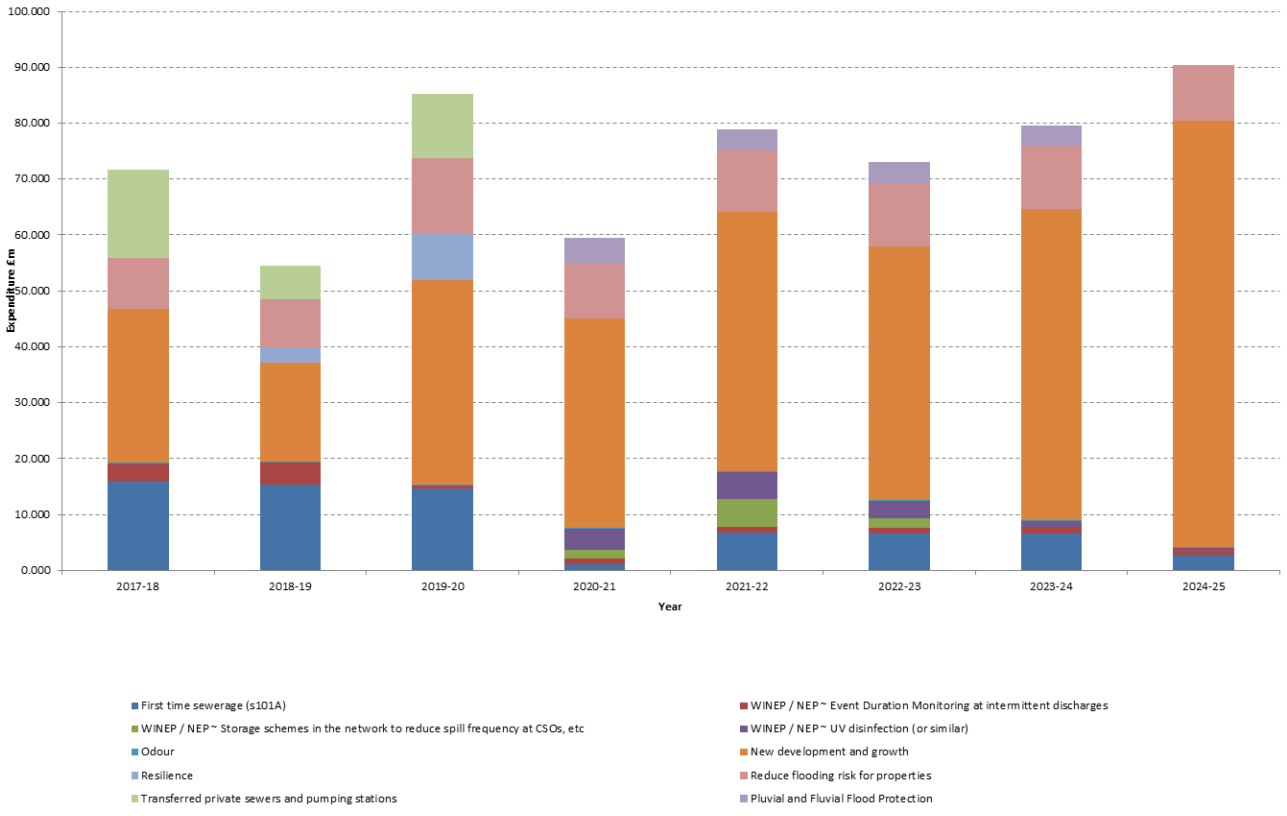
Business case	AMP7 Total Expenditure (£m) [1]	Summary of new information provided	Page number
Phosphorous Removal at Water Recycling Centres	450.766	No changes to the business case	85
New Development and Growth	261.166	No changes to the business case	92
Growth at Water Recycling Centres	173.566	No changes to the business case	98
Sewer Flooding	53.243	No changes to the business case	104
Bathing Waters	26.525	No changes to the business case	108
First Time Sewerage Section 101A	23.875	Details of the assessment process for each site, to determine whether private facilities have to potential to cause adverse environmental impact	112
No Deterioration	21.433	No changes to the business case	119
Pluvial and Fluvial Flood Protection	17.158	No changes to the business case	123

Business case	AMP7 Total Expenditure (£m) [1]	Summary of new information provided	Page number
Chemical Investigations Programmes (CIP)	16.483	No changes to the business case	127
Odour	14.004	No changes to the business case	131
Addressing Flow in the Sewerage System	13.551	No changes to the business case	134
Security of Network & Information Systems (NIS) Compliance	1.193	No changes to the business case	138
Water Resources Environmental Measures	0.130	No changes to the business case	139

1 includes adjustments made post September Plan

Please note: the spend in our enhancement tables include a negative adjustment for the enhancement spend on third party expenditure to comply with the validation check in WS1 and WWS1 that the sum of lines 14 to 16 should equal the total enhancement capex. Some of the third party spend we have allocated to line 18 is also enhancement spend, so this adjustment is required for the validation rule to work.

Figure 4 Wastewater Network+ collection enhancement totex expenditure by purpose

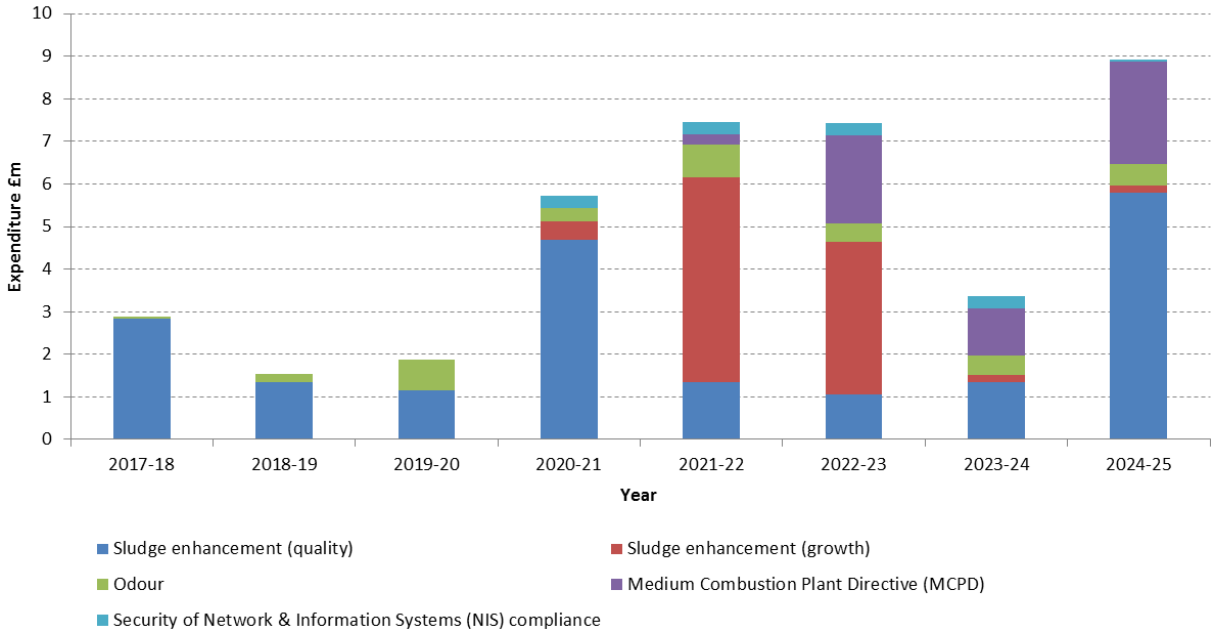


The two variances in the AMP7 profile relate to the delivery of First Time Sewerage Schemes where we have customer commitments and early obligations under WINEP relating to flow monitoring and investigations.

Figure 5 Wastewater Network+ treatment totex expenditure by purpose

Our WINEP programme is significant and has been planned to meet the obligation dates prescribed by the Environment Agency and an achievable delivery profile.

Figure 6 Biosolids treatment totex expenditure by purpose



The totex expenditure profile reflects the additional capacity required to as a result of growth and additional sludge from quality drivers under the WINEP programme. We have also allocated the Medium Combustion Plan Directive to quality as this is a new obligation.

Board Assurance

Deloitte, external assurance providers for financial elements of our Plan, reviewed tables WS2 and WWS2 to confirm that an audit trail, including supporting information and applicable documented assumptions, was available to support the data in the tables. They also confirmed that reporting requirements had been adhered to.

Jacobs, external assurance providers for technical elements of our Plan, reviewed our approach to developing investment portfolios, including the cost estimation process and the optimisation of portfolios. They reviewed a number of specific investment areas as part of their scope of work. They confirmed to our Board that there are no material concerns.

Further information on the reviews carried out are available in the reports from Deloitte and Jacobs, provided to Ofwat as annexes to our Plan.

Deloitte and Jacobs carried out further assurance of all of our query responses to Ofwat which resulted in a change to our data tables and any adjustments made post 31 January 2019.

Addressing Flow at Water Recycling Centres

Summary of this Enhancement Case

We provide the evidence that Ofwat requires to enable it to conclude that our costs are robust and efficient and customers are protected in respect of this investment.

Summary of expenditure changes

AMP7 Expenditure	September Plan	Ofwat Assessment	AW IAP revision	Comments
U_MON3 (£m)	12.266	6.783[1]	12.266	No change proposed
U_MON4 (£m)	16.729	16.709	16.729	No change proposed
U_IMP5 (£m)	94.992	94.365	69.138	Updated with EA agreed deferrals
U_IMP6 (£m)	111.719	81.106	141.058	Updated with revised EA guidance on sizing and deferrals
UWWTD pe (£m)	13.138	11.903[2]	13.138	No change proposed
U_IMP4 (£m)	3.283	2.868[3]	3.283	No change proposed
Total capex (£m)	252.127	213.734	255.612	
Total opex (£m)	7.620	0	7.954	Enhancement Opex included in Botex Modelling
Totex	259.747	213.734	263.566	

1 using pro rata allowance from EDM feeder model
2 using pro rata allowance from sanitary parameters feeder model
3 derived from allocation to 3 models

Where through the IAP assessment, Ofwat has assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September plan.

We therefore focus attention solely upon those areas where Ofwat were not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment), we provide additional evidence below to address each point of feedback.

In this updated enhancement case we will explain the following points:

- That we have now successfully agreed with the Environment Agency that we can remove a total of 47 schemes from our AMP7 plan, and have removed the spend associated with these from our Plan.
- That we will introduce a customer protection mechanism to return funding to customers for amber investments which are not required to progress during AMP7 – explained more fully in chapter 4 of our main IAP Response.

- That we have re-costed our U_IMP6 Storm Tanks programme to account for updated guidance from the Environment Agency on the size of tanks required to comply with the obligation. This has lead to an increase in both storage volume provided and associated costs.
- That we have explained the difference between the 170 U_IMP6 obligations in the WINEP and the number of investments in our Plan.
- That we believe the reallocation of the three high spilling CSO investments to Flow to Full, Storm tanks and Investigations is incorrect and all these investments should instead be assessed under the spill frequency model

More model specific comments are included in the main IAP Response in section 5, and appendix 5b.

Summary of Ofwat's analysis

Ofwat have assessed the spend described in this enhancement case across 5 different models. Four of the assessments were completed using an assessment of industry median unit rates, with 1 (Storm tanks) using a deep dive assessment:

Component of spend described in this enhancement case	Ofwat method of assessment for IAP	Summary of our response
420 investments to monitor spills under the U_MON3 driver – allocated to line 6.	Assessed in the EDM feeder model – median rate used	Optioneering included below and model critique Chapter 5 IAP Response
420 investments to monitor flow under the U_MON4 and U_INV2 drivers – allocated to line 7	Assessed in the Flow Monitoring model – median rate used	Optioneering included below and model critique Chapter 5 IAP Response
38 (post phasing) investments to increase full flow to treatment capacity at WRCs – allocated to line 9	Assessed in the Flow to Full model – median rate used	Optioneering included below and model critique Chapter 5 IAP Response
127 (post phasing) investments to increase storm tank volume under the U_IMP6 driver – allocated to line 10.	Assessed in the Storm Tanks model – deep dive assessment	Included in this case
16 investments to increase capacity at WRCs for UWWTD – allocated to line 20.	Assessed in the Sanitary Parameters model – median rate used	Optioneering included below and model critique Chapter 5 IAP Response
3 investments for high spilling CSOs at WRCs under U_INV & U_IMP4 –coded to line 35.	Reallocated from freeform line to three other model; Flow to Full, Storm tanks and Investigations	Optioneering included below and model critique Chapter 5 IAP Response

Ofwat raise the point in their deep dive on the Storm Tanks Model that *"only 151 of the 170 STWs listed in WINEP3 against the U_IMP6 driver are included*". The reason for the difference is that there were 29 sites where no investment was included in our Plan, as our detailed site assessment confirmed that the existing storage met the standard.

Adjustments to our Plan

In our September Plan we explained that we were in negotiation with our regulators about the opportunity to remove costs from our Plan in relation to quality investments for flow drivers. Since September we have continued these discussions and can now confirm removal of some schemes. The total number of investments that we have now deferred to AMP8 is as follows:

- 40 storm tanks deferred from the U_IMP6 driver – total capex of £44.48m
- 14 FFT schemes deferred from the U_IMP5 driver – total capex of £25.85m

In addition we have revisited obligations required under the UIMP_6 driver in line with updated guidance and advice received from the EA and adjusted our investments accordingly. This has resulted in an increase in storm tank volume being required to satisfy obligations to a revised design standard of volumes based on the permitted dry weather flow population equivalent using an allowance of 68 litres per head per day for storm storage volume. This has had a material impact on the capacity required, changing it from 47,720m

3

to 85,653m

3

.

Below is a timeline of how the obligations have evolved:

- March 2018 WINEP3– 170 obligations recorded based on an initial assessment of volume present on site and required storage under U_IMP6
- September 2018 PR19 submission– following detailed site-by-site assessments of storage present, 19 sites are deemed to require no investment and are excluded from our Plan. 151 investments are required at £111.719m with a total volume of 47,720m^3
- January 2019– updated guidance from the Environment Agency means increased storage requirements across all sites, changing it from 47,720m^3 to 85,653m^3. 16 of the 19 sites which did not require investment are now required, new total number of schemes is 167 at a total capex of £185.538m.
- February 2019 - Environment Agency agree to phase 40 U_IMP6 investments from AMP7 to AMP8 with a total cost of £44.48m
- April 2019 IAP response– data tables updated including 127 investments required with a total volume of 85,853m^3 at a cost of £141.058m

These changes have been reflected in our updated data tables and in the summary at the top of this Enhancement Case.

Ofwat Action ANH.CE.A4 relating to our proposed customer protection mechanism for Amber WINEP Obligations is discussed more in the main IAP Response in chapter 4.

Summary of our Response to Ofwat feedback in Storm Tank Model deep dive

For our comments on the storm tank model please see the WINEP Storage schemes at STWs to increase storm tank capacity comments in chapter 5 of the IAP Response.

Ofwat Feedback Robustness and efficiency of costs, partial pass	Summary of evidence provided in response
"ANH states it carried out a "Risk, Opportunity and Value" process to determine best value option to meet WINEP requirements. It confirms tanks were sized as lower of two possible volumes allowed (explained above) and the cheaper of two construction options selected. Low carbon solutions were considered where possible Costs are based on outturn costs of completed projects and so capture efficiencies already achieved. ANH have also standardised solutions	• We have revisited obligations required under the UIMP_6 driver in line with updated guidance and advice received from the EA since our initial submission and adjusted our investments accordingly. Volumes required are now based on the permitted dry weather flow population equivalent using an allowance of 68 litres per head per day for storm storage volume

Ofwat Feedback Robustness and efficiency of costs, partial pass	Summary of evidence provided in response
to secure further efficiencies by reducing design, commissioning and procurement costs. ANH have applied totex stretch efficiency and productivity challenges in estimating costs. External review and benchmarking by Mott MacDonald show ANH's costs to be relatively efficient (-2% from industry average for UWWTD). That said, the cost model developed by Ofwat which takes account of economy of scale points to ANH costs being somewhat above the industry average."	• We have provided further details below of the options considered • Our main IAP Response in chapter 5 discusses the ability of Ofwat models to account for economies of scale

Ofwat Feedback Customer protection, partial pass	Summary of evidence provided in response
"ANH cite under-performance penalties for the Treatment Works Compliance performance commitment and enforcement action from the Environment Agency in the event of non- or late delivery. However, the EA will not enforce in the case of 'Amber' WINEP schemes for which a need is not confirmed. A large majority (143 out of 170) of the U_IMP6 schemes in ANH's WINEP are 'Amber' and ANH make no mention of a unit cost adjustment mechanism that companies were requested to propose in the PR19 Methodology."	• In the latest update from the Environment Agency, the number of amber schemes included in our AMP7 plan for U_IMP6 has dropped from 143 to 104 • Our main IAP Response in chapter 4 discusses in detail our proposed customer protection mechanism for these amber WINEP schemes

In the section below we discuss the solutions that were developed through our Risk, Opportunity and Value (ROV) process for each driver and provide information on the relevant considerations for the preferred option The costs and benefits were developed using our asset planning and optimisation system, C55. These investments and costs were reviewed by our independent assurance providers (Jacobs).

Monitoring of storm tank spills and full flow to treatment (FFT)

U_MON3 driver provision of EDM for storm tanks

Investments under the U_Mon3 driver require the same bespoke solution for each WRC; investment provides for the project management, installation and delivery of associated ultrasonic level sensor instruments and telemetry to comply with environmental permit reporting conditions.

The selected option provides the best value for the project management, installation and delivery of associated ultrasonic level sensor instruments and telemetry to comply with environmental permit reporting conditions.

U_MON4 and U_INV 2 drivers – measuring full flow to treatment compliance

The installation of FFT monitoring at WRCs will demonstrate to regulators that the permitted FFT setting is being complied with.

Where existing assets can be upgraded to meet the obligation requirements appropriate solutions have been promoted.Where an investigation may show that existing flow provision can be used to meet the requirements of obligations and therefore reduce the value of required investment an investigation option has been promoted. This approach demonstrates that the best value option for customers has been explored.

Investment requirements under U_Mon4 and U_INV2 drivers varies according to existing asset provision at each WRC:

- Where a WRC has adequate instrumentation and the flow meter is already used to satisfy DWF permit requirements and is positioned downstream of the storm separation weir to comply with future permit requirements but the instrumentation is not linked to telemetry a bespoke solution has been identified to meet these requirements and comply with the U_Mon4 driver;
- Where a WRC has inadequate instrumentation to meet driver requirements but an existing flow meter installation situated downstream of the storm separation weir could be upgraded to comply in the future a bespoke solution has been identified to meet these requirements and comply with the U_MON4 driver;
- Where a WRC has inadequate instrumentation but an existing flow meter measuring final effluent at the end of the WRC process could possibly be upgraded to comply with the future permit requirements a bespoke investigation solution has been identified to meet these requirements. These investments fall under the U_INV2 driver. An agreed investigation specification for these installations has been developed with the Environment Agency;
- Where a WRC has inadequate instrumentation to MCERT standards and an existing flow meter measuring final effluent at the end of the WRC process cannot be upgraded to comply with the future permit a bespoke solution requiring the installation of a new flow meter downstream of the storm separation weir has been provided.

Other considerations for preferred option

Assessment Area	Summary
Uncertainty on delivery or changing needs	All options under this driver have been classified as ‘green’ under the Environment Agencys WINEP level of certainty mechanism
Environmental Impact	The provision of Event Duration Monitors will allow compliance with permit FFT requirements to be readily checked to ensure that storm tanks do not fill prematurely. This will prevent more frequent, higher strength and longer duration spills from storm tanks to receiving waters, and allow receiving waters to respond to rainfall events to provide additional dilution
Use of innovation	New reporting systems will be developed to report spills in accordance with permit requirements
Impact on company resilience	Event Duration Monitors and FFT flow monitors will give the company greater visibility of asset performance and allow the company to promote timely investment to avoid breaching spill frequency trigger limits

Increase capacity at WRC

U_IMP1 driver – increase capacity at WRCs that have crossed a population threshold under UWWTD due to historic growth.

Investments under this driver (U_IMP1) required bespoke solutions to be developed for each WRC. For each obligation the ROV process reviewed current final effluent performance and asset provision in order to establish if further investment was required to meet new permit requirements. Where multiple options to address the obligations were identified the investment with the largest EAV was chosen to provide the best value to customers.

Other consideration for preferred option

Assessment Area	Summary
Uncertainty on delivery or changing needs	All options under this driver have been classified as 'green' under the Environment Agency's WINEP level of certainty mechanism
Environmental Impact	Investment will enable compliance with the water quality requirements of the UWWTD to be achieved.
Use of Innovation	Where investment is required to provide for increased hydraulic or biological capacity the use of package solutions constructed off site such as Submerged Aerated Filters has been promoted as an alternative to traditional site based construction techniques for processes such as trickling filters or humus tanks
Impact on company resilience	Investment under this driver will provide resilience to cater for growth in the WRC catchment

Reduce CSO Discharges: U_INV and U_IMP4 drivers – reduce the impact of high spilling CSOs at WRCs

The ROV process established storm storage requirements to reduce spill frequency levels to less than 30 spills per annum in order to comply with new permit trigger levels. At one location with fewer than 30 spills per year we have agreed with the Environment Agency that instead of installing storage we can improve the screen at this CSO to reduce impact.

The selected option provides the best value options for the reduction of spills to the environment. Where possible the construction of additional storm storage will be achieved off site to reduce construction time and cost.

Ofwat have modelled these programmes of work in separate feeder models, with the U_INV investments being allocated equally to three other models. We believe that (other than being located on a treatment site as opposed to CSOs in the network) the 3 solutions proposed here are substantially similar to those in the Spill Frequency feeder model and therefore recommend that they are re-allocated to that model for assessment.

Other consideration for preferred option

Assessment Area	Summary
Uncertainty on delivery or changing needs	All options under this driver have been classified as 'green' under the Environment Agency's WINEP level of certainty mechanism
Environmental Impact	Improvements under this driver will contribute to complying with the requirements of the Urban Wastewater Treatment Regulations and will protect the water quality of receiving water bodies
Use of Innovation	Where possible the construction of additional storm storage will be achieved off site to reduce construction time.

Assessment Area	Summary
Impact on company resilience	Investment under this driver will provide resilience to cater for growth in the WRC catchment

Increase full flow to treatment at WRC: U_IMP5 driver

Investments under this driver provide for a sidestream treatment process to meet the required increase in full flow to treatment during storms. We prepared a matrix of solutions to consider for each site depending on the exiting treatment processes and ancillary equipment present on site and the capacity of the site. For smaller sites we prepared our costs using a package treatment plant.

This approach provided a better value option for customers than extending existing treatment processes and will ensure that processes remain biologically stable; extending existing process streams can disrupt the stability of the treatment process in high flows as effluent strength can be significantly less than at dry weather flows.

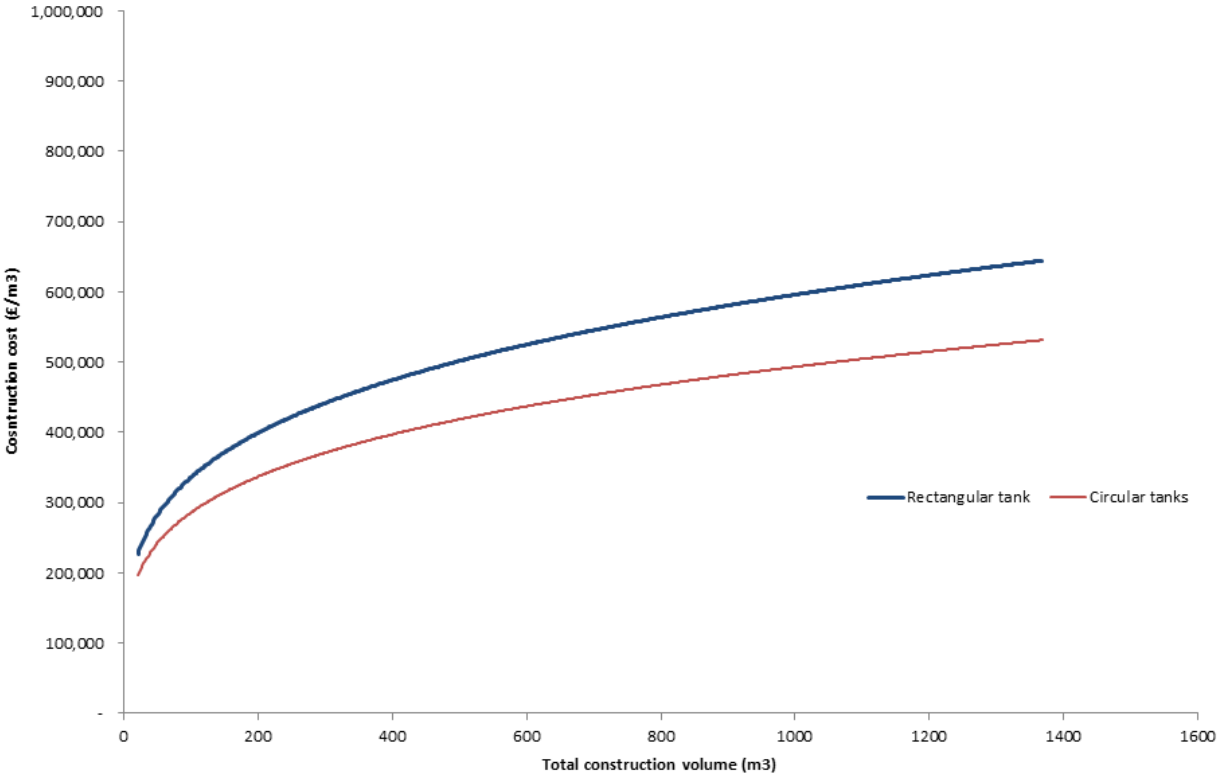
Assessment Area	Summary
Uncertainty on delivery or changing needs	A proportion of the obligations required under this driver have been classified as 'amber' under the Environment Agency's WINEP level of certainty mechanism. As such they are subject to ministerial sign off in 2021. Where possible we have agreed with the Environment Agency to phase 'amber' obligations to AMP8; where this is not possible obligations will be covered by our 'managing uncertainty' approach described in chapter 4.5
Environmental Impact	Investment will prevent the premature spill of effluent to storm tanks in dry periods allowing storm tanks to be used only during periods of wet weather or snow melt. This will prevent more frequent, higher strength and longer duration spills from storm tanks to receiving waters, and allow receiving waters to respond to rainfall events to provide additional dilution.
Use of Innovation	Where possible the provision of package solutions constructed off site will be provided.
Impact on company resilience	Investment under this driver will provide resilience to cater for growth in the WRC catchment and demonstrate compliance with the requirements of the UWWTD.

Increase Storm Tank Volume

U_IMP6 driver - Obligations under this driver have been revisited in light of updated guidance and advice received from the EA since our initial submission.

The cost of providing rectangular or circular tanks for storm storage have been compared. Our analysis shows that the provision of circular tanks is lower capex across a range of volumes. Therefore circular tanks have been selected for the investments under this driver.

Figure 7 Constructions cost circulat tank vs rectangular tanks.



Other consideration for preferred option of circular tanks

Assessment	Summary
Uncertainty on delivery or changing needs	A proportion of the obligations required under this driver have been classified as 'amber' under the Environment Agency's WINEP level of certainty mechanism. As such they are subject to ministerial sign off in 2021. Where possible we have agreed with the Environment Agency to phase 'amber' obligations to AMP8, where this is not possible obligations will be covered by our 'managing uncertainty' approach
Environmental Impact	Investment will reduce the number of settled sewage spills of watercourses. This will prevent more frequent, higher strength and longer duration spills from storm tanks to receiving waters, and allow receiving waters to respond to rainfall events to provide additional dilution.
Use of innovation	The use of off site construction processes and standard products will be utilised where possible
Impact on company resilience	Investment under this driver will provide resilience to cater for growth in the WRC catchment and demonstrate compliance with the requirements of the UWWTD.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT 1 SEPTEMBER 2018

Addressing Flow at Water Recycling Centres

Price Control(s)	Wastewater Network plus
Business Plan table and line(s)	Table: WWS2 Lines: A6 (sewage treatment column), A7, A9, A10, A20 (part), A35, B53 (sewerage treatment column), B54, B56, B57, B67 (part), B82

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A6	5.683	6.528	0.055	0.000	0.000	12.266
	A7	10.259	4.326	0.000	2.145	0.000	16.729
	A9	1.427	4.424	6.027	26.457	56.657	94.992
	A10	10.503	8.786	21.075	31.765	39.591	111.719
	A20	1.168	1.997	1.848	2.633	5.493	13.138
	A35	0.237	1.828	1.219	0.000	0.000	3.283
							Capex: 252.127 [1]
Opex (£m)	B53	0.021	0.066	0.088	0.086	0.085	0.346
	B54	0.019	0.018	0.000	0.005	0.010	0.052
	B56	0.007	0.044	0.110	0.436	1.561	2.159
	B57	0.098	0.280	0.575	1.014	1.585	3.552
	B67	0.104	0.177	0.241	0.296	0.516	1.363
	B82	0.000	0.010	0.037	0.051	0.050	0.148
							Opex: 7.620
AMP7 carry over costs: £0.000m				Whole life benefit (EAB)*: £46.239m			
Whole life value (EAV)*: £25.786m				Whole life cost (EAC)*: £20.453m			

1 There is potential for over £100m totex saving due to phasing on the above figures, see text below

* Note: Annualised values over 40 years

Investment Summary

All of the investment covered by this case relates to the capacity of our Water Recycling Centres (WRCs) to accept flows of sewage, both in dry weather when flows are lower and in wet weather when the flows increase significantly. Our Water Recycling centres have to be resilient to both scenarios, ensuring normal daily flow trends are treated, whilst also able to balance storm flows without spilling untreated sewage to the environment. We will invest in six programmes of work:

- 420 investments to monitor spills of untreated effluent during storms at WRCs under the U_MON3 driver – allocated to line 6.
- 420 investments to monitor flow passed to treatment at WRCs under the U_MON4 driver – allocated to line 7, (NB the 420 investments are not always on the same sites as the U_MON3 drivers).
- 53 investments to increase full flow to treatment capacity at WRCs where we have known lack of capacity under the U_IMP5 driver – allocated to line 9.
- 16 investments to increase capacity at WRCs that have crossed a population threshold under UWWTD due to historic growth – allocated to line 20.

- 151 investments to increase storm tank volume to reduce the risk of spills in storms at WRCs under the U_IMP6 driver – allocated to line 10.
- 3 investments to reduce the impact of high spilling CSOs at WRCs under U_INV & U_IMP4 – split out separately and coded to line 35.

There is a potential reduction in cost in this area by substituting a number of obligations with monitoring. These are specifically at WRCs with either an U_IMP5 or U_IMP6 driver but are not linked to another WINEP driver and there are no known water quality issues in the receiving waterbody. This was referenced in a joint letter from Trevor Bishop at Ofwat and Anne Dacey at the EA received on the 11th July 2018 titled PR19: Water Industry National Environment Programme (WINEP): "We do note that Anglian Water have also challenged the deliverability and affordability of the Flow Compliance programme. Ofwat will provide a view on this component at the time of business plan review. Ofwat consider that affordability and deliverability should be looked at in terms of the whole business plan when benchmarked against other companies."

As explained in Chapter 8 *Flourishing Environment*, we have identified approximately 150 water recycling centres to which this expenditure relates that have no additional driver (such as for environmental improvement, or the prevention of environmental deterioration). These schemes equate to £149 million of totex costs. We believe phasing this investment into AMP8 will ease deliverability and affordability pressures. The delivery of all U_IMP5 and U_IMP6 schemes is included in this Plan as a requirement of the WINEP, pending views from Ofwat in the context of PR19 as a whole.

Need for Investment

What incremental improvement would the proposal deliver?

The investment provides additional storage and treatment at our works delivering environmental improvements as defined by WINEP.

The needs relate to new EA guidance relating to compliance with the Urban Wastewater Treatment Regulations. Increased storm tank capacity will allow receiving waters to respond to rainfall events to provide additional dilution. Increasing FFT will ensure that storm overflows controlling FFT do not discharge to the environment on dry days and storm tanks do not fill prematurely and can be emptied effectively to prevent more frequent, higher strength and longer duration discharges from storm tanks or on site terminal pumping stations to receiving waters.

Is there persuasive evidence that an investment is required?

This investment is driven by legislation. We have offered potential savings on the scale of the programme.

Below are extracts from the third release of the Water Industry National Environment Programme (WINEP3) for Anglian Water Environment Agency and Natural England Water Industry Strategic Environmental Requirements (WISER) document EA PR19 Guidance. The following drivers form part of the WINEP.

Investment required under WINEP U_MON4 driver: Install MCERTS flow monitoring as close to the overflow as practicable to record Full Flow to Treatment (FFT) at assets where the existing Dry Weather Flow (DWF) MCERTS flow monitoring, or other installed flow monitoring, cannot be readily used to confirm the permitted FFT setting is being complied with when the overflow to storm tanks operates.

Investment required under WINEP U_IMP4 driver. UWWTR spill frequency reduction scheme. These are investments to reduce environmental impact of spills from our sewerage system and our WRCs.

Investment required under WINEP U_IMP5 driver. The FFT must be increased to meet two objectives. The first objective of U_IMP5 is to prevent the dry day operation of WRC overflows controlling FFT. The driver only applies where the dry day operation is due to the permitted overflow setting being too low a multiple of the permitted DWF. A second objective is to provide sufficient headroom within the permitted FFT to allow storm tanks to be emptied as soon as reasonably practicable so storm storage is available for subsequent storms.

Investment required under WINEP U_IMP6 driver. The WRC storm tank capacity must be increased to 68 litres/head or to 2 hours at full flow to treatment max flow through the Water Recycling Centres. The objective of U_IMP6 is to reduce the frequency, duration and concentration of discharges from storm tanks that have low permitted volume.

Previous investment has focused on the need for flow measurement to measure DWF not Full Flow to Treatment or storm capacity.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

See 'Best Option for Customers' below.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) as it enhances the quality of water courses down stream of the final effluent discharge locations at WRCs. It is also required to enhance the capacity of WRCs in order to cater for the new demand associated with the forecast population growth in our region over AMP7. In our Strategic Direction Statement published in 2017, one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'. This investment works towards this goal.

All the investments relate to those published in WINEP3 and are new obligations.

What does the expenditure enhance?

This investment will prevent deterioration of ecological status of inland water bodies at these locations and enhance the natural capital of our region.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

We have completed extensive engagement with customers on investment in environmental drivers. To save repetition, our findings are explained in more detail in the enhancement case relating to phosphorus removal.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Regarding investment for inflow at WRCs we have had several meetings and written correspondence with Defra, the Environment Agency and Ofwat in relation to the timing of this investment. Our Plan assumes all investments will be delivered in AMP7. As explained in Chapter 8 *Flourishing Environment*, and in correspondence with Ofwat, Defra and the EA, we feel that phasing the investment in addressing flow at WRCs over AMP7 and AMP8 will reduce deliverability pressures from this large scale investment programme and consequently improve customer affordability for PR19. We therefore wish to continue to engage with Ofwat on this proposal to allow phasing of these investments and monitoring to test need.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our Risk Opportunity and Value (ROV) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution. We ran a ROV process with investment alternatives has been created to achieve compliance with directives using best value options to meet WINEP obligations.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

For obligations requiring an increase in storm tank volume provision, the costs of rectangular and circular tanks were compared and the best value option selected. Where a relatively small increase in volume is required the provision of pre constructed ring chambers was promoted in preference to the construction of new tanks.

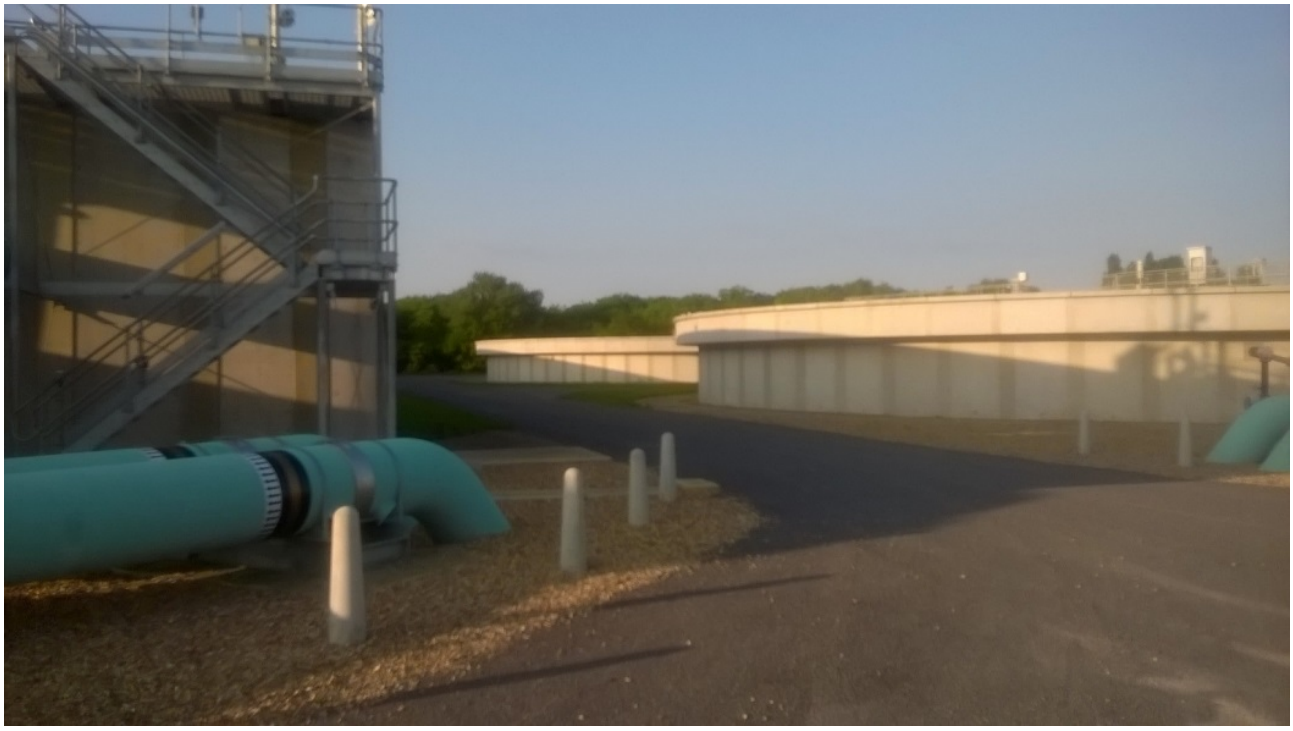
The regulatory guidance gives two options to size the storm tanks, either 68 litres of storage per customer served per day, or 2 hours storage at maximum flow. As per the guidance, we have used the lesser figure depending on the site.

For investments to address spill frequency, options for both storage and screening were considered to arrive at a best value solution.

Has the impact on natural capital and the environment been considered?

Where possible we have considered low carbon solutions, which include modular precast concrete tanks in this instance. Below is an example of our recently constructed extension to one of our largest works.

Figure 8 Example of modular precast concrete tanks



Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

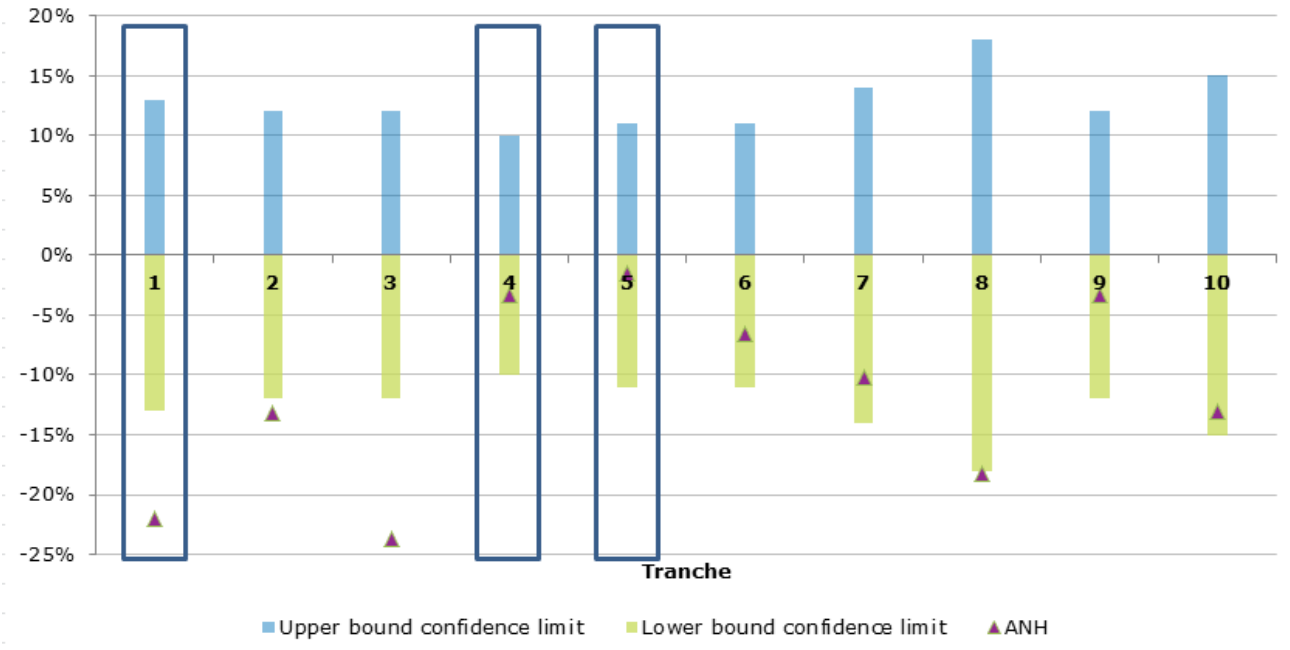
We have reviewed existing equipment on site and ensured that this is not duplicated unnecessarily in the enhancement expenditure, for example kiosks, washwater systems and return pumping stations. Our Design Standards follow EA Guidance. Our costs are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. This means that efficiencies already achieved are included in our future costs estimates, as described in Chapter 10 *Efficiency & Innovation*. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models.

Wherever possible we are trying to move away from a 'design and construct' mentality towards a 'logistics and assembly' approach, when built solutions are required. By designing once and building many it is possible to greatly increase productivity and efficiency whilst reducing embodied carbon and time on site, therefore reducing cost. Further cost efficiencies from this approach are possible from the reduced costs of design, commissioning (and decommissioning) and procurement.

Is there high quality third party assurance for the robustness of the cost estimates?

Our costs have been externally reviewed and benchmarked by Mott MacDonald against other water companies' prices for PR19, and have been shown to be efficient.

Programme	Tranche ref	Enhancement business case reference	AW Cost (£m)	Industry Average (£m)	Delta between AW & Industry (%)	Confidence range
Flow - Increase FFT	1	Addressing Flow at Water Recycling Centres	29.1	37.3	-22%	+/-13%
Flow at WRCs	4	Addressing Flow at Water Recycling Centres	19.5	20.5	-3%	+/-10%
WRC UWWTD	5	Addressing Flow at Water Recycling Centres	6.7	6.8	-2%	+/-11%



Full details of their work are given in Chapter 10 *Efficiency & Innovation*.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The need for this investment is outside of management control because it is driven by the obligation to meet the requirements of WINEP, specifically, to ensure that we meet the requirements of the UWWTD. The need for this investment is driven by a statutory obligation from the Environment Agency in the form of the WINEP. We have challenged the EA as to the need for the investments. The guidance given in their letter of 11 July 2018 has been taken into account.

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

The costs of meeting this have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option. Beyond this, we have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

For this investment, the protection consists of the following implications for non-delivery.

- Under performance penalties for the Treatment Works Compliance performance commitment
- Enforcement action from the Environment Agency for failure to meet revised effluent consents and to deliver an obligation
- Customer complaints potentially to CC Water
- Reputational damage that could be reflected through C-MeX performance
- Reporting our contribution to improving the natural capital of our region through our Natural Capital performance commitment.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7, for the first time we will introduce a new WINEP performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

The output profiles for this work as described in WWS4 align to the optimised investment profile rather than the obligation dates agreed with the EA. The optimised profile is designed to achieve a deliverable programme with smooth bill impacts whilst achieving obligation dates, hence the difference between the cost profile and output profile.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

In discussion we have offered £100m of savings in AMP7, this has been declined by the EA and the letter of 11 July 2018 refers.

Key Assumptions

This assumes there are no further investment requirements introduced by the EA following confirmation of WINEP3.

Bioresources

Additional evidence in response to IAP (31 January 2019)

Summary

We provide evidence to enable Ofwat to conclude that our proposed investments are required, are the best option for customers and that we have robust and efficient costs.

AMP7 expenditure	Anglian Water Plan (September 2018)	Ofwat assessment (January 2019)
Capex (£m)	21.881	0
Opex (£m)	1.515	0
Totex (£m)	23.396	0

Where through the IAP assessment, Ofwat has assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September plan.

We therefore focus attention solely upon those areas where Ofwat were not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment). We provide additional evidence below to address each point of feedback.

ANH.CE.A1 requires us to address areas of inefficiency or lack of evidence as perceived by Ofwat's IAP assessment of our September submission.

The investment in this enhancement case is required to:

- Increase capacity at our Pyewipe and Whitlingham Sludge Treatment Centres (STCs) to cater for growth and additional sludge as a result of tightening environmental standards, primarily phosphorous removal;
- Provide additional input monitoring for all indigenous, liquid imports and cake imports received into our STCs. This is in-line with Ofwat's Water 2020 strategy for improved monitoring of flow and dry solids at each input boundary point between Wastewater Network Plus and Bioresources. This is to provide higher quality, more accurate information on the quantity of imported sludge to STCs to enable better measurements and support trading in new markets.

Ofwat feedback - Need for investment - Fail	Summary of evidence provided in response
We are concerned that Anglian Water does not indicate the %age increase of sludge production following implementation of the WINEP programme on P-removal. Further Anglian Water does not present the percentage increase of sludge production following the population growth. There is no forecast data explanation related to data in L1,2,3 of Bio1 table.	The percentage increase in sludge production following P removal and population growth for each year of the AMP is: • to 2021/22 - 0.08% (P-removal), 0.88% (growth) • to 2022/23 - 0.14% (P-removal), 0.76% (growth) • to 2023/24 - 0.16% (P-removal), 0.71% (growth) • to 2024/25 - 2.68% (P-removal), 0.70% (growth) • to 2025/26 - 0.45% (P-removal), 0.63% (growth) This is based on forecast growth figures for our region and phosphorus consent levels in WINEP3. Sludge trading volumes are based on our modelled projections based on proximity of neighbouring company sludge treatment centres.

Ofwat feedback - Need for investment - Fail	Summary of evidence provided in response
For the Medium Combustion Plant Directive (MCPD) adjustment, Anglian Water gives no detail of size or categories of its generators to demonstrate that compliance is required with the MCPD by 2025, nor how this links to any of its capital maintenance programme which could be expected to replace or renew some of its existing generators.	Our CHP engines are all included in Tranche A. Nine out of ten sites have a thermal input greater than 5 megawatts and require compliance by 2025. CHPs at Great Billing and Whitlingham are due to be replaced by 2025, but will still require SCR installation to ensure of confidence in compliance. Our diesel engines are tranche B generators under the Specified Generator Regulations (SGR). Engines at Whitlingham and Cotton Valley will be replaced with an upgraded engine as this provides the best whole life value. Replacement of diesel generators as part of our capital maintenance programme is on a like-for-like basis, and does not include SCR installation to meet MCPD and SGR.
In our view it is not clear what is the impact of the population growth and tightening of the environmental standards on the sludge production to justify the claim. Also we consider enhancement of the monitoring capacity as business as usual, hence not eligible for an enhancement allowance.	The impact of population growth and tightening of environmental standards on sludge production is highlighted in response to the 'Need for investment' feedback. The differential between new enhancement requirements and existing business as usual monitoring capacity is highlighted in our response to the 'Management control' feedback.

Ofwat feedback Management control - partial pass	Summary of evidence provided in response
We agree with Anglian Water claims that the obligation to meet the requirements of WINEP is beyond the company control. We do not agree that improvement of the flow and dry solids monitoring as per Water 2020 is beyond the company control; in our view installation of the monitoring technology is business as usual since not eligible for an enhancement allowance.	At present there is no requirement to monitor flow and sludge volumes at the boundary between water network plus and bioresources controls. We currently monitor flow and dry solids at the point of treatment at our STCs as we consider this to be the most accurate and representative monitoring point. Water 2020 requires the new monitoring points to be installed by the beginning of the second year of the control period at the latest. This will typically require four new flow meters and dry solids meters per site (to monitor liquid imports, cake imports, primary range and secondary range), compared to a single monitoring point, as per our current and preferred option. We therefore consider that the change in monitoring requirements is beyond management control, and not business and usual.

Ofwat feedback Best option for customers - fail	Summary of evidence provided in response
There is no options appraisal demonstrated in the submission.	Our options appraisal has been conducted through the use of a decision support tool - an end-to-end model of all bioresources operations which considers costs and revenues, and investment requirements to accommodate growth and WINEP obligations over a 25 year time horizon. We have also applied management scrutiny to the outputs of the decision support tool. For example, to maintain a 90% utilisation limit, the model proposed a replacement of Cambridge STC in AMP7. Given the recent announcement to relocate Cambridge Water Recycling Centre, we considered it appropriate to postpone investment in a new STC until AMP8 and invest in optimisation and additional digestion capacity at Pyewipe.
Anglian Water confirms that: 'To date we have not entered into any trading agreements for 2018-19, however we are in regular dialogue with our neighbouring WASCs to monitor and explore opportunities.' (11a Anglian Water Bioresources Strategy 2020 - 2045.pdf, p.12). In our view the lack of bioresource trading at present indicates that the Bioresources Strategy that is concerned about 'Facilitating the development of sludge markets and how we maximise value by taking cost effective opportunities to open markets whilst maintaining stakeholder and customer confidence.' is yet to be implemented.	We have taken forward the development of sludge markets by: • Engaging with neighboring WASCs to identify opportunities for sludge trading; • Identified an opportunity to engage with two third parties contracted to remove and recycle sludge from Ministry of Defence water recycling centres serving operational bases from within the AWS operational area; • Produced and continue to develop a number of modelling tools to aid in the assessment of trading opportunities with our neighbouring WASCs. We have exchanged details of the identified sites with the neighbouring WASC's and anticipate that trading will commence by 2020/21; • Utilised a logistics modelling tool, to identify where sludge from our water recycling sites that could be viable for cross border trades to our neighbouring WASCs; • Participated in events and workshops to explore potential for co-treatment of sewage sludge with other organic wastes; • Conducted a market survey with third-parties to seek interest in providing services across our Bioresources price control.

Ofwat feedback Robustness and efficiency of costs - partial pass	Summary of evidence provided in response
We note that Anglian Water does not reveal how much saving is achieved through their efficiency approach.	Our efficiency approach will will increase resource costs to improve production management by £250k (£124.9k on full year operating costs). Doing so allows us to avoid significant extra costs of £48m in providing additional capacity at Cambridge STC in AMP7. It also reduces the likelihood of needing to open

Ofwat feedback Robustness and efficiency of costs - partial pass	Summary of evidence provided in response
We are concerned that Anglian Water does not explain how they will mitigate the risks associated with increase of the STC utilisation to 90% to pursuit the saving.	old mothballed lime stabilisation assets, whose unit costs are £96/tds higher than advanced digestion assets. This would amount to a cost of £1m for capacity to lime the balance of sludge over the 90% capacity threshold in the final two years of AMP7 (10,500tds). As part of a wider business restructure, we have a new sub-business stream for our STC's. A new head of sludge treatment has been taking responsibility for the day to day operation and performance or our ten sludge treatment centres. We have taken a number of actions which have increased STC availability and throughputs including: • increasing average engine run hours per engine by bringing engine maintenance in house; • creating Bioresources Production Manager roles with the specific objective of driving improved asset performance and utilisation; • Improved data collection and monitoring to improve our in day decision making and improve asset utilisation; • Improved information and tools to help inform trading.

Ofwat feedback Customer protection - partial pass	Summary of evidence provided in response
Anglian Water states that the following mechanisms could protect the customers in case the investment does not happen or is delayed: • customers could make complaints to CC Water. • reputational damage through C-MeX performance. • if no additional sludge capacity is delivered, then it can indirectly and adversely affect the company performance against the WINEP programme performance commitment. We are concerned that there is no direct customer protection mechanism in case of a failure of the investment delivery.	This enhancement case covers an area which is open to competition. We have highlighted in our earlier feedback responses how we are proactively encouraging the development sludge markets and have supported sludge trading with neighbouring WASCs and other third parties. Customers are protected against failure of investment delivery through market forces, and therefore we do not consider that overlaying an additional customer protection mechanism on top of this would be in the interests of customers.

Ofwat feedback - Need for investment

We are concerned that Anglian Water does not indicate the %age increase of sludge production following implementation of the WINEP programme on P-removal. Further Anglian Water does not present the %age increase of sludge production following the population growth. There is no forecast data explanation related to data in L1,2,3 of Bio1 table.

Our response

Time period	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total population served by Water Recycling Centres ('000)	7,188	7,253	7,312	7,375	7,427	7,475	7,518	7,560	7,602	7,643
PE related sludge yield increase (TDS/yr)	0.0	1379.1	1196.5	1136.8	1122.5	1051.2	911.6	897.6	917.1	904.7
P removal sludge yield increase (TDS/y)	0.0	127.2	221.3	249.8	4300.1	741.8	23.6	23.4	24.0	23.8
Year end production (TDS/y)	156,405	157,911	159,329	160,715	166,138	167,931	168,867	169,788	170,729	171,657
PE related sludge yield increase (%)	0.00	0.88	0.76	0.71	0.70	0.63	0.54	0.53	0.54	0.53
P removal sludge yield increase (%)	0.00	0.08	0.14	0.16	2.68	0.45	0.01	0.01	0.01	0.01

Enhanced P Removal related sludge yield

With the release of WINEP3, a significant number of sites within the Anglian region become subject to tightening Phosphorous consents. Typical technology solutions were developed for 8 different scenarios detailed in the table below based on the existing consent and treatment type.

Scenario	Sludge yield percentage increase
1 - New activated sludge to 1mg/l or more	14
2 - New activated sludge to less than 1mg/l	29

Scenario	Sludge yield percentage increase
3 - Existing activated sludge with P removal to 1mg/l or more	8
4 - Existing activated sludge with P removal to less than 1mg/l	13
5 - New trickling filter to 1mg/l or more	19
6 - New trickling filter to less than 1 mg/l	37
7 - Trickling filter with existing P removal to 1mg/l or more	8
8 - Existing trickling filter with P removal to less than 1mg/l	16

The expected yields were factored down by 25% to reflect our experience of design vs actual loads before being used to adjust the site specific yields for the impacted sites, this is consistent with the factor we apply to all our sludge production forecasts when converting from a design connected PE derived figure to sludge production treated at the STC. Where a single site had multiple drivers, only the tightest standard was considered for modelling purposes. For planning purposes, delivery of the programme was phased throughout AMP7 with the majority expected to be put into beneficial use in year 4.

Population Equivalent related Sludge Yield

The Anglian Bioresources Decision Support Tool (DST) was built using historic sludge production numbers from 350 WRCs representing over 95% of the total indigenous sludge production. Growth projections for all WRCs have been captured and applied to the respective WRCs in the model. Site specific sludge yields were increased in-line with the population equivalent increase. The population (PE) increase (as modelled) from 2020 to 2025 is approximately 3.99%, the total sludge yield (PE related) for the same period is approximately 4.29%. The sludge yield increase is slightly greater than population increase due to the nature by which population increase is dispersed. Each site has a different sludge yield factor based on WRC processes.

Total sludge yield projections

These factors (population equivalent and P removal) combine to provide our total projected sludge yield as expressed in table Bio 1 Line 1.

Third party sludge provision - L2, Bio1

Working with our neighbouring WASCs and using published data from the markets data information request we have been able to identify circa 6,500 tds across 107 sites of our raw sludge production at water recycling centres that are closer to a neighbouring WASC's sludge treatment facilities than our own. This represents approximately 4.15% of our total raw sludge production. We have also identified a similar number of neighbouring WASC water recycling centres where the reverse is true, therefore opening up the opportunity for reciprocal trades to reduce haulage and tankering costs, as a result of this work we continue to work with our neighbouring WASC's to unlock this opportunity.

This modelling forms the basis of Bio1 Line 2. It is envisaged that these trades would be on a reciprocal basis and as such our total sludge treated would remain broadly similar to our indigenous production.

Ofwat feedback – Need for investment

For the Medium Combustion Plant Directive (MCPD) adjustment, Anglian Water gives no detail of size or categories of its generators to demonstrate that compliance is required with the MCPD by 2025, nor how this links to any of its capital maintenance programme which could be expected to replace or renew some of its existing generators.

Our response

We have provided our response to this in the MCPD deep-dive response.

Ofwat feedback – Need for adjustment

In our view it is not clear what is the impact of the population growth and tightening of the environmental standards on the sludge production to justify the claim. Also we consider enhancement of the monitoring capacity as business as usual, hence not eligible for an enhancement allowance.

Our response

The impact of population growth and tightening of environmental standards through WINEP is highlighted in our response to first feedback statement of this deep-dive. Our justification for an enhancement allowance for monitoring capacity is provided in our response to the management control feedback.

Ofwat feedback – Management control

We do not agree that improvement of the flow and dry solids monitoring as per Water 2020 is beyond the company control; in our view installation of the monitoring technology is business as usual since not eligible for an enhancement allowance.

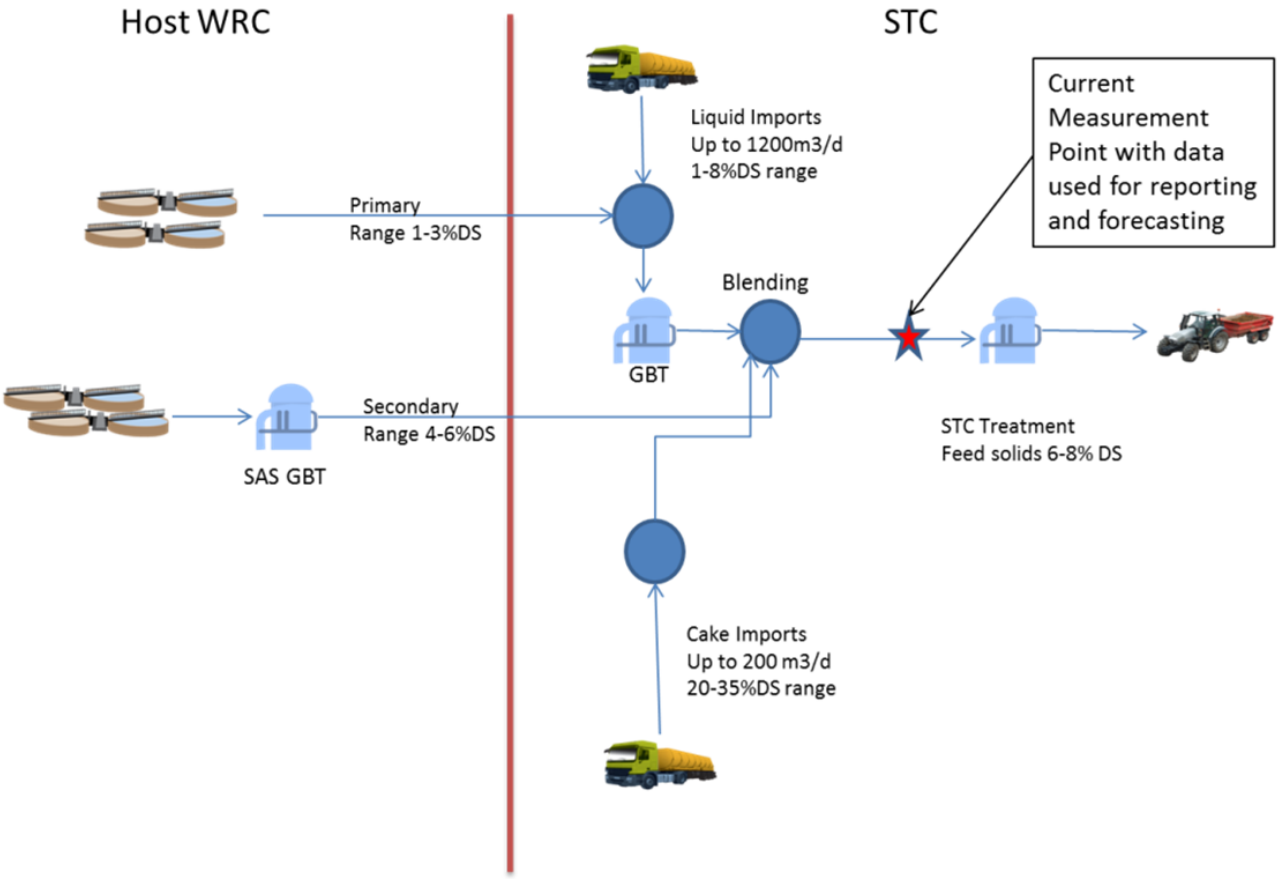
Our response

The PR19 methodology guidance appendix 6 states that "To ensure the legitimacy of the market, companies will need accurate measurements of their raw sludge production. Where companies are not already doing so, we expect them to start using instrumentation to accurately measure sludge production, preferably by April 2020 and by no later than the second year of the price control. We will take into account the extent to which companies are measuring this at PR24" and;

"We expect companies to be using instrumentation to measure sludge production accurately at the start of the control period, or at the latest by the beginning of the second year of the control. Accurate measurement of sludge production will be required for the operation of the market and is likely to form the basis of contracts. It will also be needed if we move to setting gate prices at PR24."

We consider this to be enhancement expenditure as there has previously been no requirement to monitor sludge in this way, so this is a new activity. There is a requirement for monitoring of flow and sludge quality (% dry solids) at each boundary point as sludge crosses from network plus into the Bioresources price control, or where sludge is imported from other WRC's or Bioresources assets for treatment.

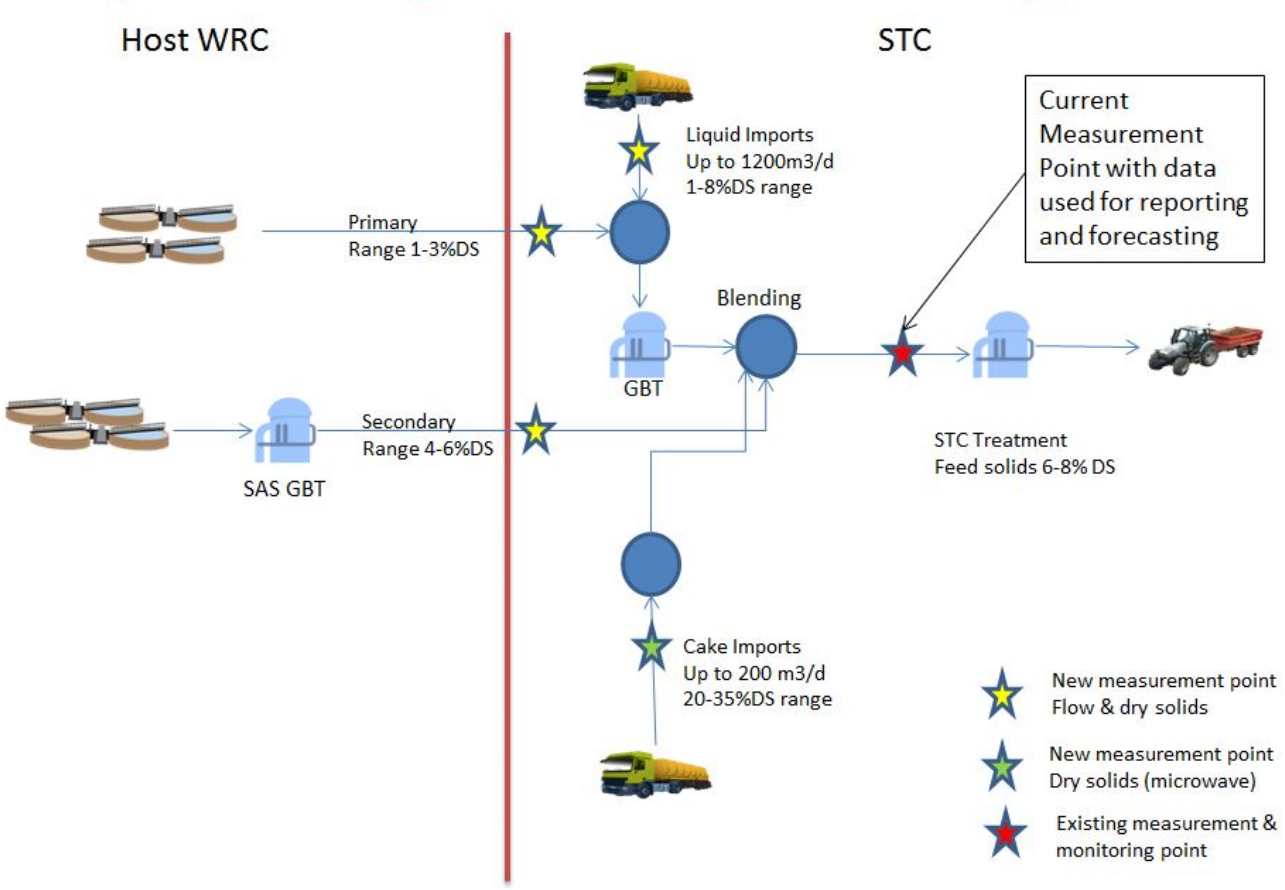
Figure 9 Current sludge measurement at a typical AWS STC site



Currently, we monitor flow and dry solids at the point of treatment on our STC's (blended sludge entering the advanced digestion process). We have set out that this is the most accurate and representative monitoring point during the consultation process and at the sludge markets working group in October 2017.

With the additional monitoring requirement, there is a material change which is not included in base costs. Measuring at each transfer point will result in multiple measurement points, where sludge is unscreened and at its most variable. We also import sludge as dewatered cake (circa. 25% DS) at seven of our ten Sludge Treatment Centres and currently there is no proven technology available on the market to measure sludge dry solids at this transfer point. For imported liquid sludge we currently record imported volumes or mass via import flow meters and weighbridges, dry solids is recorded using dry solids probes fitted to our in-house fleet of tankers that move approximately 75% of sludge produced at our STC's for onward transport and treatment at our STC sites. For raw dewatered cake imports mass is measured at our STC weighbridges and dry solids is taken from routine spot dry solids testing at the dewatering site.

Figure 10 Proposed sludge measurement at a typical STC



Our proposed solution is to install sludge flow meters and dry solids probes at each transfer point for indigenous sludge and liquid sludge reception points. Typically this requires four new flow meters and dry solids meters per site with associated telemetry for data recording. This has been included at twenty one sites (10 STC's and 11 raw dewatering hub sites) and a microwave sensor based solution at our seven STC's with raw cake reception.

Ofwat feedback - Best option for customers

There is no options appraisal demonstrated in the submission.

Our response

Decision support tool

Extensive optioneering was undertaken using our decision support tool. The support tool is a network model of our end to end Bioresources operations and includes sourcing of sludge from our network plus WRC assets, transport to sludge treatment centres (STCs) or for intermediate dewatering at our raw dewatering hub sites through to recycling of treated product to agricultural land. The model works in annual buckets over a 25 year model horizon and considers impacts of growth and WINEP in terms of sludge production, relative costs and revenues at each site and process step and investments required to meet the system demands over time.

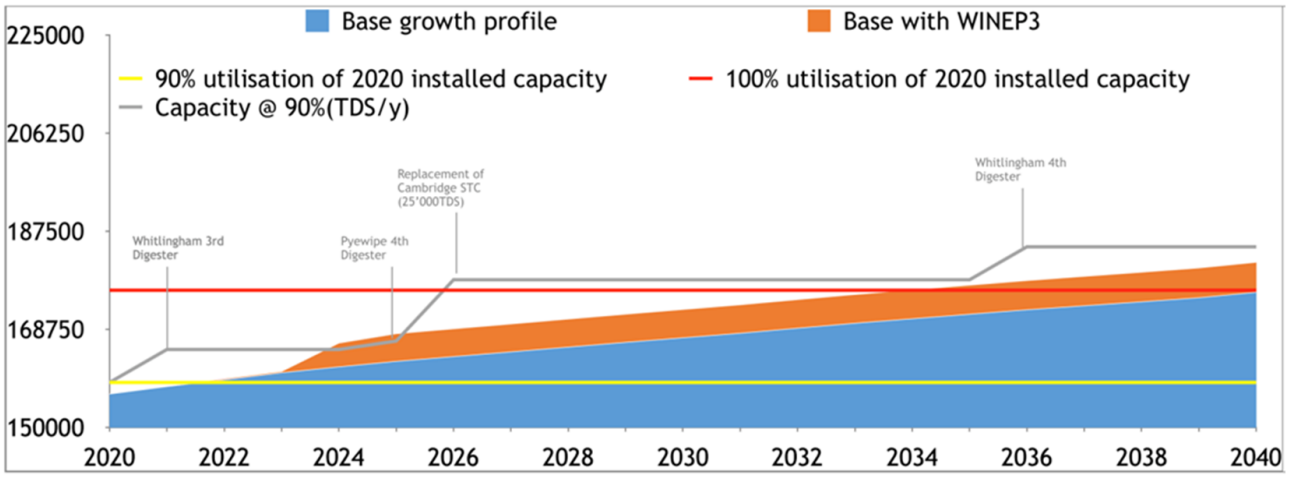
We modeled a number of scenarios to inform our investment plan, these included;

- No new capacity

- New STC capacity
- Expand existing STC capacity

Modeling demonstrated that 'no new capacity' was not feasible. With no investment in capacity, the amount of sludge produced exceeds the current installed capacity at 90% utilisation of design capacity in 2022. No investment would mean we would be required to operate our STC asset base at 96% utilisation by 2025.

Figure 11 STC capacity



We allowed the model to consider new STC capacity and/or expansion of existing STC's to meet the objective of treating all sludge at a capacity utilisation of 90%. Solving to the lowest TOTEX cost per tonne dry solid across the end to end Bioresources process chain (logistics, treatment and recycling) the model recommended increasing capacity at Whitlingham and Pyewipe over a new STC or significant re-build to meet the capacity required. Sensitivity analysis on sludge production was also undertaken, higher or lower production did not change the recommended investments for the period to 2025. Pyewipe and Whitlingham are the only sites available within our current network where capacity can be expanded without significant asset re-build or change. The alternative would be re-build of an STC or a new STC elsewhere within the network and significant increase capital cost and carbon impact.

Summary of enhancements

Project name	Recommended alternative	Initial cost (£m)	Full year annual operating costs (£m)	Equivalent Annualised Benefit (£m)	Equivalent Annualised Cost (£m)	Equivalent Annualised Value (£m)	Output
Pyewipe STC - additional digestion capacity	Additional digestion capacity	7.0137	0.0695	0.9612	0.4145	0.5467	Additional 1800 TDS
Whitlingham STC - sludge treatment capacity	Additional digestion capacity	11.4315	0.2365	6.3431	0.7338	5.6093	Additional 6400 TDS
Optimisation	Bioresources availability optimisation	0	0.1249	1.131	0.125	1.006	Improved performance of STCs

Project name	Recommended alternative	Initial cost (£m)	Full year annual operating costs (£m)	Equivalent Annualised Benefit (£m)	Equivalent Annualised Cost (£m)	Equivalent Annualised Value (£m)	Output
Input monitoring	All inputs monitoring	4.5747	0.0331	5.0437	0.6131	4.4306	Full monitoring at 21 sites

Equivalent Annualised Value = Equivalent Annualised Benefit – Equivalent Annualised Cost. Based on a 40 year planning horizon

EAB and EAC align to the Treasury Green Book Methodology and the Ofwat recommended Spackman approach to annuitising and discounting. This ensures the maximum net benefit is derived for the service objectives set by our customers.

The following sections provide detail on the selection of the recommended alternatives for each area of investment.

Pyewipe Sludge Treatment Centre

This proposed investment is for additional anaerobic digestion capacity by the construction of a forth digester tank 2,887m^3. This will increase the STC design throughput to 17,500 tds per annum matching the existing capacity of the HpH advanced hydrolysis system commissioned in AMP5.

Whitlingham Sludge Treatment Centre

This investment is to increase the design capacity of the STC to 26,600 tds per annum, this is to be achieved by the modification of the existing CAMBI thermal hydrolysis process, build of an additional 4000m^3 of digester tank and increased liquid import capacity.

Optimisation

Bioresources Production manager posts were created in 2018 with the primary focus on STC performance in terms of asset utilisation, throughput and CHP output. These have aided significantly in driving improved performance in 2018-19. The investment is required to increase the number of production managers from two to four FTE's to ensure we can operate our asset base at greater than 90% for a short duration in order to defer investment in additional STC capacity until AMP8 where additional capacity at Cambridge is recommended. Doing so, allows us to avoid a significant extra costs of providing additional capacity at Cambridge STC in AMP7.

Input Monitoring

This investment involves installation of flow and online dry solids monitoring at each of the boundary transfer points between water recycling network plus and the Bioresources price control. The investment also includes the measurement of flow and dry solids at all import points for liquid and dewatered cake sludge that in hauled to sites from remote WRC's and Bioresources dewatering hub site.

Assessment area	Summary
Uncertainty on delivery or changing needs	Opening of markets and cross border trading could influence the need and timing of this investment. The rate of population growth and impact of sludge production as a result of WINEP will also have an impact.
Customer preferences	Customer conversations on biosolids highlighted a preference to retain the ability to treat and recycle the sludge produced. Customers were also supportive of our strategy to use advanced anaerobic digestion technologies and generate renewable power via our CHP engines.

Assessment area	Summary
Environmental impact	Improved data capture allows better optimisation of dry solids at source works with the aim of reducing volumes and tanker miles.
Use of innovation	Pyewipe uses our innovative in house designed HpH advanced digestion technology and has delivered industry leading performance in terms of conversion of organic matter to renewable energy. The Whitlingham STC investment involves refurbishment and upgrade of the CAMBI thermal hydrolysis process, this takes advantages of the latest developments and innovations with thermal hydrolysis including significant increases in throughput from the original asset. We have developed a system wide production planning tool for activities across the Bioresources price control. This tool aids operational, tactical and strategic decisions and allows scenarios and plans to be tested to determine the optimum production plan and maintenance interventions whilst considering sludge stocks and production. These will be the primary tools for the Bioresources production managers. Use of innovative monitoring techniques for online dry solids monitoring of imported sludge cake.
Impact on company resilience	This investment ensures we retain sufficient capacity to treat our sludge production at 90% capacity utilization. Provides more data and realtime data to aid production planning and decision around trading and markets.

Ofwat feedback - Best option for customers

In our view the lack of bioresource trading at present indicates that the Bioresources Strategy that is concerned about 'Facilitating the development of sludge markets and how we maximise value by taking cost effective opportunities to open markets whilst maintaining stakeholder and customer confidence.' is yet to be implemented.

Our response

We are supportive of opening of markets for Bioresource activities both in terms of inter WASC trading and use of third parties. We have been active in many areas both at a bilateral level and through encouraging the development of market-assisting tools like the Biosolids Assurance Scheme to encourage the development of bioresources markets. We also include information on our bioresource trades in response to Action ANH.CMI.B1-2 in section 11.13 of our main IAP Response.

Summary of Trading Discussions

We have regularly engaged with our neighbouring WASCs over the past four years. These discussions have included bilateral talks over potential short term non-committal trades and long term fully committed trades.

The table summarises the meetings held and the key actions and activities that arose warranting further investigations.

Water and sewerage company	Meeting date	Meeting date	Meeting date	Meeting date	Status
Thames	14 January 2016	8 June 2016	12 July 2016	6 June 2018	Initial meetings identified options for long term and short term trades. Long term trading out of raw cake with the transfer of cake from Tilbury to TMS Riverside sites has been discussed. This potential trade was highlighted as an example of 'good practice' in the Ofwat Wholesale Markets Guidance document issued in March 19. However, insufficient capacity and Thames Water's strategy changes mean this is not an option until 2023 at the earliest. Short term non-committal trades on liquid sludge along boundary areas have also been identified. This would be on a reciprocal basis to reduce transport movements and costs.
Severn Trent	11 January 2016	31 August 2016	30 January 2018		Spare capacity is unavailable in close proximity to the border areas. SVT does not have the ability to receive or export sludge as raw cake. Short term non-committal trades on liquid sludge along boundary areas have been identified. This would be on a reciprocal basis to reduce transport movements and costs.
Yorkshire	10 December 2015	10 April 2017			There is no opportunity at present for long term committed trades due to lack of capacity within the boundary areas. We have entered into a number of short term trades with YW over the period, receiving dewatered raw sludge cake into both Pyewipe and Gt Billing STCs. Liquid sludge trades are not feasible due to excessive transport distances between the respective STCs. In addition to these meetings we actively participated in the YW Bioresources market testing exercise during 2018.

Through these meetings we have identified an opportunity to engage with two third parties contracted to remove and recycle sludge from Ministry of Defence water recycling centres serving operational bases from within the AWS operational area. The agreements will allow the contractors to import this sludge onto our STCs for treatment and recycling. Contracts have been exchanged and we anticipate this will import 121.8 TDS per annum.

Models & Tools

We have produced and continue to develop a number of modelling tools to aid in the assessment of trading opportunities with our neighbouring WASCs.

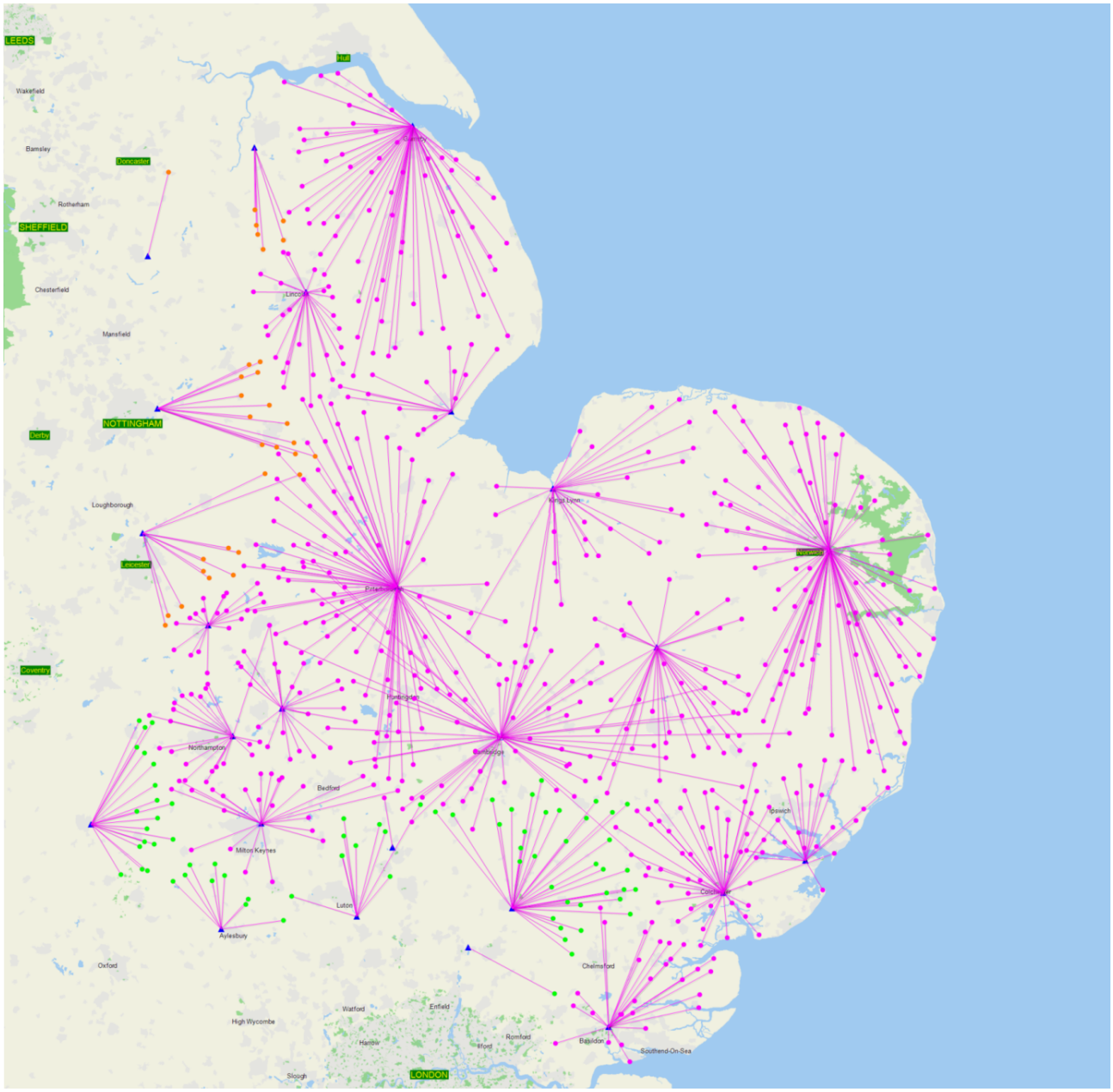
- We used the 25 year strategic model to assess viability of trades at various gate fees to assess which sites would be viable for trading.
- We used our transport planning tool (Paragon) to assess the viability of short term trades with neighbouring WASC's. This assessed all sites where the distance travelled for moving sludge from water recycling centres to a STC for treatment was equal or greater in distance compared to a neighbouring WASC's facility.
- We have completed the rollout of a new weekly production planning model (PPM) that provides a complete view of the end to end Bioresources network including transport, treatment and recycling operations. The model provides a dynamic view of cost on both a system and site level together with capacity utilisation rates against a weekly sludge production profile which considers the seasonal nature of sludge production based on historic trends. The outputs of this model will provide a greater insight of capacity, headroom, unit cost and risk, thus enabling the management teams to make better informed decisions on trading opportunities.
- Based on 16/17 cost base for our STC assets modelling demonstrated that three would be open to trading sludge.

To date we have exchanged details of the identified sites with the neighbouring WASC's in terms of volumes, sludge type and quality, we have also exchanged draft contract terms and anticipate that trading around these opportunities will commence by 2020/21.

Sludge trading logistics

The figure below is a visualisation output from our logistics modelling tool, this shows sludge from our water recycling sites that could be viable for cross border trades to our neighbouring WASCs.

Key: Pink dots – AWS WRCs transporting to AWS STCs and dewatering hubs; Green Dots – AWS WRCs where sludge has potential to trade with Thames Water STC sites; Orange dots - AWS WRCs where sludge has potential to trade with Severn Trent STC sites



3rd Party Trading – Co-Treatment

We are supportive of on-going work to explore potential for co-treatment of sewage sludge with other organic wastes. We have participated at a number or events and workshops. This has included:

- Ofwat Sludge Working Group presentation on barriers to trading – July 2016
- ADBA conference – time to mix food-waste & sludge – July 2018
- Water Industry/EA - Co-treatment Workshop – January 2019

This to date has included six meetings - the most recent in January 19 - with policy makers and regulators including site visits to our sludge treatment centres.

We have also actively engaged and have held discussions with third-party service providers and conducted a market survey to seek interest in providing services across our Bioresources price control. We engaged with over eighty potential third party providers that have plants or operate plants within or close to our operating areas. We received six responses to the enquiry, four from third party providers interested in treating sludge and two from neighbouring WASCs.

We have also modelled the impact of new trading opportunities within our operating area assuming that regulations are amended to allow co-treatment with third party other organic waste treatment providers becomes financially viable. We recognise and acknowledge that current regulation does not prohibit co-treatment from taking place. However, all work we have done, consistent with the view of the majority of other WASCs across the industry, demonstrates in many cases that co-treatment with sewage sludge or other organic waste is not financially viable due to the additional financial burden that exists when operating outside the Sludge Use in Agriculture regulations.

In addition to co-treatment of wastes we have also considered opportunities for co-location of sewage sludge and other organic waste treatment. We have evaluated a number of sites for this type of arrangement including our sites at Cottonvalley (Milton Keynes), Great Billing (Northampton) and Bedford. At both Cotton Valley and Great Billing we considered options for new reception facilities for other organic wastes (OOW), blending facilities and re-configuration of our existing digestions assets to release one for treatment of OOW, biogas and energy generation equipment would be shared with biogas blended to be used within our existing CHP fleet. Capacity would be created by re-distribution of sewage sludge across our wider network. Following evaluation and financial modelling to date these options have been discounted for the following reasons;

- Seasonal variations in sewage sludge production risks there being insufficient capacity for treating sewage sludge within the regulated asset base during the months of peak sludge production (February – June)
- Our existing asset base uses CHP for power generation from biogas. CHP is no longer supported by government incentives for renewables following closure to new applicants into the Renewable Obligations Order in March 2017
- Significant capacity already exists in the area for anaerobic digestion of other organic wastes within the local area leading to some uncertainty as to availability of suitable feedstock and sustainable gate fees

We continue to identify opportunities, including through working with other WaSCs to facilitate the development of bioresource markets.

Ofwat feedback - Robustness and efficiency of costs

We note that Anglian Water does not reveal how much saving is achieved through their efficiency approach. We are concerned that Anglian Water does not explain how they will mitigate the risks associated with increase of the STC utilisation to 90% to pursuit the saving.

Our response

Our efficiency approach of investing in bioresources production manager posts, reduces the need to reopen our old mothballed lime stabilisation assets that have a much higher unit rate for treatment, based on 2016/17 data our lime plants were £96 per tonne dry solids higher in unit cost compared with our advanced digestion asset base. The cost of liming the balance of sludge over the 90% installed capacity threshold for the final two years of AMP7 (10,500 tds) equates to approx. £1m compared with costs of additional resource to aid improved production management of £250k.

We have invested over the past two AMP periods in our Bioresources asset base to provide capacity to treat sludge production through our ten advanced anaerobic digestion facilities. Over this same period, we have closed a number of smaller conventional digestion sites and less sustainable lime treatment plants. In parallel with this capital investment we have introduced and continue to implement a production based approach to our end to end Bioresources value chain.

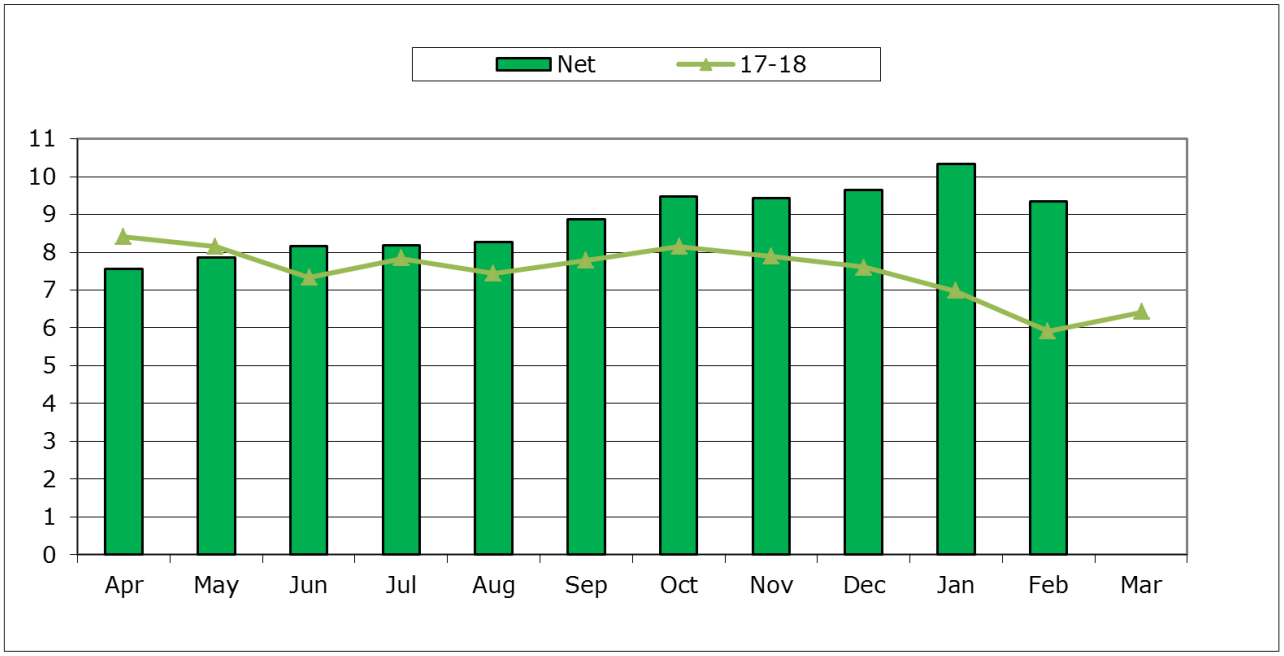
Since 2010, we have used performance data to drive change in our approach to operations and maintenance activities. This includes:

- Decision to bring in house the operation and maintenance of our CHP engine asset base in 2014/15. This allowed for a clear focus on engine operation to ensure maintenance interventions are tailored to the specific site conditions and in line with OEM recommendation. Bringing engine maintenance in house increased average engine run hours per engine (comparing across the same engine asset base) from an average hours run per engine of 5,611 hours per engine when engine operation and maintenance was outsources to 6,632 hours run per engine since the in-house CHP was created.
- Targeted new investment for capacity and operational resilience at sites and where benefits are greatest. For example, the additional digestion and CHP capacity at our largest STC at Great Billing in 2015, not only provides improved up time and performance, it also gives greater network flexibility allowing the site to flex throughput at times of high sludge production.
- Creation of Bioresources Production Manager roles with the specific objective of driving improved asset performance and utilisation. Improved co-ordination between operations, maintenance teams and our capital delivery vehicles and partners as a result, has provided significant improvements in both performance and throughputs. Within the current financial year we have significantly increased the volume of sludge treated through our advanced digestion STCs and are on course to treat 5.5% more than our previous best year in 16/17 and 12% higher throughput that in 17/18, this will also result in improved power generation from our CHP fleet with an expected year end out turn on 108GWh and increase of 9GWh on our previous best and 19GWh than in 2017/18.
- Investment has been made in improved data collection and modelling. We are currently building a database to support our haulage and logistics operations. We have invested in improved monitoring at the receiving sludge treatment and dewatering centres to visualise and provide real-time sludge stock information. These tools are designed to improve our in day decision making and improve asset utilisation. We have also invested in investment and production planning models. The investment model (Bioresources decision support tool) is a 25 year model that aids our investment decision making at a strategic level to inform where and when additional capacity is required, judge these investments against long term committed trading opportunities and the timing of planned major asset interventions that reduce capacity in the short to medium term. A production planning model that will be run weekly by the production managers to plan our sludge treatment over a rolling 12 week period. This model considers the seasonal and varying nature of our sludge production on a week by week basis, planned outages and in week restrictions due to un-planned outages. This model provides a dynamic view of the Bioresources network and covers all aspects, logistics, treatment and recycling providing a week by week view of unit cost and both a network and individual treatment site level.

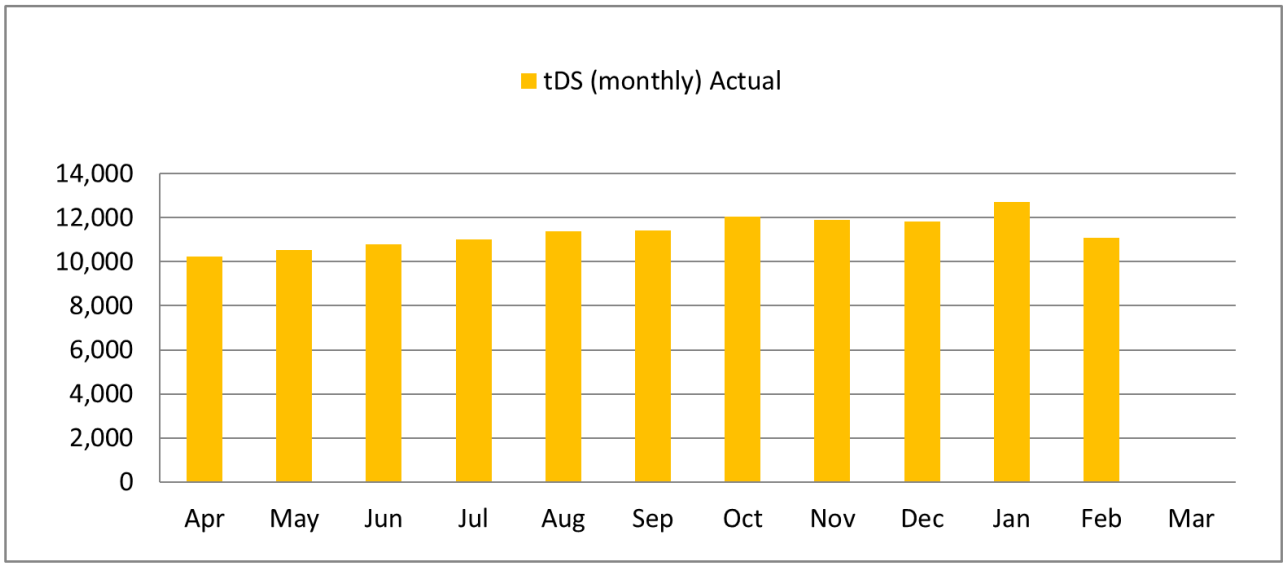
In addition to the above we are in the process of re-structuring our business into Water, Water Recycling and Retail business streams. As part of the new water recycling business stream we have created a new sub-business stream for our STCs. A new head of sludge treatment has been appointed responsible for the day to day operation and performance or our ten sludge treatment centres. This new structure will be in place from April 2019.

The graph below demonstrates the improvements made over 2018/19 to the end of February 19 as a result of the interventions made in the late spring/ early summer outlined above.

Picture 2 Total monthly net power output GWh/Mth



Picture 3 Monthly treated sludge production v Target



The result of the above initiatives and investments show an upward trend in our STC availability and throughputs, this gives confidence that we can move our trigger point for new capacity investment from 80 to 90% capacity utilisation. Improved data and modelling tools allow us to flex capacity. For example our nominal design capacity is based on a hydraulic retention time of 14 days in our anaerobic digesters, during times of high sludge production or with plants off-line for planned maintenance we will allow sites to increase throughputs to a minimum retention time of 12 days or a maximum stated organic loading rate per m3 of retention time this gives us the ability over short durations to flex our capacity from approx. 458tds/d to 541tds/d. The actions we have taken with the increased focus and production based approach has led to an increase in maintenance spend, however this is more than offset by the increased revenues and benefits from increased

CHP generation and the reduction in the overall unit cost of treatment as the approach drives us to process sludge at centres that returns the lowest overall end to end unit cost for operation of services across the price control.

As a result of the interventions and initiatives above, together with improved information and tools to help inform trading we expect to treat all our raw sludge production via our ten STCs in 2019/20 and continue with sustained improvements in uptime and CHP outputs putting us into a strong position to delivery against our strategy as set out in the business plan submission.

Ofwat feedback – Customer protection

Anglian Water states that the following mechanisms could protect the customers in case the investment does not happen or is delayed:

- *customers could make complaints to CC Water.*
- *reputational damage through C-MeX performance.*
- *if no additional sludge capacity is delivered, then it can indirectly and adversely affect the company performance against the WINEP programme performance commitment.*

We are concerned that there is no direct customer protection mechanism in case of a failure of the investment delivery.

Our response

This enhancement case covers an area which contestable and open to volume risk due to markets, being part of an average price control. We have highlighted in our earlier feedback responses how we are proactively encouraging the development sludge markets and have supported sludge trading with neighbouring WASCs and other third parties. Customers are protected against failure of investment delivery through market forces, and therefore we do not consider that overlaying an additional customer protection mechanism on top of this would be in the interests of customers.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT 1 SEPTEMBER 2018

Bioresources

Price Control(s)	Bioresources
Business Plan table and line(s)	Table: WWS2 Lines: A2, A3, B49, B50

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A2	4.545	1.201	0.875	1.107	5.413	13.141
	A3	0.436	4.804	3.500	0.000	0.000	8.740
							Capex: 21.881
Opex (£m)	B49	0.138	0.151	0.178	0.230	0.385	1.084
	B50	0.000	0.000	0.088	0.173	0.171	0.432
							Opex: 1.515
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £12.518m		
Whole life value (EAV)*: £10.631m					Whole life cost (EAC)*: £1.887m		

* Note: Annualised values over 40 years

Investment Summary

The investment in this enhancement case is required to:

- Increase capacity at our Pyewipe and Whitlingham Sludge Treatment Centres (STCs) to cater for growth and additional sludge as a result of tightening environmental standards, primarily phosphorous removal (approximately £17.5m capex).
- Provide additional input monitoring for all indigenous, liquid imports and cake imports received into our STCs (approximately £4.2m capex). This is in-line with Ofwat's Water 2020 strategy for improved monitoring of flow and dry solids at each input boundary point between Wastewater Network Plus and Bioresources. This is to provide higher quality, more accurate information on the quantity of imported sludge to STCs to enable better measurements and support trading in new markets.

Need for Investment

What incremental improvement would the proposal deliver?

The third release of the Water Industry National Environment Programme (WINEP) introduces new or tightened standards for final effluent Phosphate concentration at a number of Water Recycling Centres (WRCs) (see Chapter 8 *Flourishing Environment*).

Nutrients (P removal at activated sludge WRCs) and WINEP – Nutrients (P removal at filter bed WRCs). It is expected that the enhanced treatment required to meet these standards will increase sludge production by varying amounts at each of these sites.

Is there persuasive evidence that an investment is required?

Insufficient capacity to receive and treat raw sludge will lead to sludge removal being inhibited at regional Water Recycling Centres (WRCs), risking compliance with environmental standards and permits and posing a threat to the environment.

Using the Anglian Bioresources Decision Support Tool (DST), raw sludge production has been modelled from 2020-2045. The model takes input data for each of our WRCs and projects changes to sludge production over time when overlaying growth projections and future quality obligations. This modelling has demonstrated that additional sludge treatment capacity will be required to receive and treat this sludge during AMP7.

Our preferred option delivers a strategy that ensures the additional sludge produced can be collected and recycled though our bioresources asset base. It is supportive of new sludge markets and we are actively exploring trading opportunities with our neighbouring water and sewerage companies (WASCs). See Annex 11a *Anglian Water bioresources Strategy 2020-2045*.

The provision of additional input monitoring for all indigenous, liquid imports and cake imports received into our STCs is a requirement which is in-line with Ofwat's expectation as set out in Water 2020 for improved monitoring of flow and dry solids at each input boundary point between network plus and bioresources. This will allow us to record more accurately the transfers between Wastewater Network Plus and Bioresources, and enable trading in new markets in the future.

In the past investments have been made during each AMP cycle to ensure that we maintain sufficient capacity to treat all raw sludge produced as a result of our water recycling operations. Since the 'Safe sludge' Matrix was agreed with key industry stakeholders in 1998 our strategy has been to treat all raw sewage sludge produced to the required standards for recycling to agriculture.

Since AMP4 our investment programmes have focused on improving end product quality by investing in Advanced Anaerobic Digestion systems. Not only does this improve the quality of the end product recycled to farmland, it also increases the conversion of organic matter to biogas thus increasing the amount of renewable electricity generated at our sites whilst reducing the tonnage of end product needing to be recycled to land.

The WINEP for AMP7 is more than double the size it has been in the past. Previous plans have targeted investments when production exceeded 80% of our design capacity. We will now plan investments when production at STCs reaches 90% of capacity, in support of Ofwat's drive to open new markets and cross-border inter-Water and Sewerage Company (WASC) trading where we have shown innovation in promoting such trades already.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

We have engaged extensively with our Customer Engagement Forum and it's Sustainability and Resilience sub-panel. A key aspect of this debate has been delivery of our significant WINEP obligations to the benefit of the environment, while also meeting customer priorities and ensuring affordability. There is support from customers to increase bill levels to deliver environmental and resilience improvements. This was shown to be the case in both the acceptability research on our outline business plan and through our 'Be the boss' digital engagement.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) because it enhances the capacity of two STCs to cater for increased sludges as a result of growth in the region and tightening environment standards, primarily P Removal.

It also improves our monitoring capability at our STCs.

What does the expenditure enhance?

The expenditure to provide additional input monitoring is a requirement which is in-line with Ofwat's expectation as set out in Water 2020 for improved monitoring of flow and dry solids which will enhance the quality of the information to support trading in new markets.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our Bioresources customer engagement indicated a high level of confidence in Anglian Water to maintain high quality standards in delivery of our products for recycling. In addition evidence from qualitative research and engagement activities suggests many customers think this work is important. Although wastewater appears to be an "invisible" service that some customers don't think about very much, evidence from several quantitative and qualitative sources indicates generally high levels of satisfaction with the wastewater and environmental service.

Consultation sessions with customers where held in December that discussed:

- Perspectives on Anglian Water: Heaven and Hell
- Environmental responsibility: Personal and commercial
- Biosolids: Awareness and perceptions, and
- Investment prioritisation: PR19 strategy.

The customer consultation group showed strong support for our bioresource strategy that centres around advanced anaerobic digestion producing products for use in agriculture and renewable energy via our Combined Heat and Power (CHP) engines. A quote from the group was *"It's clearly a no brainer, it's a necessary process and I'm pleased that Anglian are investing in it"*.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued? Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Multiple scenarios for intervention options were modelled and compared over 5, 10 and 25 year periods using the DST to ensure best value solutions for customers were promoted to the business plan. Alternatives offered for consideration included potential expansion of an existing STC, the replacement of existing STCs with larger plants, conversion of a non-STC WRC and long term committed sludge trading with neighbouring WASCs.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our ROV (Risk, Opportunity and value) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Has the impact on natural capital and the environment been considered?

Tightening requirements for phosphate removal should deliver environmental benefits. Our contribution to the natural capital of our region will be captured and reported through our Natural Capital performance commitment.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Our costs have been developed using our corporate cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan.

In addition each alternative has been quality assured by a member of the Totex Cost Estimation team.

We have adapted our strategy to target 90% utilisation at STCs compared to 80% historically. This means the need to invest in additional capacity is reduced.

Our sludge digesters are of a modular design that reduces costs and carbon and have been promoted for this expenditure area.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. These costs have been reviewed by our external assurance providers (Jacobs).

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by the obligation to meet the requirements of WINEP, specifically, to ensure that we are compliant with the tightened standards for final effluent phosphate concentration. It is also important that we meet Ofwat's expectation as set out in Water 2020 for improved monitoring of flow and dry solids.

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

The costs of meeting the obligations have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option.

We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this portfolio the protection consists of the following implications for non-delivery.

- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through C-MeX performance.
- There is an indirect linkage to the WINEP programme where we have included delivery performance commitment. To enable this is occur additional sludge capacity will be required, as covered in this business case.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

We are proposing a WINEP performance commitment for AMP7. This performance commitment incentivises delivery of the WINEP to unlock early benefits for the environment and customers.

Affordability

Has the impact on affordability been considered?

We have considered this and we have identified the impact of WINEP on customer bills. Over AMP7 we expect our average bills to increase by around 1%. If our WINEP investment was at the same level as AMP6, our average bills would be decreasing by 0.3% over the AMP.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

Our WINEP for AMP7 is more than double the WINEP in AMP7 which has put significant pressure on bills. We have worked hard to ensure this is affordable and are providing additional affordability and vulnerability support to our customers in AMP7.

Key Assumptions

There will be no further additions to the programme arising from later versions of the WINEP.

We anticipate that new sludge markets will develop over the course of the AMP cycle. Initially this will be limited to cross border trading between WASCs. We have assumed trading is likely to be reciprocal with similar levels of sludge being traded in and out.

The DST considered all costs (operating and capital) and revenues across the bioresource price control, covering logistics, treatment and recycling. As sludge volumes increase over time as a result of growth, and assuming quality drivers, the model recommends new investments to provide the required treatment capacity. The location and size of the additional capacity are determined by assessing the lowest unit cost of treatment across the life of the 25 models.

The strategy is based on operating our STC asset base at >90% utilisation, this has increased from our previous business plans that were based on 80%.

Medium Combustion Plant Directive (MCPD)

Additional evidence in response to IAP

Summary

AMP7 expenditure	Anglian Water Plan (September 2018)	Ofwat assessment (January 2019)
Capex (£m)	7.768	0
Opex (£m)	0	0
Totex (£m)	7.768	0

Where through the IAP assessment, Ofwat have assessed our Plan as either a 'pass' or 'N/A' assessment we conclude that Ofwat is fully satisfied with the information provided in our September plan. We therefore focus attention solely upon those areas where Ofwat were not fully satisfied (i.e. we have received a 'partial pass' or 'fail' assessment). We provide additional evidence below to address each point of feedback.

ANH.CE.A1 requires us to address areas of inefficiency or lack of evidence as perceived by Ofwat's IAP assessment of our September submission.

We also refer below to the Ofwat cost assessment models:

- Wholesale Wastewater Enhancement Feeder Model Freeform provided on a Microsoft excel workbook,
- Wholesale Wastewater Enhancement Feeder Model Sludge provided on a Microsoft excel workbook.

This investment is to:

- Install selective catalytic reduction (SCR) units and associated monitoring across 48 sites that have diesel powered generators to ensure they can operate as Tranche B Specified Generators and will comply with the Specified Generator Regulations, and
- Upgrade 20 existing Combined Heat and Power (CHP) engines to ensure compliance with the new MCPD and Specified Generator Regulations.

Ofwat feedback Needs analysis - fail	Evidence
Page 85 of ANH's Wastewater Tables commentary gives the case for the enhancement expenditure proposed. The portion of £5.8m allocated to the bioresources control has been reallocated to sludge enhancement (quality) – line 2 of WWS2. The remaining £1.95m is assessed as this free form line associated with sewage treatment that is consistent with the business plan tables. However, this expenditure should not be allowed for in the IAP due to poor justification – as shown below.	We have provided further justification of the business need in response to each of the statements below.
ANH gives no detail of the size or categories (Tranche A or Tranche B) of its generators to demonstrate that compliance is required with the medium combustion plant directive (MCPD) by 2025, nor how this links to	Our CHP engines are all included in Tranche A. Nine out of ten sites have a thermal input greater than 5 megawatts and require compliance by 2025. CHPs at Great Billing and Whitlingham are due to be replaced by 2025, but will still require

Ofwat feedback Needs analysis - fail	Evidence
its capital maintenance programme which could be expected to replace or renew some of its existing generators within this timeframe. We note that some generators (Tranche A generators with a rated thermal input equal to or less than 5 megawatts) do not need to be compliant until 2030, by which time ANH may have been due to replace some of them anyway. It is not clear whether any of ANH's generators are in this category and therefore should not be included in the AMP7 investment programme.	SCR installation to ensure the highest level of confidence in compliance. Our diesel engines will become tranche B generators under the Specified Generator Regulations (SGR) and will need to be permitted before they are used for the capacity market. Engines at Whitlingham and Cotton Valley will be replaced with an upgraded engine as this provides the best whole life value. Replacement of Great Billing and Kings Lynn are excluded from enhancement costs as these are lean burn, low NOx engines. Replacement of diesel generators as part of our capital maintenance programme is on a like-for-like basis, and does not include SCR installation to meet MCPD and SGR. One Tranch A site (Chelmsford) has a thermal input less than 5MW and does not need to be compliant until 2030. Chelmsford has been included in this enhancement investment as best value and efficiency can be achieved by delivering upgrades as a single programme with the use of a standard design in AMP7.
ANH does not provide evidence of existing performance of its generator fleet to demonstrate that investment is required to bring them up to MCPD standards.	We conducted tests on our CHP engines showing that two engines initially failed (Cliff Quay 1 and Great Billing 1), and required a retest and eight engines passed as a result of uncertainty factors being applied (Basildon 1&2, Cambridge1 , Great Billing 3&4, Pyewipe 1, and Whitlingham 1&2). A further review of historic performance against MCPD limits showed a further engine (Cotton Valley 2) above the MCPD limit, and a further four at over 90% of the limit (Colchester 1&2, Pyewipe 1, Chelmsford 1). None of our existing diesel powered generators meet the NOx limit. Our SCR installation project at Canwick Water Recycling Centre has provided assurance that this will reliably ensure we achieve the limit.
We note of a total of £7.768m, the proposed capex spend is £1.949m in sewage treatment (i.e. 25%) and £5.819m in bioresources (75%). The ANH case states the investment is to: • install selective catalytic reduction (SCR) units and associated monitoring across 48 sites that have diesel powered generators to ensure they comply with the new Medium Combustion Plant Directive (MCPD), and • upgrade 20 existing Combined Heat and Power (CHP) engines to ensure compliance with the new MCPD.	Of the 48 diesel powered generators, 24 are for wholesale water, and 24 are for wholesale wastewater. We have allocated all of the enhancement expenditure to this single enhancement case.

Ofwat feedback Needs analysis - fail	Evidence
It is likely that there are diesel powered generators used to provide power back-up and TRIAD management in wholesale water too, but there is no proposal for enhancement expenditure to comply with the MCPD regulations in wholesale water.	
We presume the investment proposed on the 48 diesel powered generators is allocated to sewage treatment and that that on the 20 CHPs is allocated to bioresources.	We confirm that this assumption is correct.
ANH states (of its diesel generators?) "We use them to avoid importing electricity during peak periods and to help the National Grid balance supply and demand on its transmission network." However, we note that in the regulations there are exemptions from emission limits for plants which operate for no more than 500 operating hours per year, as a rolling average over a period of five years. ANH has not set out adequately that there is a case to upgrade all 48 diesel powered generators. It is not clear that any of them operate for more than 500 hours per year.	All of our diesel powered generators operate for less than 500 hours per year and so are exempt from the MCPD regulations. However, they are tranche B generators that will need to comply with Specified Generator Regulations regardless of their running hours.
We note that no other company is requesting enhancement expenditure for upgrading CHP engines, despite all companies having some and the regulatory requirement applying to all companies in England and Wales. We note that Thames Water states on page 9 of its bioresources growth and quality business case (CSD006-BR-01b-PR19-CA-FE) "We believe that the cost of compliance with MCPD in AMP7 will be negligible. The application of the MCPD standards has been deferred until 2030 for smaller classes of equipment (such as boilers) and until 2025 for larger classes of equipment (such as combined heat and power engines). Therefore, the replacement programme for the equipment can be delivered as essentially end of life replacement."	Our review of other companies business plans highlighted that Yorkshire Water has included enhancement expenditure for it's biogas CHP fleet. This is new legislation and therefore costs associated with it have not been included in maintenance expenditure, and therefore consider that it should be included in our plan as enhancement expenditure.

Ofwat feedback - Needs analysis

This expenditure should not be allowed for in the IAP due to poor justification – as shown below.

We provide justification for this expenditure in our answers to the following comments to address Ofwat's specific points.

Ofwat feedback - Needs analysis

ANH gives no detail of the size or categories (Tranche A or Tranche B) of its generators to demonstrate that compliance is required with the medium combustion plant directive (MCPD) by 2025, nor how this links to its capital maintenance programme which could be expected to replace or renew some of its existing generators within this timeframe.

We note that some generators (Tranche A generators with a rated thermal input equal to or less than 5 megawatts) do not need to be compliant until 2030, by which time ANH may have been due to replace some of them anyway. It is not clear whether any of ANH's generators are in this category and therefore should not be included in the AMP7 investment programme.

The Medium Combustion Plant Directive and Specified Generator Regulations refer to Medium Combustion Plants, these plants can consist of more than a single engine. Where a common stack pipe is used, thermal input for the Plant should include all emitters, both CHP engines and the hot water/steam boilers attached. Nine of our STCs have total thermal input greater than 5MW with only Chelmsford falling below this. The nine sites will be included in Tranche A for compliance by 1/1/2025 as set out in guidance from the Environment Agency in February 2019.

Chelmsford is Tranche A for compliance by 1 January 2030 as it is below the 5MWth threshold for the 2025 deadline. While Chelmsford does not need to comply with the new MCPD legislation until 2030, we believe best value and efficiency can be achieved by delivery as a single programme and use of a standard design.

The table below provides a full breakdown of CHP engine locations and planned maintenance schedules for 2020-25. We have engines from a number of manufacturers with electrical efficiency varying between 28-42%. The total thermal input for each plant (site) is shown, this includes any boilers as listed on the EPR.

Cambridge No. 1 and Cambridge No.2 were not put forward for funding due to the possibility of significant investment and expansion of Cambridge STC in AMP8. It was recently announced by the chancellor that significant funding had been released to re-develop the Cambridge WRC site for housing and businesses in response to a bid from the local authorities. This will require Cambridge WRC and associated STC to be relocated. The anticipated timing for this is during the next AMP. We will therefore manage compliance of these engines through to end of life with enhanced monitoring and maintenance.

Site	Cumulative thermal input incl boilers (MWth)	Engine	Estimated run hours ('000)/ intervention required				
			2020-21	2021-22	2022-23	2023-24	2024-25
Basildon	5.4	MWM 2016/12	60/ Service		72/ Service		84/ Service
		MWM 2016/12	60/ Service		72/ Service		84/ Service
Cambridge	5.4	MWM 2016/12	72/ Service		84/ Service	0/ Replace	
		Mann E2842		50/ Service		60/ Service	
Chelmsford	<5.0	Perkins 4006		32/ Service		32/ Service	

Site	Cumulative thermal input incl boilers (MWth)	Engine	Estimated run hours ('000)/ intervention required				
			2020-21	2021-22	2022-23	2023-24	2024-25
		Perkins 4006		32/ Service		32/ Service	
Cliff Quay	9.7	MWM 2020/12	48/ Service		64/ Service		80/ Service
		MWM 2020/12	48/ Service		64/ Service		80/ Service
Colchester	9.7	MWM 2020/12		48/ Service		64/ Service	
		MWM 2020/12		64/ Service		80/ Service	
Cotton Valley	11.0	Cummins QSV91		0/ Replace		15/ Service	
		Caterpiller 3512	50/ Service	60/ Service	70/ Service		80/ Service
Great Billing	18.9	Jenbacher 420		80/ Service	0/ Replace	10/ Service	20/ Service
		Jenbacher 420		80/ Service	0/ Replace		10/ Service
		Jenbacher 420		80/ Service	0/ Replace		10/ Service
		MWM 2020/16	32/ Service		48/ Service		64/ Service
Kings Lynn	8.5	Jenbacher 320	70/ Service		80/ Service	0/ Replace	10/ Service
		Jenbacher 320	70/ Service		80/ Service	0/ Replace	10/ Service
Pyewipe	9.7	MWM 2020/12	48/ Service		64/ Service		80/ Service
		MWM 2020/12	48/ Service		64/ Service		80/ Service
Whitlingham	12.0	Cummins QSV91		0/ Replace		15/ Service	
		MWM 2020/12		48/ Service		64/ Service	

Our general strategy is to operate and maintain our engine fleet until they reach 90,000 run hours and this is represented in the above table. At 90,000 run hours we assume replacement of the engine in our recommended investment strategy, however this will be considered on a case by case basis following inspection of the engine, as the best value to the customer may be to run for a further 30,000 hours before replacement. A number of the older engines are not the latest lean burn gas engine technology and are not suited to engine re-mapping to consistently meet the MCPD limits, we have selected investments to upgrade the largest two of these engines (Cummins QSV91 engines) within our enhancement investment strategy whilst installing SCR technology on the remainder. Engine replacement costs for Great Billing and Kings Lynn are excluded from this enhancement case as they are already lean burn low NOx engines. The options considered for the investments in this business case are summarised below.

Selective catalytic reduction

Selective catalytic reduction (SCR) is an advanced active emissions control system that can be used on both diesel and gas fuel engines to reduce NOx emissions. A liquid reductant agent is injected and passed through a special catalyst into the exhaust stream of a diesel engine. The reductant source is usually automotive-grade urea.

Assessment area	Summary
Uncertainty on delivery or changing needs	Continue to monitor performance against new permit limits and keep track of new emerging abatement technology and generation equipment
Customer preferences	Customers showed strong support for our strategy to generate renewable electricity from biogas
Environmental impact	Higher certainty of compliance, improved air quality and use of 'Best available technology'
Use of innovation	SCR is best available technology at current time

Replacement

Assessment area	Summary
Uncertainty on delivery or changing needs	Continue to monitor performance against new permit limits
Customer preferences	Customers showed strong support for our strategy to generate renewable electricity from biogas
Environmental impact	Modern lean burn low NOx engines offer best in class performance and improved emissions performance
Use of innovation	Modern lean burn low NOx gas engines offer best in class performance in terms of generation efficiency and reduced emissions

The cost-benefit analysis of our proposed solution is provided below. The outputs allow for any RPE effects above the stated inflationary factor of CPIH. The tables exclude any efficiency factors we have subsequently applied to these investments in our submitted Business Plan Tables.

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Output
Combined Heat and Power Medium Combustion Plant Directive compliance	MCPD SCR addition (18 engines)	7.265	7.749	0.484	Upgrade 20 existing engines to ensure compliance with new MCPD.
Combined Heat and Power Medium Combustion Plant Directive compliance	CHP MCPD replacement (2 engines)	3.490	3.685	0.194	

*EAV = Equivalent Annualised Benefit (EAB) – Equivalent Annualised Cost (EAC) (based on a 40 year planning horizon)

EAB and EAC align to the Treasury Green Book Methodology and the Ofwat recommended Spackman approach to annuitising and discounting. This ensures the maximum net benefit is derived for the service objectives set by our customers

The chosen alternative for the CHP engines is to retro-fit selective catalytic reduction units (SCR) with associated monitoring to eighteen of our twenty two engines. We propose that two engines (Cummins QSV91 engines at Whitlingham and Cotton Valley) are replaced with modern lean burn units and that engines at Cambridge will remain without upgrade. The engines at Cambridge will be managed through enhanced management and maintenance through to end of life due to likely relocation of the WRC site prior to the 2025 deadline.

Diesel

Selective Catalytic Reduction (SCR) is widely accepted to be the most effective way for diesel powered generators to meet the NOx emissions limit of 190mg/Nm^3 @ 15% O_2. SCR installation will allow these 48 diesel generators to participate in demand management initiatives and grid incentives, including the Capacity Market and Short Term Operating Reserve (STOR). Therefore these generators will become Tranche B generators under the Specified Generator Regulations, and will need to be permitted before they are used for Capacity Market or STOR.

Alternatively, they would need to revert back to emergency backup use only, in which case they would become excluded generators under the Specified Generator Regulations and wouldn't require permitting. This would lead to an increase in our overall operating costs due to the loss of income from Capacity Market and STOR, and an inability to take part in other future flexibility opportunities.

Our investment for generator replacement in AMP7 does not identify particular generators. These investment costs are based on a like for like generator replacement and will not address the MCPD or Specified Generator regulations. Therefore SCR installation would be avoided on any generators likely to be replaced either within AMP7, or within the payback period of the individual schemes. In these cases, the funding would either be used for SCR at the point the generator is replaced, or alternatively used to fund the next lowest payback scheme. This enhancement case does not include any costs for replacing or renewing diesel generators, only the costs to retrofit SCR onto existing engines.

The cost-benefit analysis of our proposed solution is provided below.

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Output
Generator MCPD compliance	Install catalytic converter at 24 water sites	0.061	0.096	0.036	Selective catayltic reduction (SCR) units for ad-blue dosing and associated monitoring at 24 sites

Investment	Alternative	EAV (£m)	EAB (£m)	EAC (£m)	Output
Generator MCPD compliance	Install catalytic converter at 24 water recycling sites	0.071	0.104	0.034	Selective catayic reduction (SCR) units for ad-blue dosing and associated monitoring at 24 sites

Ofwat feedback - Needs analysis

ANH does not provide evidence of existing performance of its generator fleet to demonstrate that investment is required to bring them up to MCPD standards.

We set out below, evidence of the existing performance of our fleet.

Biogas CHP

For the biogas CHP fleet we undertake annual compliance testing and reporting against the limits set out in the site environmental permit that covers all combustion activities in relation to the sludge treatment centre. Limits for MCPD are broadly similar to the existing limits as set out in the EPR permit when allowing for adjustment of the oxygen concentrations. Our current performance (2018/19) against these limits whilst demonstrating compliance eight engines pass as a result of uncertainty factors being applied. In 2018/19 two engines failed but passed on re-test after maintenance work was carried out.

Engine	NOx	CO	VOC	Comments (pass/fail)
Basildon 1	Pass	Pass	1433	Passes on overall uncertainty
Basildon 2	566	Pass	1125	Passes on overall undertianty
Cambridge 1	747	Pass	n/a	Passes on overall undertainty
Cambridge 2	Pass	Pass	n/a	Pass
Chelmsford 1				Not tested
Chelsmford 2				Not tested
Cliff Quay 1	881	Pass	n/a	Fail - requires action/ retest (passed on retest)
Cliff Quay 2	Pass	Pass	n/a	Pass
Colchester 1	Pass	Pass	n/a	Pass
Colchester 2	Pass	Pass	n/a	Pass
Cotton Valley 1 (1st)	Pass	Pass	n/a	Pass
Cotton Valley 2 (2nd)	Pass	Pass	n/a	Pass
Cotton Valley 1 (1st)				Unable to test - not running
Cotton Valley 2 (2nd)	Pass	Pass	n/a	Pass

Engine	NOx	CO	VOC	Comments (pass/fail)
Great Billing 1	619	1522	1502	Fail - engine out for rebuild. To be retested after rebuild complete
Great Billing 2	Pass	Pass	Pass	Pass
Great Billing 3	617	Pass	Pass	Passes on overall uncertainty
Great Billing 4	654	Pass	Pass	Passes on overall uncertainty
Kings Lynn 1	Pass	Pass	Pass	Pass
Kings Lynn 2	Pass	Pass	Pass	Pass
Pyewipe 1	609	Pass	n/a	Passes on overall uncertainty
Pyewipe 2	Pass	Pass	n/a	Pass
Whitlingham 1	534	Pass	n/a	Passes on overall uncertainty
Whitlingham 2	534	Pass	n/a	Passes on overall uncertainty

We also commissioned our testing supplier (EnviroDat) to review historic performance and transpose these results against the MCPD limits, this paints a similar picture with a number of engines in 2017/18 failing or at risk of failing the MCDP limits for NOx of 190mg/nm3

Engine unit	NOx result at 15% O2 (mg/nm3)	Above/ below MCPD limit?
Basildon engine A2	117	Below limit
Basildon engine A1	158	Below limit
Cambridge engine 1	153	Below limit
Cambridge engine 2	135	Below limit
Cliff Quay A2 engine 1	126	Below limit
Cliff Quay A1 engine 2	126	Below limit
Colchester engine A2	184	>90% of limit
Colchester engine A1	179	>90% of limit
Cotton Valley 1 engine A4	110	Below limit
Cotton Valley 2 engine A4	208	Above limit
Great Billing engine 1	174	>90% of limit
Kings Lynn engine 1	147	Below limit
Kings Lynn engine 2	128	Below limit
Pyewipe A1 engine 1	205	Above limit

Engine unit	NOx result at 15% O2 (mg/nm3)	Above/ below MCPD limit?
Pyewipe A3 engine 2	178	>90% of limit
Whitlingham engine A4	144	Below limit
Whitlingham engine A7	167	Below limit
Chelmsford engine 1	183	>90% of limit
Chelmsford engine 2	162	Below limit

Whilst it is possible to adjust engine settings to decrease NOx levels to meet MCPD targets, this does increase risk of failure on wider environmental permit emission targets for the sites. For example, a number of our sites have limits for VOC's in stack emissions. Adjusting engine settings to reduce NOx leads to an increase in VOC's. Therefore, investment in abatement technology reduces risk of non compliance whilst improving overall air quality. The new directive also introduces limits for sulphur dioxide (SOx) which is influenced by fuel quality. For our biogas CHP engines the prime influence is hydrogen sulphide levels within the biogas. Our advanced hydrolysis systems, combined with the activated carbon filtration systems we already have in place, mean we typically have low levels of hydrogen sulphide in our biogas. Therefore no additional investment has been assumed for SOx abatement.

Installation of SCR abatement technology increases uncertainty of compliance and ensures a reduced base level of emissions as opposed to adjusting engine settings and/or carrying out additional maintenance interventions as a result of a failed test.

Diesel

The NO_x limit of 190mg/Nm^3 @ 15% O_2 has been set so that diesel powered generators will not comply without emissions abatement, therefore none of our diesel engines currently meet MCPD standards and therefore require enhancement expenditure. We have conducted a pathfinder SCR installation project at Canwick WRC on one of the newer engines within our fleet of diesel generators. This project has demonstrated that we cannot meet the NO_x limit of 190mg/Nm^3 @ 15% O_2 without abatement, and has given us certainty that SRC will allow us to reliably achieve this limit. This scheme has also given us more certainty over the likely costs of delivering further SCR installations.

Ofwat feedback - Needs analysis

It is likely that there are diesel powered generators used to provide power back-up and TRIAD management in wholesale water too, but there is no proposal for enhancement expenditure to comply with the MCPD regulations in wholesale water.

Of the 48 diesel powered generators, 24 are for wholesale water and 24 are wholesale wastewater. This enhancement case covers the proposal for compliance with MCPD regulations for both water and wastewater.

Ofwat feedback - Needs analysis

We presume the investment proposed on the 48 diesel powered generators is allocated to sewage treatment and that that on the 20 CHPs is allocated to bioresources.

This is correct. The diesel generator investment is allocated to sewage treatment and the CHP engines to Bioresources.

Ofwat feedback - Needs analysis

ANH has not set out adequately that there is a case to upgrade all 48 diesel powered generators. It is not clear that any of them operate for more than 500 hours per year.

The diesel powered generators will run for less than 500 hours per year, and therefore won't be captured under the MCPD. Due to their use in the Capacity Market and STOR they will become Tranche B Specified Generators, and will therefore need to comply with the Specified Generator Regulations regardless of their running hours.

Ofwat feedback - Needs analysis

No other company is requesting enhancement expenditure for upgrading CHP engines, despite all companies having some and the regulatory requirement applying to all companies in England and Wales.

We note that Yorkshire Water have also included enhancement expenditure for MCPD compliance for their biogas CHP fleet, the expenditure was broadly similar to that included in our plan. We have reviewed the requirements under the Directive which is to improve air quality. This is new legislation and we consider is not included with in a base operating and maintenance costs and therefore falls under the enhancement heading.

Selective catalytic reduction

Selective catalytic reduction (SCR) is an advanced active emissions control system that can be used on both diesel and gas fuel engines to reduce NOx emissions. A liquid reductant agent is injected and passed through a special catalyst into the exhaust stream of a diesel engine. The reductant source is usually automotive-grade urea.

Assessment area	Summary
Uncertainty on delivery or changing needs	Continue to monitor performance against new permit limits and keep track of new emerging abatement technology and generation equipment
Customer preferences	Customers showed strong support for our strategy to generate renewable electricity from biogas
Environmental impact	Higher certainty of compliance, improved air quality and use of 'Best available technology'
Use of innovation	SCR is best available technology at current time

Replacement

Assessment area	Summary
Uncertainty on delivery or changing needs	Continue to monitor performance against new permit limits.
Customer preferences	Customers showed strong support for our strategy to generate renewable electricity from biogas
Environmental impact	Modern lean burn low NOx engines offer best in class performance and improved emissions performance

Assessment area	Summary
Use of innovation	Modern lean burn low NOx gas engines offer best in class performance in terms of generation efficiency and reduced emissions

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT SEPTEMBER 2018

Medium Combustion Plant Directive (MCPD)

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A32, B73

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A32	0.389	0.620	2.467	1.492	2.801	**Capex: 7.768**
Opex (£m)	B73	0.000	0.000	0.000	0.000	0.000	**Opex: 0.000**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £11.434m		
Whole life value (EAV)*: £69.653m					Whole life cost (EAC)*: £0.748m		

* Note: Annualised values over 40 years

Investment Summary

This investment is to:

- install selective catalytic reduction (SCR) units and associated monitoring across 48 sites that have diesel powered generators to ensure they comply with the new Medium Combustion Plant Directive (MCPD), and
- upgrade 22 existing Combined Heat and Power (CHP) engines to ensure compliance with the new MCPD.

Need for Investment

What incremental improvement would the proposal deliver?

This expenditure will improve air quality in the region.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

This is a leagl requirement.

Is there persuasive evidence that an investment is required?

MCPD is a new directive that controls emissions to air; the directive will cover our CHP engines and boilers at our STC sites (CHP emissions have previously been monitored and permitted via the EA through Environmental Permit Regulations). Following the introduction of this new regulation, investment is required to enable the running of our standby generators for TRIAD and peak tariff avoidance and to earn revenue through participation in National Grid's demand side response initiatives.

The MCPD comes into force on the 1 January 2019 and will restrict our ability to avoid TRIAD [1]and peak electricity tariffs and prevent our participation in revenue earning initiatives which will negatively affect opex.

There has been no historic investment required in this area as this is a new directive.

1 The TRIAD refers to the three half-hour settlement periods with highest system demand between November and February, separated by at least ten clear days. National Grid uses the TRIAD to determine transmission charges for customers with half-hour metering

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) because it enhances 48 diesel powered generators, in line with the requirements of the new regulations.

What does the expenditure enhance?

The expenditure reduces harmful emissions from these diesel generators. The expenditure will also enhance the environment as lower emissions will be returned from the CHP engines through compliance with the MCPD. This supports the delivery of our 'Flourishing Environment' and 'Smaller Footprint' outcomes.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

In response to the introduction of the Medium Combustion Plant Directive (MCPD) we propose to implement emissions control on our fleet of diesel generators and CHPs. Emissions control will allow us to improve air quality and continue to use these assets to deliver significant financial and carbon benefits. The renewable energy generated by our fleet of CHPs avoids the need to import energy with a higher cost and carbon footprint. Further financial benefits are provided by exporting excess power to the grid and from the sale of renewable incentives (REGOs). Our diesel generators also provide significant financial benefits. We use them to avoid importing electricity during peak periods and to help the National Grid balance supply and demand on its transmission network. In 2017/18 the financial benefits attributable to our fleet of diesel generators and CHPs was in excess of £15m

There is little understanding amongst customers about our energy efficiency programmes and the requirements to meet European standards on unsafe emissions. Still, many participants in qualitative research felt that Anglian Water should take steps to reduce its own carbon footprint and are supportive of our efforts to do so. Opinion was divided, however, as to whether the company had a leading role to play. We have engaged with customers to understand the importance of the environment, affordability, and reducing our carbon emissions. In engagement with the online community on our natural capital performance commitment, there was overwhelming support for environmental responsibility. After affordability, protecting the environment was one of the key reasons given for supporting a package of service improvements in our recent research. In acceptability research on the outline plan our carbon performance commitments were considered to be of high or medium importance important by 80%.

Most customers say they consider the environment in their day-to-day life, and the proportion saying this seems to be increasing. It is important to customers that businesses balance the needs of themselves, their customers, the local community and the environment. After affordability, a desire to protect the environment was one of the key reasons given for supporting a package of service improvements in recent research. This proposal will not only deliver financial and air quality benefits, but will also contribute towards our long-term goal of carbon neutrality by 2050.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

The Ofwat industry wide feedback report on the September '17 RCV submission clearly demonstrates that advanced anaerobic digestion technologies combined with recovery of biogas to generate renewable energy products as the most appropriate technology of those used across the industry, giving the lowest unit cost of treatment at a broadly similar capital cost to that of conventional technologies. The value per annum of producing renewable heat and electricity via our CHP engines

to the business is circa £14m per annum and this is set to rise further as we move to treat all sludge produced through our Advanced Digestion assets. It's this benefit that drives down the unit cost of treatment with has a direct link to customer bills.

AW were an early adopter of advanced anaerobic digestion and CHP. The engines are all accredited under the Renewables Obligation (RO) scheme and quality for renewable obligations certificates for 20 years from the date of commissioning. The majority of engines in our fleet are accredited through to 2027 and beyond. The RO scheme is now closed to new entrants.

Environmental permitting regulations require biogas produced is used beneficially and sets strict limits on how much gas can be flared, failure to comply would result in prosecution for permit non compliance. An alternative to investing is improved gas clean-up equipment to comply with the new medium combustion plant directive (MCPD) would be to change strategy and invest in alternative means of energy recovery such as gas clean up and grid injection. However, this would require substantial capital investment of circa £80m across our 10 sites and whilst the technology qualifies for the renewable heat incentive (RHI) the tariff level is not guaranteed and is subject to change up to the point of commissioning. It is therefore our view that retaining CHP as our energy recovery option as best value for our customers.

This strategy is also consistent with our strategic direction statement and supports our plans to increase renewable electricity generation and our long term plan for carbon neutrality by 2050.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

As stated above we considered a range of options. For example, we carried out a trial to replace diesel with HVO biodiesel (Hydrotreated Vegetable Oil) in our generators. This demonstrated that we would not be able to achieve the emission reductions required by MCPD. Other fuels (such as natural gas) and other technologies (for example energy storage) were also rejected due to cost and/or their inability to provide the necessary service and resilience. Consideration was given to electricity storage options but the business case for this is yet to be proven.

Our existing strategy centres around anaerobic digestion with CHP and we are legally obliged to recover and use the biogas produced under the site Environmental Regulations Permit (EPR). We are therefore limited in options that we have without wholesale strategy change for our Bioresources activities. Alternative means of energy recovery such as gas clean up and grid injection are available, however a change in strategy at this time does not provide the best value for our customers. Our preffered option ensures we have sufficient installed capacity to treat our raw sludge whilst being open to opportunities for trading with WASCs and other third parties.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term. Failure to invest to ensure requirements of MCPD can be achieved would result in EPR permit non-compliance and probable prosecution. Thus, without emissions control the use of our CHPs and diesel generators will be severely constrained. In the short-term we will be unable to secure contracts with the National Grid to help balance supply and demand on their transmission network and in the longer-term we will be unable to use all of our diesel generators to avoid peak electricity prices. Alternative options considered such as gas to grid require substantial capital investment with the risk that financial benefits resulting from the RHI are uncertain.

Has the impact on natural capital and the environment been considered?

This investment will improve the quality of emissions from our generators, potentially improving the natural capital of our region by reducing our carbon footprint and mitigating the impacts of climate change.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

The cost has been taken from suppliers who provide and install catalytic converters for diesel standby engines. These have been further validated by internal QA of our cost base team. The proposed interventions are the most cost effective currently available. Consideration was given to electricity storage options but the business case for this is yet to be proven.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. These costs have been reviewed by our external assurance providers (Jacobs).

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The MCPD is a statutory driver, linked to EU directive 2015/2193.

The expenditure is driven by the new MCPD legislation and is therefore outside management control. We have challenged and reviewed the requirements of the legislation and selected appropriate options to meet these.

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

In addition to basing our estimates on efficient costs drawn from our AMP6 performance, we have then applied further totex stretch efficiency and productivity challenges to those costs, as described in the Efficiency and Innovation chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

This is a legal requirement, failure to meet the new standard would mean that we would be unable to run our fleet of generators thus compromising quality an quantity of our product in the event of a power outage.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

For this investment, the protection consists of the following implications for non-delivery.

- Enforcement action for failure to comply with the directive.
- Reputational damage that could be reflected through C-MeX performance.

Affordability

Has the impact on affordability been considered?

The cost has been taken from suppliers who provide and install catalytic converters for diesel standby engines. These have been further validated by internal QA of our cost base team. The proposed interventions are the most cost effective currently available.

Key Assumptions

That the regulations in their current form do not change.

That the implementation of the new MCPD will result in tighter standards for our CHP engines and these will require significant investment in exhaust gas cleaning or engine upgrades in order to meet the standard.

That it is possible to retrofit SCR units to all of the existing generators.

Shallow Dive Business Cases

In the following section we have included for completeness our enhancement business cases that were subject to a shallow dive by Ofwat for IAP. If further evidence is required there are comments included at the start of each enhancement business case.

In this section we do not comment on the enhancement modeling approach, as response and comments are detailed in Chapter 5 of IAP Response

Phosphorus Removal at Water Recycling Centres

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the

- WINEP/NEP Nutrients (phosphorous removal at activated sludge and filter bed STWs model review
- WINEP/NEP Investigations (wastewater) model review
- WINEP/NEP National phosporus removal technology investigations model review

in Chapter 5 of our main IAP Response for our comment on the IAP assessment of costs.

Price Control(s)	Wastewater Network plus
Business Plan table and line(s)	Table: WWS2 Lines: A14, A18, A19, B61, B65, B66

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A14	0.160	0.000	0.000	0.000	0.000	0.160
	A18	2.718	8.706	25.305	57.569	27.089	121.387
	A19	5.004	35.584	96.518	119.470	36.219	292.795
							Capex: 414.343
Opex (£m)	B61	0.000	0.000	0.000	0.000	0.000	0.000
	B65	1.220	1.975	2.419	2.821	4.572	13.007
	B66	1.418	2.164	4.092	6.920	8.822	23.416
							Opex: 36.423

AMP7 carry over costs: £34.527m	Whole life benefit (EAB)*: £24.350m
Whole life value (EAV)*: £-22.256m	Whole life cost (EAC)*: £46.606m

* Note: Annualised values over 40 years

Investment Summary

All of the investments in this enhancement case relate to the removal of phosphorus from treated effluent being returned to the environment from our Water Recycling Centres (WRCs). We will invest in the following programmes.

- 160 new or upgraded phosphorus removal plants at WRCs under the Good Ecological Status obligation (coded to lines 18 and 19).
  - 126 Phosphorus removal plants using chemical or physical treatment solutions
  - 34 investigations into Natural Capital solutions.
- Four Common Standard Monitoring Guidance (CSMG) Investigations into phosphorus (coded to line 14).
- Three new or upgraded phosphorus removal plants at WRCs under the UWWTD p.e. obligation (coded to lines 18 and 19 depending on whether the existing treatment at the site is trickling filters or activated sludge).
- 18 phosphorus removal investments under the No Deterioration obligation (coded to lines 18 and 19).
- One investment to reduce phosphorus at a Site of Special Scientific Interest (SSSI) obligation (coded to line 19).

Following consultation with the EA and Ofwat and confirmation of our approach to WINEP phasing in a letter from the 11th July 2018, we have allowed in AMP7 for 15 natural capital solution projects within programme to be carried over for early delivery in AMP8.

Investment under these obligations has previously been required in AMP2 to AMP6. Previous programmes have been considerably smaller than the AMP7 plan. For example, in AMP5 we completed 29 phosphorus removal schemes. In AMP6 we are currently completing 44 phosphorus removal projects across our sites.

Need for Investment

What incremental improvement would the proposal deliver?

The proposal will deliver improvements to the quality of water in the rivers to which the WRCs discharge.

Is there persuasive evidence that an investment is required?

This investment is driven by our obligation to comply with the WINEP. This investment is driven by legislation. We have challenged the EA on the timing of this investment. We have adopted a number of Natural capital (low carbon) solutions to address the need which has reduced the costs.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

In our Strategic Direction Statement published in 2107 one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'.

This expenditure is enhancement (rather than base) as it is to deliver higher standards of river water quality.

What does the expenditure enhance?

This investment will lead to an incremental improvement of ecological status of inland water bodies at these locations, contributing to improving the natural capital of our region. It will also increase production of the Nutri-bio product from our sludge treatment centres helping to reduce demand for finite mineral phosphate fertilisers from agriculture in our region.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our customer engagement has shown that 83% of customers consider a flourishing environment is important to them and that they are willing to pay for environmental performance (p187). 66.7% of customers across the whole customer base strongly agreed that it was important to improve rivers and coastal waters (p196).

Stated Preference studies found significant willingness to pay for improving environmental performance across the Anglian Water region among both household and non household customers. Acceptability research also indicates that protecting the water environment (e.g. rivers, wetlands, and coastal waters) is a reasonably high priority for customers (mentioned as one of three top priorities for the company by 53% of participants). *Anglian Water Customer Research and Engagement Synthesis Report. Annex 12c.*

On service levels our main stage study as part of our Customer Engagement Process looked at improvement and deterioration of RWQ for current performance. They found the majority of Household (HH) respondents would like to see performance maintained (55%) whilst the majority of Non HH (NHH) respondents wanted performance to improve (48%) (*PR19 Main Stage Willingness to Pay Study,* Eftec Economics for the Environment & ICS consulting, pages 43 and 55.)

Working with our online community we have explored the principle of using natural capital approaches as part of our water recycling strategy. Support was positive as customers saw this approach as innovative and a less aggressive alternative to hard engineering. Benefits were seen to be more wide ranging than traditional solutions creating a win-win in terms of cost, compliance and environmental impact.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Wetlands were also seen as providing visible assets which could provide habitats and wider environmental benefits by encouraging natural biodiversity such as increased bird populations, which in turn consume insects and should then result in local farmers needing to use less pesticides. The potential for use as visitor and educational attractions was also highlighted. Customers also recognised the opportunities for collaborative working with external groups such as Rivers Trusts.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

In response to these findings we are developing a Natural Capital ODI. Engagement with customers tested whether customers understood this performance commitment and whether our performance commitment level was stretching. 92% of customers understood our definition and 63% agreed the performance commitment level was stretching. 90% of customers considered this performance commitment to be of medium or high importance.

Our proposal is to develop a strategy alongside our PR19 business plan and between 2020 and 2025 report on the implementation of that strategy, along with our performance on a number of indicators of natural capital and our wider contribution to natural capital in the region.

A 'Risk, Opportunities and Value' (RoV) process with investment alternatives created to achieve compliance with directives using least options has been used to arrive at appropriate solutions to WINEP obligations.

Where the WINEP required more than one investment for phosphorus at the same site under separate drivers, we have only included investment for the tighter standard to avoid duplication.

For the removal of phosphorus we have used the data from the UKWIR industry phosphorus removal trials completed in AMP6 which compared different technologies and assessed them both in terms of cost and performance. We have selected the best value option from these technologies that was reliably able to achieve the required standard during the trials, depending on the new consent requirements from the EA for the site. These include for consents:

- >1 mg/l - we have used wetland-based systems, chemical dosing and optimisation of existing assets
- between 0.5 mg/l and 1mg/l - we have used chemical dosing and/or a Dynasand unit depending on the existing treatment at the site
- between 0.35 mg/l and 0.5 mg/l - we have based our costs on a Dynasand unit
- <0.35 mg/l - we have based our costs on a Mecana unit.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

For sites with consents over 1 mg/l we are exploring opportunities to use Natural Capital techniques which should provide wider benefits to the environment. We commissioned a study by CAPCAN into phosphorus removal using natural free surface water wetland-based systems, industry experts in this field. CAPCAN's findings were that:

1. Discharge levels of 1-1.5mg/l can be achieved through nature-based systems

2. Such levels are best delivered by catchment partnership approaches working together with communities and regulators
3. Nature-based systems take time to establish and can be less resilient to extremes of temperature and flow, and therefore may be best delivered in conjunction with flexible permitting approaches.

Has the impact on natural capital and the environment been considered?

Delivering solutions using Natural Capital approaches may take longer than traditional solutions; we requested that Natural England, the Environment Agency and Ofwat support the phasing of some WINEP obligations over AMP7 and AMP8 to facilitate this approach. It was confirmed in a joint letter from these organisations in the 11th July that this was accepted subject to conditions.

The UKWIR P trial describes other technologies that can be used. We assessed each of these and concluded that the above technologies presented the best whole life value for the relevant consent range with reliable performance.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Given the scale of phosphorus required by the EA in AMP7, we have been trialing new and innovative solutions in pursuit of efficiency savings. For instance, we have been trialing certain new bespoke elements provided by Mecana. Where possible, our costs are estimated from our well populated cost models using our latest unit costs from previous delivery. This means the costs presented for this investment include the cumulative efficiencies already achieved up to this point, as described in the Efficiency & Innovation chapter of our Plan. Where previously proven costs are not available because we are trialing new innovative approaches - for instance the bespoke Mecana elements that have been used during our phosphorus trial - we have used the asset cost data available from the phosphorus trial.

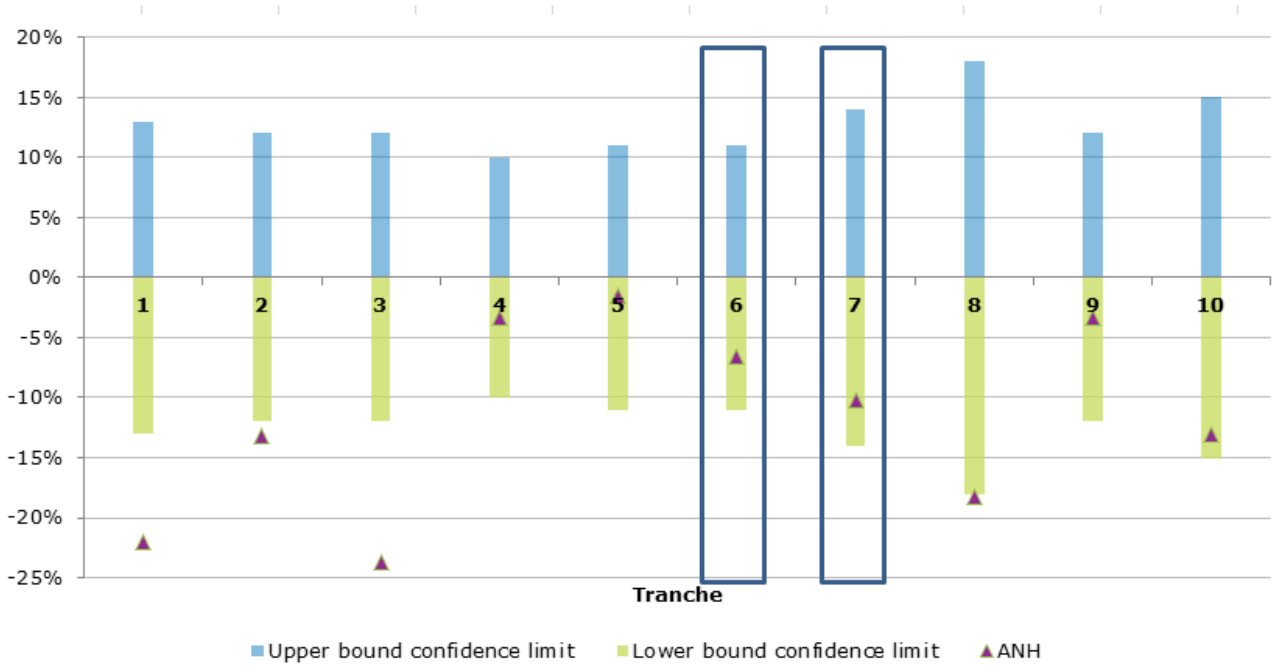
For the phosphorus dosing we have continually driven down the cost through modular design and build. This has also reduced the embodied carbon as illustrated in the case study below.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models.

Our costs have been externally reviewed and benchmarked by Mott MacDonald against other water companies' prices for PR19, and have been shown to be efficient.

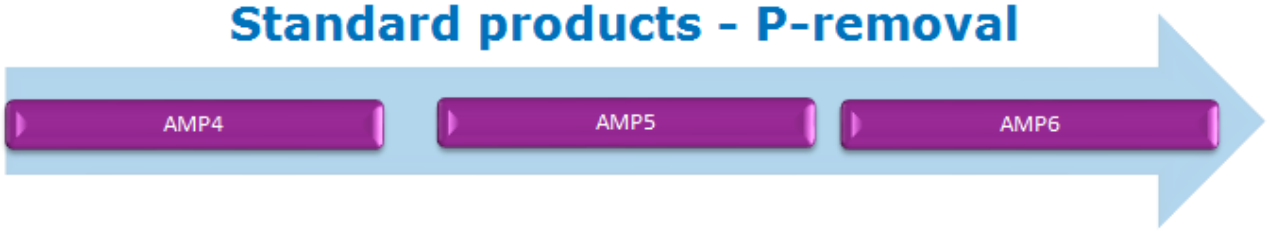
Programme	Tranche ref	Enhancement business case reference	AW Cost (£m)	Industry Average (£m)	Delta between AW & Industry (%)	Confidence range
WFD GES improvements	6	Phosphorus removal	68.5	73.4	-7%	+/-11%
WRC WFD	7	Phosphorus removal (87%) / No Deterioration (13%)	18.6	20.7	-10%	+/-14%



We have further included for Natural Capital solutions (low carbon) in our plan reducing this cost of delivery further. Full details of their work are set out in the *Efficiency and Innovation* chapter of our Plan.

We have continually driven down the cost of delivering P-removal schemes over the last two AMPs which is illustrated in the following figure.

Standard products - P-removal



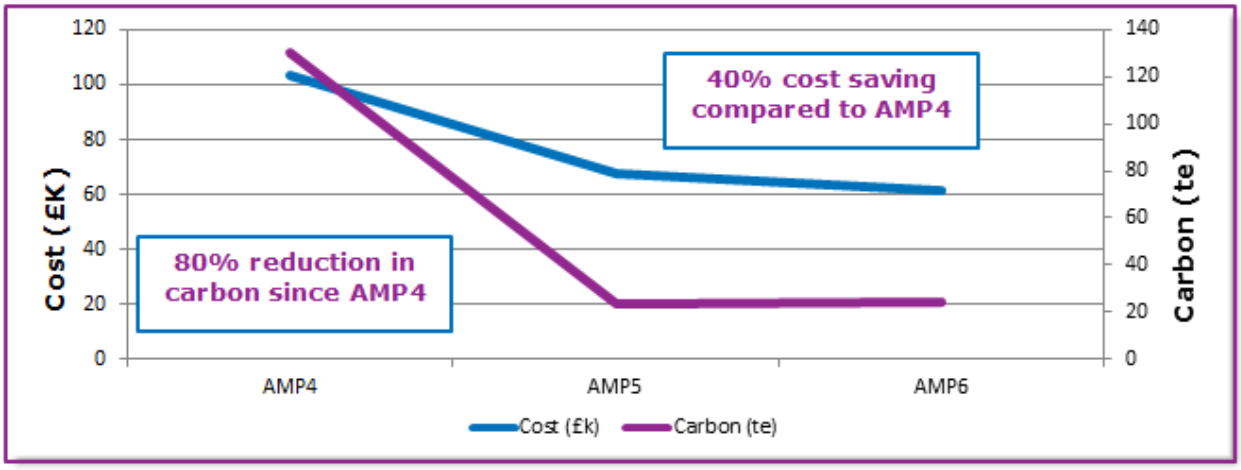
The AMP4 design had a category 1 tank (sometimes multiple tanks) and associated dosing equipment within a large kiosk requiring a large concrete slab to support it.

The AMP5 Standard product design has a single bunded tank arrangement with separate dosing kiosk. The product comes in 3 different tank sizes.

Built off site, moving away from traditional on-site construction significantly reducing construction programme.

The AMP6 standard product includes the following changes:

- Trim dose point to meet tighter consents (1mg/l P)
- Dual dosing lines removed.
- Updated controls.
- Change to comms. based signals, which reduces hard wiring and avoids needs to increase capacity of telemetry outstations.



Cost	£103.9k	£67.5k	£61.3k
Carbon	130te	23.7te	24te
Number delivered	27	39	34
Average time on site	4 weeks	3 weeks	3 weeks

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The need for the investment is driven by WINEP3 and is legal obligations. We have challenge the need with the Environment Agency (EA) which is described below.

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

During the WINEP consultation process with the Environment Agency we have been in constant contact with our regional EA team. During stage 1 and 2 of WINEP we were able to challenge the need for specific investments where we did not believe the environmental improvement was cost beneficial. Following the issue of WINEP we have also been in contact with Defra, the EA and Ofwat about phasing.

Through this process we have achieved a reduction in the enhancement expenditure on P removal by successfully proposing to use natural capital solutions at 34 sites, with 15 of those sites carrying over into AMP8. This demonstrates our commitment to keeping bills low and managing costs, at the same time as looking after the environment and choosing low-carbon solutions.

Beyond this, we have also applied further totex stretch efficiency and productivity challenges, as described in the Efficiency and Innovation chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we do not. For this portfolio the protection consists of the following implications for non-delivery:

- Underperformance penalty payment Treatment Works Compliance performance commitment for failure to comply with consents.
- Enforcement action from the Environment Agency for failure to meet revised effluent consents and to deliver an obligation
- Customer complaints potentially to CC Water
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7, for the first time we will introduce a new WINEP performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

This expenditure is part of a legal obligation. We have challenged the need with the Environment Agency and had the costs validated. Through discussions with the EA we have reduced the scale of the programme making it more affordable to customers.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

We have challenged the need for this investment and identified the customer bill impacts for the WINEP programme. The WINEP programme is over double the scale of expenditure compared to AMP6.

Key Assumptions

This assumes that no new drivers or sites are added to the WINEP3 requirements following PR19. We are also testing with the supply chain their capacity to supply iron salts in the quantities required to achieve these new standards across all sites. Our suppliers will have to increase production significantly.

New Development and Growth

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the new developments, new connections, growth at sewage treatment works and reducing sewer flooding risk (wastewater growth model) review in Chapter 5 of our main IAP Response for our comment on the IAP assessment of costs.

Price Control(s)	Wastewater Network plus
Business Plan table and line(s)	Table: WWS2 Lines: A25, B72

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A25	37.501	46.412	45.342	55.516	76.153	**Capex: 260.924**
Opex (£m)	B72	0.001	0.016	0.029	0.058	0.137	**Opex: 0.242**
AMP7 carry over costs: £58.591m					Whole life benefit (EAB)*: £60.961m		
Whole life value (EAV)*: £46.854m					Whole life cost (EAC)*: £14.107m		

* Note: Annualised values over 40 years

Investment Summary

The investment in this enhancement case is to ensure that we are planning to meet the growth requirements of 200,000 new homes in the region through the following approaches.

- New strategic trunk sewers at 2 locations (Norwich and Huntingdon).
- Capacity enhancements at multiple locations informed by live local forecasts.
- Lead best practice with developers wishing to lay their own on-site sewers.
- An innovative new programme of permanent flow monitoring in the catchment at over 500 strategic locations including over 200 development sites, coupled with near real time modelling of flood risk.
- Investigations and improvements to CSOs that have been affected by growth.
- Increases in the capacity of our existing rural vacuum systems installed as part of our historical Section 101a programme.

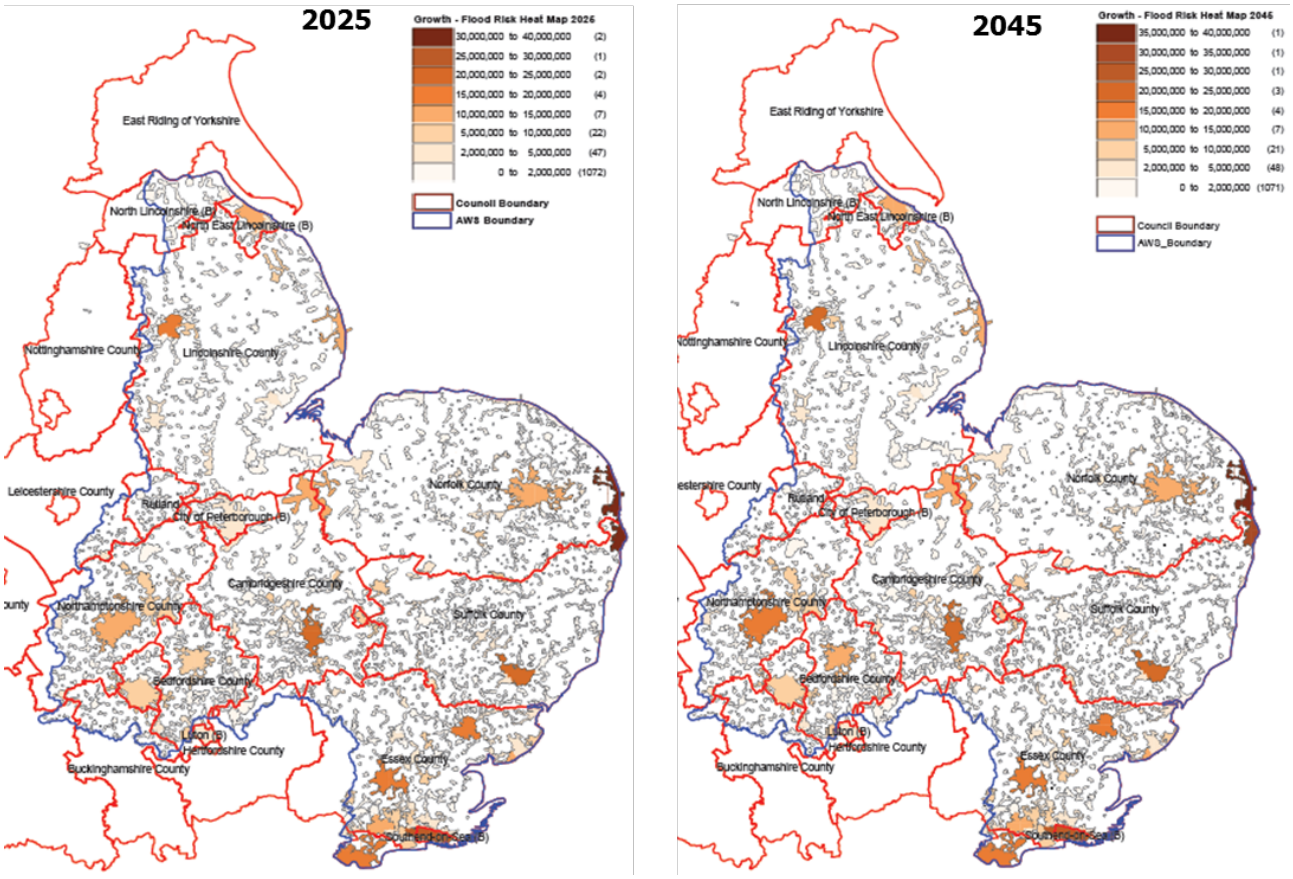
Need for Investment

Is there persuasive evidence that an investment is required?

We have general duties under the Water Industries Act 1991(Section 94) to provide, improve and extend a system of public sewers to ensure an area is effectually drained. Under Section 106 of the Act, properties have a right to connect to our sewerage network. We have based our estimates of growth on Local Authority forecasts and expect more than 200,000 properties to connect to our sewerage network in AMP7 (Table WWS3, lines 1 and 2).

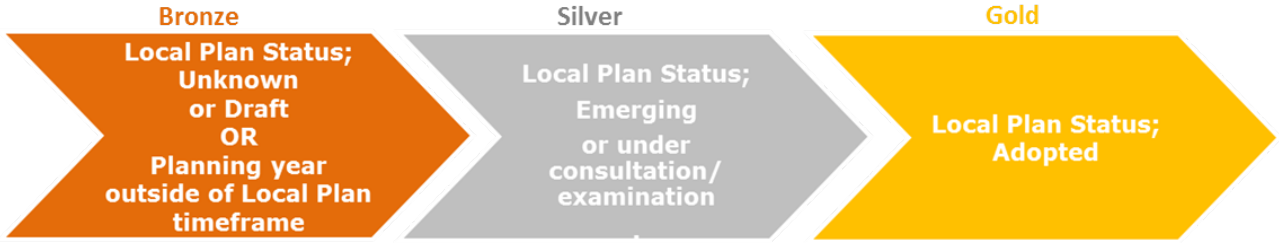
We have a duty under the Water Industry Act 1991 to serve new customers without causing detriment to the environment. This duty covers the provision of new sewers, adoption of sewers and connection of sewers to our existing network. This investment focuses on our provision of new sewers: foul, surface water and Sustainable Drainage Systems (SuDS). The flood risk heat maps below show the impact of growth on catchments in our region under a 'do nothing' scenario.

Figure 12 Flood risk heat maps



Our growth strategies have been driven from a spatially mapped Growth Forecast Model which uses housing forecasts from Local Authorities and considers trade, holiday population and demand management measures, such as a declining per capita consumption, all aligned with our Water Resources Management Plan. Due to the large number of discrete sewer catchments we serve, changes to growth site locations have significant impacts on the solutions we consider.

We have also undertaken additional analysis to ensure our plans are tailored to need and we have rated our confidence in the demand forecasts at catchment level across a number of AMPs, based on the Local Authority Local Plan status. Our confidence is rated from Bronze, to Silver to Gold, in increasing order of confidence.



Prior to AMP6, growth in housing numbers had been lower than expected due to economic and market conditions. We reflected this in the numbers provided in our business plan at PR14. We anticipated 18,000 new houses in year 1 rising to 25,000 new houses in Year 5. However,this pattern of lower-thn-expected growth has changed. Between April 2015 and March 2018, we have had 66,171 actual connections compared to a forecast of circa 60,000 new houses.

We are forecasting around 200,000 new houses in AMP7 based on Local Authority forecasts. The higher forecast reflects the drive from the Government to build more homes in our region. There are five elements that drive this higher number.

1. Local plans: Each Planning Authority is expected to have a Local Plan in place by the start of AMP7. Government will intervene if Planning Authorities fail in this.
2. National Planning Policy Framework: This sets out that Planning Authorities must deal with planning applications with a presumption to grant planning permission for sustainable developments. Where planning is not granted then appeals are becoming more common and more often successful.
3. Stalled Sites: Large developments sites have a high start-up cost. These are the sites most likely to provide long-term deliverable housing. The government have created a £2.3bn Housing Infrastructure Fund which is aimed at large sites that stalled owing to high start-up costs. A significant number of these sites are in the Anglian Water region.
4. Increased Build Rate: Government plans are targeting increased build rates on larger sites, using technology such as offsite manufacture. Other measures include diversifying the housing market through encouraging SME builders.
5. Oxford to Cambridge Corridor: This growth area covers Cambridgeshire, Bedfordshire, Buckinghamshire and Oxfordshire. The plans for the corridor will make it a development location of national significance and the area is predominately in Anglian Water's area.

The five key points above are designed to support Government plans to increase the supply of new homes to meet needs. This aligns with our Strategic Direction Statement ambition of facilitating sustainable growth, which was supported by customers.

What incremental improvement would the proposal deliver?

We have led the industry in developing our first Water Recycling Long Term Plan (WRLTP) to provide transparency as to how we plan to manage the supply of water recycling services to meet the demands of our growing customer base, urban creep and climate change over the next twenty five years. Our plan promotes sustainable solutions for maintaining reliable and affordable levels of service, facilitates working in partnership to mitigate flood risk and will ensure there is no detriment in our sewerage network as a result of growth.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Customers have told us that protecting the environment is important to them, and in the consultation on our outline plan in April and May 2018, 72% of participants in our 'Be the Boss' digital engagement tool voted for high investment for protecting the environment. Although delivering a flourishing environment was ranked sixth out of the ten outcomes, 83% of customers thought it was important in the acceptability research on our SDS in 2017 . And there is evidence, including that from our Community Perception research that this is increasing in importance to our customers, and is a key measure for how their perceive our actions within the community.

In particular, we have seen an increased importance attached to preventing pollution, which is the most engaging content theme in social and digital media content (page 213) and a higher willingness to pay to prevent pollution incidents occurring (page 215) and was a top ranking issue for water recycling services in the acceptability research (page 223).

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) because it enhances the capacity of our wastewater network in order to meet the demand of new development and growth in the region in AMP7. This aligns with our Strategic Direction Statement published in 2017 as one of our four long term ambitions is to 'enable sustainable economic and housing growth in the UK's fastest growing region'.

What does the expenditure enhance?

The expenditure enhances our asset base and enables us to meet the growth demands in our catchments by the construction of strategic trunk sewers, permanent flow monitoring and CSO improvements as well as increasing the capacity of our existing rural vacuum systems.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Our proposal meets the needs of the housing growth forecasts in the region. Customers acknowledge that the combination of increasing demand and decreasing supply creates challenges. 'Supply Meets Demand' is regarded as one of the most important of the company's ten outcomes. Customers are very concerned about population growth and new development; enabling sustainable growth is generally seen as the second most important of the company's four long-term goals. Customers therefore want the company to plan ahead, influencing the planning system and work in partnership with developers.

Research suggests that problems with the sewerage service are infrequent, in particular for household customers. Satisfaction with the sewerage service appears to be slightly lower than for the water service. However, it is still high and data shows it is increasing. Therefore thinking ahead to minimise disruption to customers' lives is a key goal and this is supported by our Willingness to Pay survey, in which customers have a strong preference to avoiding deteriorating service levels.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

We are confident that the proposed investment represents the best value for customers. As described in more detail in the 'Robustness & Efficiency of Costs' section, we have used a three tiered approach aligned with the UK Waste Water Supply Demand Framework (UKWIR, 2014) to identify an investment that is robust, efficient and offers the best value for customers. Our catchments have been prioritised according to risk using our InfoNet asset management tool and a number of possible solutions identified for each catchment using Infoworks ICM hydraulic modelling, which were then subject to a cost benefit analysis process. Monitoring key indicators for growth (such as flow and growth intelligence) will enable us to continuously deliver solutions at the optimal time throughout the AMP for maximum efficiency. This will ensure maximum long term value for customers.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

We have undertaken extensive hydraulic modelling to understand the spatial and temporal risk of any detriment that would occur in the system. This has allowed us to understand the risks. In most instances we have used SUDs (natural Capital - Low Carbon) solutions to create capacity in the system. We have then layered on sewer upgrades and flow attenuation schemes when these become impracticable.

We will monitor flow as an indicator of growth at certain 'trigger' points within the each catchment. This information will feed into live modelling to enable us to review the risk, and reprioritise investment where required as part of an adaptive strategy to manage growth uncertainty.

Has the impact on natural capital and the environment been considered?

We have ambitious targets for removing and managing surface water in our drainage network, so, for the first time, we have explored SUDS opportunities to provide capacity for growth in a more sustainable manner, as well as traditional upsizing or hybrid solutions. We have considered growth intervention options with and without climate change and to a shorter and longer term design horizon for each catchment. The most cost beneficial option was selected in each case.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Wherever possible, costs have been estimated based upon the most recent unit costs available in our well populated cost library. Thus, the efficiencies that are embedded in these costs as a result of innovation over previous years and AMPs are included in our proposed investment.

We have a duty under the Water Industry Act to serve new customers, without causing detriment to the environment. To arrive at our estimated costs, we have used a robust and high-tech approach. Initially, all of our 1000+ catchments were screened via our InfoNet asset management tool to identify up-sizing requirements from the nearest potential connection point. The results were considered alongside predictive detriment analysis to identify the highest risk catchments. A detailed review of the growth data was then completed in the promoted catchments to improve confidence. This used known appetite for development and review of the specific connection locations for the growth into the existing sewer network. The InfoNet tool was then re-run for these priority catchments using the revised data, promoting those at highest risk to the final stage of a hydraulic modelling assessment. For the final assessment, we used Infoworks ICM hydraulic modelling to consider a strategic approach to catchment growth, assessing future growth scenarios (with and without climate change) against the existing sewer networks. This provides greater confidence in the capacity deficit alongside a range of modelled solutions.

Finally, we have also applied further totex stretch efficiency and productivity challenges, as described in Chapter 10 *Efficiency and Innovation*.

Monitoring key indicators for growth (such as flow and growth intelligence) will enable us to continuously deliver solutions at the optimal time for maximum efficiency. As we promote investment in growth strategies, we will also strive to integrate solutions with existing flood risk and maintenance requirements within the catchment to gain further delivery efficiencies and reduce impact of construction on our customers.

Where possible, we will deliver any built solutions using a modular approach with a focus on logistics and assembly rather than design and construction. This approach will allow greater quality as the individual components can be constructed in a less challenging environment, in addition to reduced carbon, reduced time on site and so minimised disruption to customers, and reduced cost.

Is there high quality third party assurance for the robustness of the cost estimates?

The solutions and approach have been reviewed by our external assurers. The costs and solutions have been reviewed by our independent Totex Estimation team.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

We have a duty under the Water Industry Act 1991 to serve new customers without causing detriment to the environment. This duty covers the provision of new sewers, adoption of sewers and connection of sewers to our existing network. This investment focuses on our provision of new sewers: foul, surface water and Sustainable Drainage Systems (SuDS).

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

We have controlled costs by using a three tiered approach (aligned with the UK Waste Water Supply Demand Framework) involving our InfoNet asset management tool to prioritise the catchments most in need of investment. Once identified, Infoworks ICM hydraulic modelling provided up to eight solution options per catchment, ranging from targeted surface water removal supplemented by localised storage, to wider scale upgrade of existing sewerage infrastructure.

Cost benefit analysis has also been used to identify the best value option. Only the two lowest cost solution options were taken forward for full assessments of benefits, including natural capital assessment of SuDS. Following this, the solution of greatest cost benefit is promoted for investment in AMP7.

In addition to basing our estimates on efficient costs drawn from our AMP6 performance, we have then applied further totex stretch efficiency and productivity challenges to those costs, as described in the Efficiency and Innovation chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

For this investment, the protection consists of the following implications for non-delivery.

- Potential enforcement action from Ofwat for failure to provide new water networks to meet the demand of new developments, our duty under the Water Industry Act.
- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through D-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Customers are protected through the D-mex mechanism where companies are monitored against actual and growth forecasts.

Affordability

Has the impact on affordability been considered?

The timing of investments involves trade-offs in cost and risk between current and future customers. We must reconcile the need to keep bills affordable with the need to plan for future challenges. While we believe our growth forecasts are robust, they can be dependent on macro-economic factors so our long term strategies are adaptive to change and respond to the key indicators we monitor. We have selected the most cost beneficial option and have phased investment across AMP7 and AMP8 where possible. Monitoring key indicators for growth (such as flow and growth intelligence) will enable us to deliver solutions at the optimal time. The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The costs of this investment are offset by the additional revenue we expect to generate from new customers.

Key Assumptions

Housing need and supply targets have been obtained from Local Planning Authorities. We are required to use this source of data for our WRMP and it is the best option for obtaining a robust housing forecast for AMP7.

Assumptions within our capacity assessment tools used during the Bronze, Silver, Gold deficit assessment process.

Growth at Water Recycling Centres

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the new developments, new connections, growth at sewage treatment works and reducing sewer flooding risk (wastewater growth model) review in Chapter 5 of our main IAP Response for our comment on the IAP assessment of costs.

Price Control(s)	Wastewater Network plus
Business Plan table and line(s)	Table: WWS2 Lines: A26, B73

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A26	10.137	46.147	33.509	53.823	20.206	**Capex: 163.823**
Opex (£m)	B73	0.608	1.073	1.719	2.617	3.727	**Opex: 9.743**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £13.480m		
Whole life value (EAV)*: £0.210m					Whole life cost (EAC)*: £13.270m		

* Note: Annualised values over 40 years

Investment Summary

To meet the demands of growth in our region we have identified that the following activities are required.

- Increase in biological process capacity at 29 WRCs.
- Address future expected dry weather flow (DWF) non-compliance through reducing flows or applying for a new DWF at 17 WRCs.
- Investigate the impact of urban creep at 6 WRCs.
- Install flow monitors at 8 WRCs where growth is thought to bring flows >50 m^3/d.
- Provide upgrades at WRCs to treat four emerging new garden towns.

These investments have been developed from understanding the confidence in the need coupled with a modular build to meet the growth demands. Where appropriate, we have considered the existing capacity deficit. A hierarchy of solutions was considered and the most cost beneficial selected.

Each solution was selected following a detailed catchment-level review. For sites requiring an increase in biological process capacity (where optimisation was not possible) it is often more cost beneficial to go for a shorter design horizon and a modular solution. For sites requiring new DWF, options to remove surface water through sewer relining were considered against the possibility of meeting a new DWF, which may or may not require process unit extensions.

Need for Investment

What incremental improvement would the proposal deliver?

We have general duties under the Water Industry Act 1991(Section 94) to provide, improve and extend a system of public sewers to ensure an area is effectually drained. Under Section 106 of the Act, properties have a right to connect to our sewerage network. We expect more than 200,000 properties to connect to our sewerage network in AMP7 (Table WWS3, lines 1 and 2).

The investment proposed here will meet demand for increasing connections and manage the impact on the environment.

Is there persuasive evidence that an investment is required?

Our overall approach to assessing the need for future investment is set out in our Water Recycling Long Term Plan and Chapter 8 *Flourishing Environment*.

The capacity of our WRCs (that is, the population they can serve) is limited by two factors: their hydraulic capacity (measured by their Dry Weather Flow, DWF) and their biological capacity. We have assessed all of our WRCs to understand their capability to meet the future population growth. Growth is forecast to continue in our region at a higher than average rate, with a predicted population increase of 1.1% per year during AMP7. This equates to an additional population of almost 430,000 during AMP7 and around 200,000 new homes. Our WRCs in catchments where significant growth is occurring are rapidly running out of biological capacity or headroom in the Dry Weather Flow aspect of their permits

We are exploring alternatives to increasing capacity at our WRCs, including liaising with our external flood risk management partners to seek mutually beneficial integrated solutions for surface water removal. However, investment is still required.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

We have engaged with customers on our ambition to enable sustainable growth in our region and on our asset health measures and performance commitments. This is set out in Chapter 12 *Customer Engagement*, Chapter 13 *Performance Commitments* and their annexes.

Stakeholders with an interest in enabling growth include developers (including self-lay), local authorities and other statutory bodies and other infrastructure providers, as well as our wider customer base.

At the earliest stages of development and infrastructure planning, we engage with partners including developers, local authorities, Internal Drainage Boards, Highways teams and the Environment Agency.

We have engaged with customers on our ambition to enable sustainable growth in our region and on our asset health measures and performance commitments. This is set out in Chapter 12 *Customer Engagement*, Chapter 13 *Performance Commitments* and their annexes.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

We consider this expenditure to be enhancement because it increases our capacity to recycle wastewater and return it to the environment, to meet the needs of growth. This expenditure will do this by providing upgrades, increasing flow monitoring, reducing flows and increasing biological process capacity at our water recycling centres.

What does the expenditure enhance?

This enhancement expenditure will help to ensure we are delivering against our 'Flourishing environment' outcome by building the capacity in our assets to meet our future growth needs. In doing so this will help us to meet the long-term ambition set out in our Strategic Direction Statement to enable sustainable economic and housing growth in our region.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

We have engaged with customers on our long term ambition to enable sustainable economic and housing growth, on our *Flourishing Environment* outcome and on our asset health measures. Population growth and change is an issue that many customers are particularly concerned about, both in terms of the impact this has on the appearance and feel of their local area, and in terms of the pressures it puts on local services. *Enabling sustainable economic and housing growth* was ranked second of our four long term ambitions. More detail is given in Chapter 5, Chapter 12 and supporting annexes, as well as the report from our Customer Engagement Forum.

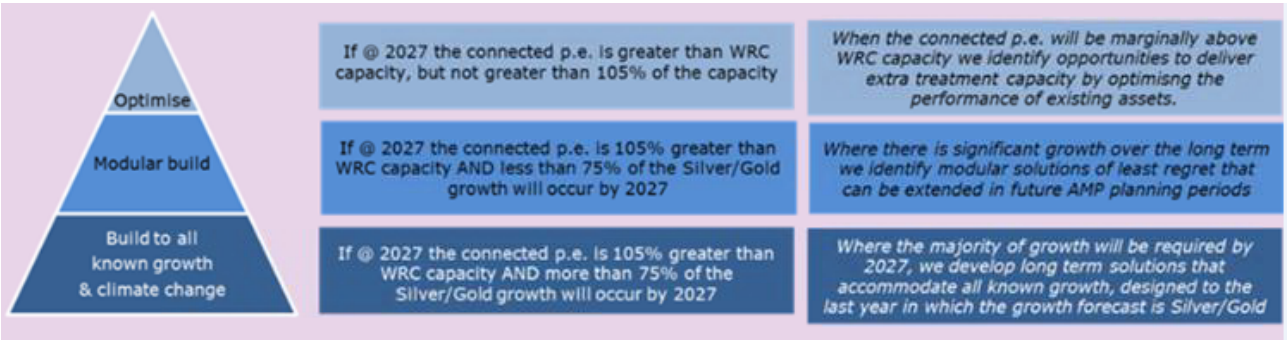
Did the company consider an appropriate range of options with a robust cost-benefit analysis before concluding that the proposed option should be pursued?

We have considered a hierarchy of solutions and improved monitoring to enable an adaptive delivery programme that will flex according to external drivers.

Figure 13 Solution hierarchy

SOLUTION STRATEGY HIERARCHY Sewer Catchment	SOLUTION STRATEGY HIERARCHY Water Recycling Centres
Investigate, monitor and model impacts of catchment key indicators – flow & growth intelligence	Investigate, monitor and model WRC key indicators – incoming flow & load, final effluent flow & quality, & growth intelligence
Partnership – Surface Water Management	Demand Management: reduce catchment flows (surface water, misconnections and infiltration) in partnership
AW only – Surface Water Management	Demand management: reduce catchment flows (surface water, misconnections and infiltration)
Optimise existing assets in catchment e.g. real time control of Pumping Stations	Optimise existing assets at WRC
Relining – address infiltration	Extend process units (flow) – existing permit
Disconnection – address misconnections	Extend process units (load) – existing permit
Extend existing	Extend process units (flow) – new permit
Reroute existing	Extend process units (load) – new permit
Storage	Convert WRC to PS
Address intermittent discharges	Create 'Super' WRCs (new or existing), close small WRCs
New strategic sewer	New or relocated WRC

Figure 14 Solution design horizons



Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Our approach to assessing the need for investment and finding best value solutions is set out in Chapter 10 *Efficiency and innovation.* Customers acknowledge that the combination of increasing demand and decreasing supply creates challenges. Supply Meets Demand is regarded as one of the most important of the company's ten outcomes. Customers are very concerned about population growth and new development; enabling sustainable growth is seen as one of our most important long-term goals. Customers therefore want us to plan ahead, influence the planning system and work in partnership with developers and local authorities.

Problems with the sewerage service are infrequent, particularly for household customers. Satisfaction with water recycling service appears to be slightly lower than for the water service but it remains high and increasing. Thinking ahead to minimise disruption to customers' lives is therefore a key goal and this is supported by our Willingness to Pay survey in which customers have a shown a strong preference to avoiding deteriorating service levels.

Stakeholders suggested that we assess plans for our WRCs on a case by case basis, rather than investing in ensuring that all population centres of a certain size have a second treatment works. This aligns with our approach to managing growth that impacts our WRCs.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Project risks have been assessed through a Risk, Opportunity, Value (ROV) process as part of standard business operation practices. Our Solution hierarchy shows that we implement flexible and 'no build' solutions first.

Has the impact on natural capital and the environment been considered?

All of our approaches include low cost carbon solutions that have been developed and deployed during AMP6. These embedded efficiencies are included within our solution costs.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Our approach to assessing the need for investment and finding best value solutions is set out in Chapter 10 *Efficiency and innovation*.

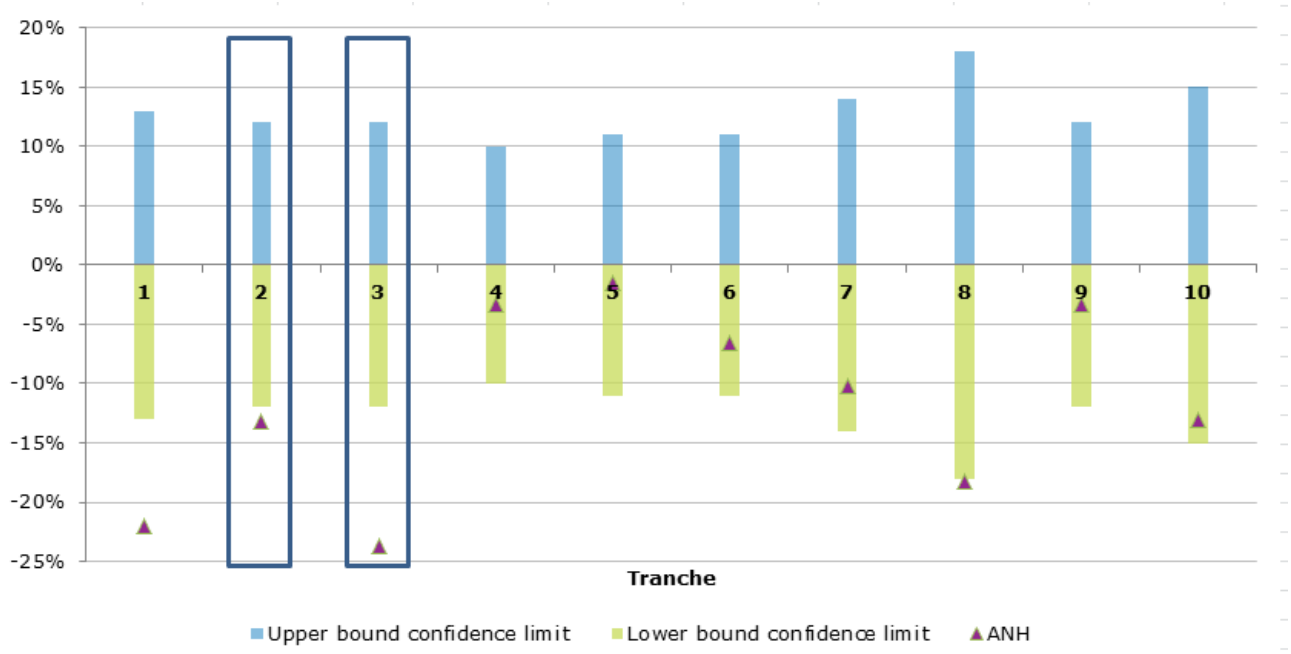
All costs have been derived using our cost estimation system. The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan. In addition, each alternative has been through a quality assurance process.

Wherever possible we are trying to move away from a 'design and construct' mentality towards a 'logistics and assembly' approach, when built solutions are required. By designing once and building many it is possible to greatly increase productivity and efficiency whilst reducing embodied carbon and time on site, therefore reducing cost. Further cost efficiencies from this approach are possible from the reduced costs of design, commissioning (and decommissioning) and procurement. New approaches such as this help to ensure that future growth in our region is affordable in the future.

Is there high quality third party assurance for the robustness of the cost estimates?

Our costs have been externally reviewed and benchmarked by Mott MacDonald against other water companies' costs for PR19, and have been shown to be efficient.

Programme	Tranche ref	Enhancement business case reference	AW Cost (£m)	Industry Average (£m)	Delta between AW & Industry (%)	Confidence range
WRC capacity enhancement	2	Growth at Water Recycling Centres	34.2	39.3	-13%	+/-12%
WRC DWF programme	3	Growth at Water Recycling Centres	28.0	36.7	-24%	+/-12%



Full details of their work are set out in Chapter 10 *Efficiency and innovation*.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

We have general duties under the Water Industry Act 1991(Section 94) to provide, improve and extend a system of public sewers to ensure an area is effectually drained. Under Section 106 of the Act, properties have a right to connect to our sewerage network. We expect more than 200,000 propertied to connect to our sewerage network in AMP7 (Table WWS3, lines 1 and 2).

This expenditure is ultimately driven by the rapid rate of housing and economic growth in our region which is expected to continue during AMP7 and beyond. This is expected to increase the volume of wastewater that we will need to recycle, treat and return to the environment.

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

By using local authority data, working directly with Local Authorities and developers we have taken a proactive approach to understand where growth will be delivered and when to focus investment. We have assessed the impact of growth on our wastewater treatment plants and only taken plants forward for review where growth could result in a detrimental impact.

We have also applied further totex stretch efficiency and productivity challenges, as described in the Efficiency and Innovation chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

The pace and exact location of housing growth is uncertain. The development of our long-term adaptive plan allows us to defer investment until we know where supply-demand deficits are going to manifest and which investment option will resolve the deficit most efficiently. The following sanctions apply if we fail to deliver the outcomes these investments support:

- ODI underperformance penalities for asset health, treatment works compliance, and pollution incidents if the necessary standards are not achieved.
- Potential increase in customer complaints direct or to Consumer Council for Water
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Reputational damage that could be reflected through C-MeX performance.

Customers are protected through the D-mex mechanism where companies monitored against actual and growth forecasts.

Affordability

Has the impact on affordability been considered?

The rate of economic and housing growth in our region means that the extra capacity at WRCs requires significant investment. Our solution hierarchy has helped us to identify the most cost-effective solution at each of our WRCs to ensure that we deliver capacity improvements which both help us to enable growth in our region whilst also providing long-term value for money for our customers.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The need for this investment is driven by growth and additional costs are offset by the additional customers served, this expenditure therefore has a minimal impact on bills.

Assumptions

Housing need and supply forecasts have been obtained from Local Planning Authorities. We are required to use this source of data for our WRMP and it is the best option for obtaining a robust housing forecast for AMP7.

Sewer Flooding

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the new developments, new connections, growth at sewage treatment works and reducing sewer flooding risk (wastewater growth model) review in Chapter 5 of our main IAP Response for our comment on the IAP assessment of costs.

Price Control(s)	Sewage collection
Business Plan table and line(s)	Table: WWS2 Lines: A30, B77

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A30	9.066	10.176	10.530	10.644	9.447	**Capex: 49.864**
Opex (£m)	B77	0.775	0.752	0.729	0.715	0.409	**Opex: 3.379**
AMP7 carry over costs: £0.000m						Whole life benefit (EAB)*: £20.226m	
Whole life value (EAV)*: £16.695m						Whole life cost (EAC)*: £3.531m	

* Note: Annualised values over 40 years

Investment Summary

Our AMP7 approach to flooding investment has been to develop a plan that promotes the use of sustainable, innovative solutions. We are proposing a suite of options:

- providing storage by up sizing our existing system
- increase investment in managing flows through property level protection (mitigation)
- commencement of the delivery of a multi AMP Surface Water Management Plan which takes a catchment and community level approach to addressing the root cause of sewer flooding by removing surface water flows from the foul network

We will also extend our partnership funding programme to address flood risk. This is covered in a separate enhancement case.

Need for Investment

What incremental improvement would the proposal deliver?

There are currently 1,667 properties known to be at risk of internal or high risk external flooding. Due to the low lying nature of our area, the Anglian region is becoming increasingly susceptible to the impacts of climate change. Flood risk is further exacerbated by forecast housing growth and urban creep.

Previously, investment has been targeted at reducing property level flood risk for properties at high risk of internal flooding resulting in removals from the DG5 register.

For AMP7, we are proposing investments with two main focusses:

- Continued investment in property level flood risk is required to ensure that our customers are protected
- targeted investment to divert surface water from entering sewers and increasing flood risk.

By diverting surface water that is connected to the sewer we reduce peak flow and therefore flooding risk. We consider this to be a longer term approach and when combined with other activities such as our existing "Keep-it-clear" blockage prevention programme, will have a significant impact on addressing flood risk.

Is there persuasive evidence that an investment is required?

Customers are supportive of our proposed AMP7 performance commitments for reducing the number of properties affected by internal and external sewer flooding. Full details of this are set out in our *Performance Commitments* chapter.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Our customers consider sewer flooding is a particularly serious (but rare) service failure. This has been a consistent finding in our qualitative and quantitative customer research.

As part of our valuation workstream, we have conducted an innovative study which determined the wellbeing impact of customers who had specifically experienced sewer flooding.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

What does the expenditure enhance?

This investment is considered to be enhancement (rather than base) as this will improve the service to customers who are currently at risk of flooding due to hydraulic overload of sewers and will increase the resilience of our wastewater services to extreme weather.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

From our seven water quality and customer satisfaction goals, 93% of customers said that zero pollutions and flooding was very important to them. A key aspect of this approach is increased engagement with our customers, their communities and other partners to develop catchment plans which enhance the communities we work in. An assessment of our customers' response to the surface water management (SWM) strategy found that they are excited by and engaged with our approach to reduce the risk of flooding through surface water management, particularly with regards to working in partnership to achieve this.

In the online community research focused on flooding, participants supported the idea of a progressive surface water management strategy. The focus on keeping water in one place felt efficient and less wasteful than relying on the system alone. Participants felt reassured that something was being done about this issue, and learning about it positioned Anglian Water as a company that is aware of long-term sustainability issues. There was support for the company's goal to reduce unwanted water flow by 100%. (Customer Research & Engagement Synthesis Report, v14, p166).

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Traditional approaches to managing flooding and pollution risks, principally underground storage and network alterations, are becoming less viable due to the environmentally unsustainable nature of the solutions and their prohibitive costs.

By investing in a broader range of solutions such as surface water management, we are able to reduce flood risk for a greater number of customers in the short term through the removal of surface water flows, by managing the driver of sewer flooding risk at source. Reducing surface water flows in our networks also reduces operation carbon and cost by reducing the need to pumping and treatment additional flows which is dealt with by surface water solutions.

We consider the focus on alternatives relative to traditional solutions (i.e. building larger sewers) is more aligned with our four long term Strategic Direction Statement ambitions. We consider that these alternatives can have a lower cost and carbon impact which is beneficial to both customers and the environment.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

All flooding investments had two alternatives, one traditional using storage and upsizing techniques and one Sustainable Urban Draining solution (SUDs). Where SUDs could not fully mitigate the risk of flooding it was combined with a part traditional solution.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our approach assesses the pre and post risk position for any solution. We are therefore able to compare the benefits and costs for multiple solutions with differing costs and benefits in a systematic way.

Has the impact on natural capital and the environment been considered?

In developing our final proposals, we have actively promoted alternatives to traditional solutions, which have natural capital, carbon and cost benefits.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

We have identified properties at risk of flooding through a comprehensive regional modelling exercise, using our detailed hydraulic models, validated with on site measurement. Having used these models to establish need, we use the outputs of the models to develop options to resolve the flood risk.

The scope of each option is costed in our investment management system. Costs have been developed from outturn AMP6 costs so that previously achieved efficiencies are reflected in the baseline for our future costs estimates. This process is described in more detail in the *Efficiency & Innovation* chapter of our Plan.

For the traditional component of solutions, all 1,667 properties known to be at risk of internal or high risk external flooding have been included within the scope of this investment. These properties were grouped by common hydraulic issues into 643 separate investments. We have used the UKWIR Risk Based Assessment (RBA) prioritisation approach alongside internal value model assessment has been applied to optimise and prioritise the schemes which have been included in the plan.

We have carried out cost-benefit analysis enable us to select cost beneficial schemes.

Is there high quality third party assurance for the robustness of the cost estimates?

The assurance process carried out by Jacobs found that: Anglian's business planning methodologies and its tools for identifying needs and solutions, estimating costs and benefits and optimising expenditure were robust from a technical perspective and based upon sound risk-based principles using reliable asset-specific data.

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

Investment is driven by our delighted customers outcome and ODI commitments.

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

We have managed costs of the overall programme by limiting the selected schemes to those that are assessed as cost beneficial, using societal valuation derived from our customer engagement work. We have not taken an overall cost beneficial programme approach. This does mean some customers will still experience flooding from sewers which we will need to manage.

In addition to basing our estimates on efficient costs drawn from our AMP6 performance, we have then applied further totex stretch efficiency and productivity challenges to those costs, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

By investing in a broader range of solutions such as surface water management, we are able to reduce flood risk for a greater number of customers in the short term through the removal of surface water flows, by managing the driver of sewer flooding risk at source. Reducing surface water flows in our networks also reduces operation carbon and cost by reducing the need to pumping and treatment additional flows which is dealt with by surface water solutions.

We consider the focus on alternatives relative to traditional solutions (i.e. building larger sewers) is more aligned with our four long term Strategic Direction Statement ambitions. We consider that these alternatives can have a lower cost and carbon impact which is beneficial to both customers and the environment.

All flooding investments had two alternatives, one traditional using storage and upsizing techniques and one Sustainable Urban Draining solution (SUDs). Where SUDs could not fully mitigate the risk of flooding it was combined with a part traditional solution.

For this investment area the protection consists of the following implications for non-delivery.

- Underperformance penalty payments for sewer flooding, both internal and external performance commitments if we fail to meet our performance commitment level.
- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Our Plan proposes performance commitments for both internal and external sewer flooding.

Affordability

Has the impact on affordability been considered?

We have selected a suite of investments that are cost beneficial. We believe that by selecting cost beneficial flood solutions we have kept costs down for the overall bill impact whilst delivering improved service in line with our performance commitment.

Bathing Waters

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the review of the WINEP/Nep UV disinfection model review in Chapter 5 of our main IAP Response for our comments on the IAP assessment of costs.

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A21, B68

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A21	5.750	8.755	3.167	4.646	2.590	**Capex: 24.907**
Opex (£m)	B68	0.289	0.268	0.364	0.319	0.379	**Opex: 1.618**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £44.425m		
Whole life value (EAV)*: £42.839m					Whole life cost (EAC)*: £1.586m		

* Note: Annualised values over 40 years

Investment Summary

All of the investment in this enhancement business case relates to improving bathing and shellfish water under obligation drivers set out in WINEP. We will carry out investigations and upgrading of our plants and networks across eight shellfish waters and seven bathing water areas. The activities include:

- upgrading two Water Recycling Centres (WRCs) at Southwold and Walton to provide UV disinfection for bathing water quality improvements
- upgrading three network pumping stations at Jaywick, Walton on the Naze and Clacton Martello Tower to reduce storm overflow spill frequency to bathing waters
- a two-year investigation of four shellfish harvesting areas in Essex with particular regard to nutrient enrichment
- wider investigations and remedial actions to improve bathing water quality throughout the our region.

Need for Investment

What incremental improvement would the proposal deliver?

Investment is required under the following WINEP obligation drivers:

- BW_IMP3: Bathing Water schemes to improve waters to Good or Excellent where there is evidence of customer support.
- BW_ND: Schemes to improve waters failing their Baseline class.

Is there persuasive evidence that an investment is required?

Investment in this area is driven by the obligations set out in WINEP.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

The quality of bathing waters makes a significant contribution towards tourism and the wider economy. The awareness of the economic, social and environmental value of bathing waters and the seaside economy has increased over recent years and is set to continue.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) because it enhances the quality of coastal bathing waters in our region.

What does the expenditure enhance?

This expenditure is a driver under WINEP. We will carry out investigations and make investment across eight shellfish waters and seven bathing water areas.

This contributes to the delivery of our 'Flourishing Environment' outcome and enhances the natural capital of our region.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

In the acceptability research on the Strategic Direction Statement, A Flourishing Environment was ranked 6th of the 10 outcomes, with 83% of customers saying this was important to them. (The highest ranking outcome was seen as important by 97%, and the lowest by 67%). Customers also rated the environment 3rd of the company's six challenges (seen as important by 85% of customers. (The highest ranking challenge was voted as important by 89% and the lowest by 52%).

However, when asked to prioritise between just three of the six challenges (climate change, population and economic growth, and environmental protection), customers who took part in the online community trial and who visited our bus chose environmental protection as their top priority. Customers taking part in the online community trial said this was the challenge that felt most relevant to them on a personal level and which they felt they could influence.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

During AMP6 we have funded a number of studies at the majority of our bathing waters by CREH (Centre for Research into Environment and Health) at Aberystwyth University. These studies consisted of large scale sampling programmes of bathing waters and nearby potential pollution sources in both wet and dry weather for a period of days. Following this information, tracer studies were conducted which involved releasing a tracer at specific high risk locations and monitoring the movement of these tracers over several tidal cycles. These studies have informed the proposed investment or proven where further work is needed by others such as third parties.

Subsequently, we conducted a Risk, Opportunities and Value (RoV) process to consider all investment alternatives which achieve compliance with directives in order to arrive at appropriate solutions that meet our WINEP obligation. Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution.

Has the impact on natural capital and the environment been considered?

Environmental protection is considered an important aspect of our work. However, awareness of the company's environmental and community activities is low. Raising awareness of these activities boosts positive perceptions of the company. There is support for the company's plans to reduce the negative impact of its operations on the environment and to work with others to achieve wider change

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Costs have been based on activity carried out during AMP6 and have been validated by our internal Quality Assurance. The costs are based on our AMP6 out turn costs taken from our extensive cost model library, meaning that previously delivered efficiencies already form the baseline for our future costs estimates, as described in the *Efficiency & Innovation* chapter of our Plan. The costs have been validated by our Totex Cost Estimation team and tested through our internal Totex Sponsors Group.

We undertook an extensive optioneering exercise as described in above under 'best option for customers'.

Is there high quality third party assurance for the robustness of the cost estimates?

Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. These costs have been reviewed by our external assurance providers (Jacobs).

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

A 'Risk, Opportunities and Value' (RoV) process to consider all investment alternatives which achieve compliance with directives has been used to arrive at appropriate solutions to meet our WINEP obligation. Investment is required under the following WINEP drivers.

- BW_IMP3: Bathing Water schemes to improve waters to Good or Excellent where there is evidence of customer support.
- BW_ND: Schemes to improve waters failing their Baseline class.

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

We have applied further totex stretch efficiency and productivity challenges, as described in the Efficiency and Innovation chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

For this investment the protection consists of the following implications for non-delivery.

- Underperformance penalty payment for the bathing waters attaining excellent status performance commitment.
- Enforcement action from the Environment Agency for failure to deliver an obligation.
- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7, for the first time we will introduce a new WINEP Performance commitment (described in the main narrative). This performance commitment is designed, where appropriate, to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term. We have worked hard to ensure delivering the WINEP for our customers is affordable, and there is strong support from customers for our proposed bill levels in AMP7. There will be additional support for a specific sub-set of customers who struggle to afford their bills.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The scale of the investment is not material and is driven by WINEP, it has a minimal impact on customer bills.

Key Assumptions

This assumes there are no further investment requirements introduced by the EA following confirmation of WINEP3.

First Time Sewerage - Section 101A

IAP response

We refer Ofwat to the model review of first time sewerage in Chapter 5 of our main IAP Response for our comments on the IAP assessment of costs. In our model review we suggest this area is better suited to a deep dive aproach.

In order to support this deep dive we have provided some new information.

All promoted schemes have had a site assessment completed to ascertain whether existing private facilities are causing, or have the potential to cause, adverse environmental or amenity effects. This involves consideration of the application information provided, the responses received from consulted bodies and information obtained from a site inspection, where the applicant will normally be present. On the basis of all of the above, the Initial Assessment report will be completed and will recommend either rejection of the application or that a detailed assessment is undertaken. The schemes are subject to our ROV (Risk, Opportunity and Value) process to ensure the most appropriate cost beneficial solution is arrived at. This process is supported by on site permeability testing, hydraulic modelling and ground surveys and takes into account statutory designations and flood plains.

Under this process, two schemes were initially rejected but were then referred under a formal appeal to the Environment Agency (EA). The EA have reviewed and determined that there is an obligation to provide a mains drainage scheme at;

- Belstead - 37 duty properties to connect
- Little Bealings – 16 duty properties to connect

The table below provides data that demonstrates our plan for AMP7 provides a decrease in both spend and cost per connectable property since AMP6;

	AMP3	AMP4	AMP5	AMP6	AMP7
Capex £M	53.7	111.6	67.4	71.9	23.8
Outputs	3130	6846	2970	1562	529
£k/ connectable property	17.2	16.3	22.7	46.0	45.0

Illustrations of the options considered for four of the ten S101a investments are shown in the following Table as examples. The options foreach scheme are initially assessed in a duty assessment. If the capital cost for an option is much larger than the only alternative, such as for cesspools, the alternative was considered prohibitive and cost benefit analysis was not pursued further.

Options considered

Investment & alternative[1]	Capital cost £	Full yer AOC £	EAB £	EAC £	EAV £
S101a Billockby & Clippesby (33 connectable properties)					
cesspools to serve 33 properties	4,133745	-	-	-	-106,304
gravity treatment at CAIPST, 33 demarcation chambers	2,090,463	-	-	-	-82,693
gravity treatment at ACLEST, 33 demarcation chambers PREFERRED OPTION -lowest cost and best value)	1,871,435	886	70,014	72,272	-2,258
s101a Morley St Botolph (68 connectable properties)					
cesspools to serve 70 properties	6,587,546	-	-	-	-169,378
gravity collection, 2 pumping stations & rising main to WYMOST and 70 demarcation chambers	3,065,463	4,346	144,270	120,757	23,513
gravity collection, 2 x pumping station & rising main to WYMOST & 68 demarcation chambers (PREFERRED OPTION - lowest cost)	2,186668	4,346	132,769	117,761	15,008
s101a Rockland St Peter (75 connectable properties)					
cesspools to serve 75 properties	8,994,535	-	-	-	-216,086
gravity collection including demarcation, 1 pumping station, treatment ATTLST (PREFERRED OPTION, lowest cost and best value)	1,854,631	1,653	159,122	73,047	86,075
s101a Wormegay (68 connectable properties)					
cesspools	9,121,218	-	-	-	-236,998
gravity collection including demarcation chambers, 2 pumping station, treatment at MIDTST (PREFERRED OPTION, lowest cost and best value)	3,977,347	4,989	156,311	153,735	2,576

1 AOC - Annual Operating Costs (£), EAB -Equivalent Annualised Benefit (£),EAC - Equivalent Annualised Cost (£), EAV – Equivalent Annualised Value (£) (EAB-EAC) (based on a 40 year planning horizon).

EAB and EAC align to the Treasury Green Book Methodology and the Ofwat recommended Spackman approach to annuitising and discounting. This ensures the maximum net benefit is derived for the service objectives set by our customers

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A1, B48 (WWN3, S4002 and S4002A)

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A1	1.018	6.618	6.542	6.502	2.688	**Capex: 23.367**
Opex (£m)	B48	0.090	0.088	0.096	0.108	0.126	**Opex: 0.508**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £1.148m		
Whole life value (EAV)*: £0.176m					Whole life cost (EAC)*: £0.972m		

* Note: Annualised values over 40 years

Investment Summary

The investments in this enhancement case have been driven by applications received up to June 2018. The applications have been assessed resulting in the promotion of 10 schemes for 552 houses, where duty has been determined for investment during AMP7. The most cost beneficial option was selected as the preferred option for each investment.

We are not requesting an allowance to provide additional capacity for applications received at the end of AMP6 and during AMP7. However there is an allocation to appraise applications during the AMP and the results of these appraisals will support our PR24 submission for delivery in AMP8. Our proposed investment for AMP7 compares to an investment of approximately £54m for AMP6.

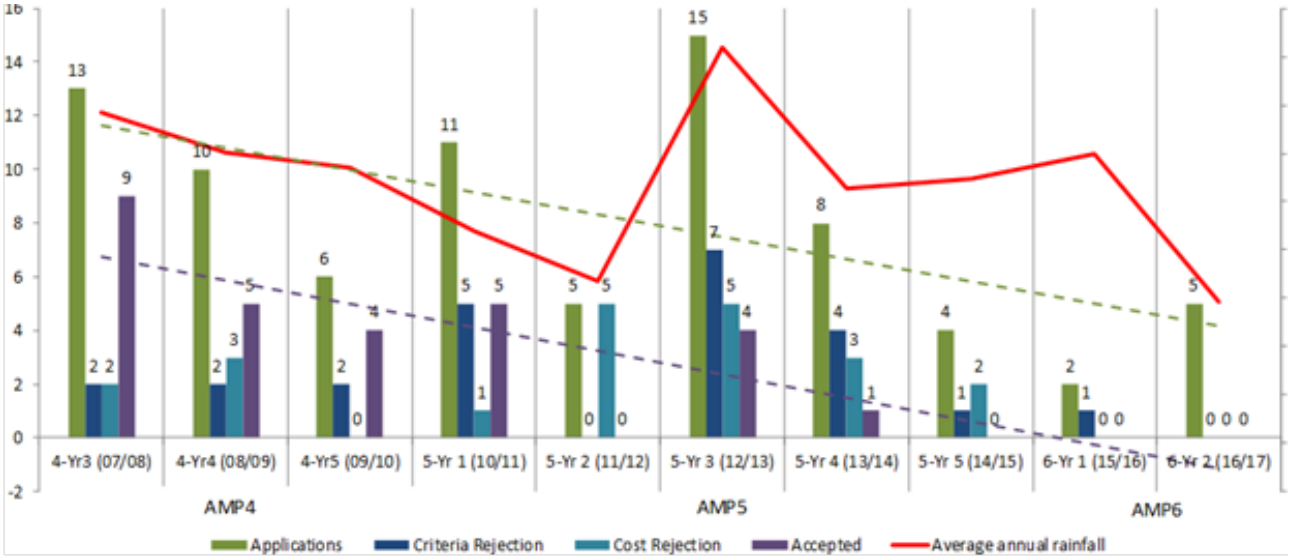
Need for Investment

S101A of the Water Industry Act is a statutory driver for investment.

What incremental improvement would the proposal deliver?

Since S101A was added to the Water Industry Act in 1995, we have seen the larger un-served rural populations apply early for first time sewerage, due to the greater potential for environmental and amenity impacts from private treatment. Since 1995 the application rate remained high, averaging 40 per annum until 2002, when it dropped to nine per annum to 2015 and 4 per annum since then. We have seen a reduction in properties per scheme, and we expect this to continue as we increase the area to which we provide sewerage services. Scheme acceptance trend is also downwards, with applications rejected if they fail to meet the s101A criteria or are unaffordable. The image below illustrates these trends:

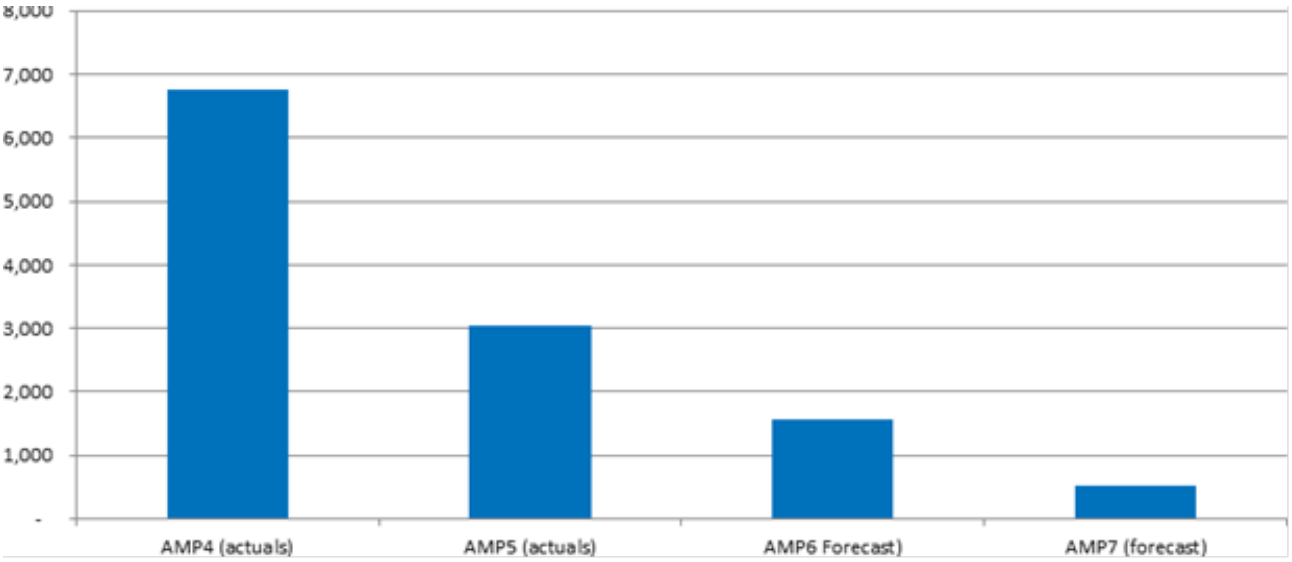
Figure 15 Historic trends in 101A applications



Is there persuasive evidence that an investment is required?

We have seen a reduction in s101A applications and acceptance rates and expect this to continue as the percentage of connected properties increases and the affordability of schemes decline. The graph below shows the decreasing number of properties accepted since AMP4, we have therefore excluded any new starts on applications received in the next five years.

Figure 16 Section 101A properties connected



The applications tend to come from communities, Parish Councils and homeowners. Therefore it can be assumed customers support this planned investment.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

Under the Water Industry Act s101A we are required to connect un-serviced catchments of 2 or more properties where requested, causing environmental detriment and it is cost beneficial to do so. We have assessed all applications received up to June 2018 and have promoted those where duty has been determined for investment in AMP7.

This is enhancement expenditure as it:

- increases the size of our sewer network,
- increases the number of customers we provide sewerage services to, and
- delivers environmental improvement.

What does the expenditure enhance?

In our Strategic Direction Statement published in 2017, one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'. S101A investment reduces the risk of pollution from these properties and improves the quality of the watercourse to which they discharge, improving environmental resilience.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

This investment is driven by customer applications. It supports three outcomes flourishing environment, delighted customers, positive impact on communities.

Customer engagement has demonstrated strong support for the avoidance of pollution, which Section 101A investment delivers;

The Community Perception Study research shows that there has been a large rise in those customers that are focused on the environment. For example, 83 per cent felt it was important for businesses to balance the needs of themselves, their customers, the local community and the environment (n=1404).

The analysis of social and digital media content for the period 1st February 2017-31 January 2018 also found that pollution and the environment was the most engaging content theme.

Our societal valuation studies found significant willingness to pay for improving environmental performance. Results from the Willingness to Pay Survey suggest customers have a strong preference for avoiding deterioration in service levels, especially in relation to environmental outcomes, for example, bathing water quality, river water quality and pollution incidents.

In the Acceptability research on our Strategic Direction Statement, when customers were introduced to our seven water quality and customer satisfaction goals, zero pollutions and flooding was ranked second most important.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

All promoted schemes have been subject to our ROV (Risk, Opportunity and Value) process to ensure the most appropriate cost beneficial solution is arrived at. This process is supported by on site permeability testing, hydraulic modelling and ground surveys and takes into account statutory designations and flood plains.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

All applications are assessed using a standard CBA approach. This is required as there is an appeal process by the applicant should the duty not be accepted.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

We have assessed the risk of future applications. The downward trend shows that the number of applications are slowing down, this is despite having large rural areas that still have no mains drainage. Any new application will be considered for delivery during AMP8.

Has the impact on natural capital and the environment been considered?

The proposed solutions have a particularly intrusive impact on communities. We fully engage with them through the delivery process to ensure their needs are accommodated. The environmental detriment caused by private sewerage systems has to be established in conjunction with the Environment Agency before the duty is accepted (often via visible evidence of pollution to the watercourse), so all schemes will be confident of achieving a local environmental benefit.

We will report our contribution to the natural capital of our region through our natural capital performance commitment in AMP7.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

All interventions have been consistently costed using our ‘C55’ investment optimiser and cost estimation tool. The system utilises a library of cost models which have been built using AW actual out turn scheme costs, meaning that efficiencies already achieved form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan.

C55 is particularly useful for these costs. We have a long history of delivering these schemes so our catalogue of efficient costs is extensive. As we know the applications that we will progress, our cost estimates can account for the local geography, length of sewer and other infrastructure requirements.

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

The solutions include any innovation we have delivered in the AMP for example our industry leading work on use of directional drilling for gravity sewers (rather than open cut) to reduce both carbon and cost. Our innovation in directional drilling is in more accurate control through varying soil types which allows a greater percentage of 'No Dig' work.

It's possible that the historic applications processed represented the more straightforward and less costly schemes. This could impact the unit cost compared to other companies.

Is there high quality third party assurance for the robustness of the cost estimates?

Each scheme is subject to a quality assurance check from a member of the Totex Cost Estimation team and in addition the cost estimation system is subject to an independent assurance audit.

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. These costs have been reviewed by our external assurance providers (Jacobs).

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

These investments are driven by customer applications under Section 101A of the Water Industry Act, therefore our ability to manage costs is limited. However, we have kept overall costs down by not requesting funding for new schemes where duty is accepted in AMP7 as we had done at PR14.

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

Under the act we are required to connect un-serviced catchments of 2 or more properties where it is requested, causing environmental detriment and is cost beneficial to do so. For each investment we consider the cost and benefit of a private cess pool against providing sewerage connection. Once duty has been accepted the costs are further controlled by conducting a cost benefit analysis on a range of alternative options.

We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. Customer protection consists of the following implications for non-delivery:

- Enforcement action for failing to comply with our duties under the Water Industry Act
- Customer complaints potentially to CC Water
- Reputational damage that could be reflected through C-MeX performance

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

This expenditure is totally customer focused and driven by customers and communities. The expenditure therefore has direct benefits and is closely monitored by the Section 101a applicant.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term. This is a requirement of the revised Water Act for this area. As mentioned before we have kept overall totex in this area down by not including provision for new applications where we accept duty in AMP7, based on the reducing trend of acceptance of duty.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The costs of this programme are small in relation to overall totex and do not have a material impact on the whole customer base. S101a investments also increase the number of customers paying a sewerage charge which reduces overall bill impact.

Key Assumptions

Unlike previous AMPs we have not included any new schemes arising during in AMP7. This is a risk in this programme.

No Deterioration

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the Model by Model Critique (Chapter 5 of our main IAP Response) for our response to the IAP assessment of costs.

Price Control(s)	Sewage Treatment
Business Plan table and line(s)	Table: WWS2 Lines: A16, A20 (part), B63, B67 (part)

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A16	0.108	0.000	0.000	0.000	0.000	0.108
	A20	0.420	3.780	0.271	3.751	11.770	19.993
							Capex: 20.101
Opex (£m)	B63	0.044	0.030	0.059	0.029	0.028	0.190
	B67	0.087	0.148	0.202	0.248	0.457	1.142
							Opex: 1.332
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £1.374m		
Whole life value (EAV)*: -£0.417m					Whole life cost (EAC)*: £1.791m		

* Note: Annualised values over 40 years

Investment Summary

The investment in this enhancement case is to ensure that there is no deterioration of sanitary parameters in the final effluent at our Water Recycling Centres (WRCs) under the Water Framework Directive (WFD) driver. We will invest in 10 schemes in total to ensure no deterioration of the following parameters, as set out below.

- Ammonia (four improvement schemes and two investigations) coded to lines 16 and 20
- Biochemical Oxygen Demand (BOD) (three improvement schemes) coded to line 20
- Nitrate (one investigation) coded to Line 16

No deterioration drivers relating to phosphorus at 18 sites are covered by a separate enhancement case specifically dealing with phosphorus removal which is all coded to lines 18 and 19 depending on whether the existing treatment at the site is trickling filters or activated sludge.

Need for Investment

What incremental improvement would the proposal deliver?

This investment provides an incremental environmental improvement at 8 water recycling centres ensuring there is no deterioration of sanitary parameters in the final effluent.

Is there persuasive evidence that an investment is required?

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

Investment under these drivers has previously been required in PR94 (AMP2), PR99, PR04 (UWWTD only), PR09 and PR14 (WFD and UWWTD). The investment in this case relates to the WINEP driver code WFD_ND and WFD_INV. Without this investment the EA has assessed that the receiving water bodies would be ecologically affected. These are schemes to meet requirements designed to prevent deterioration in the sanitary parameters BOD and ammonia.

Improved data and modelling techniques have resulted in an increase in the number of waterbodies qualifying for investment under WFD drivers.

As the population served by a WRC increases, more discharges exceed the population thresholds set in the UWWTD Regulations. Similarly, population growth increases the number of WRC discharges qualifying for investment under WFD 'no deterioration' criteria as the increased pollutant load discharged from a WRC may cause current water body quality classification to be exceeded. Options to meet new discharge limits using catchment or natural capital approaches will be explored.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) as it enhances the quality of water courses down stream of the final effluent discharge locations at WRCs. It is also required to enhance the capacity of WRCs in order to cater for the new demand associated with the forecast population growth in our region over AMP7.

What does the expenditure enhance?

This investment will prevent deterioration of ecological status of inland water bodies at these locations, maintaining the natural capital of our region. In our Strategic Direction Statement published in 2017, one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

We have completed extensive engagement with customers on investment in environmental drivers. To save repetition, our findings are explained in more detail in the enhancement case relating to Phosphorus removal.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

For the treatment of specific parameters 'optioneering' was undertaken to ensure best value solutions for customers were promoted to the business plan. For the achievement of solids and BOD compliance the costs of mechanical solids removal processes such Submerged Aerated Filters were compared with conventional settlement tanks.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

This investment is meet legal requirements.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

At this stage we do not believe natural capital solutions will deliver the required standards at these sites.

Has the impact on natural capital and the environment been considered?

All our solutions embedded low carbon solutions for example the use of precast concrete tanks rather than insitu concrete tanks.

Robustness and Efficiency of Costs

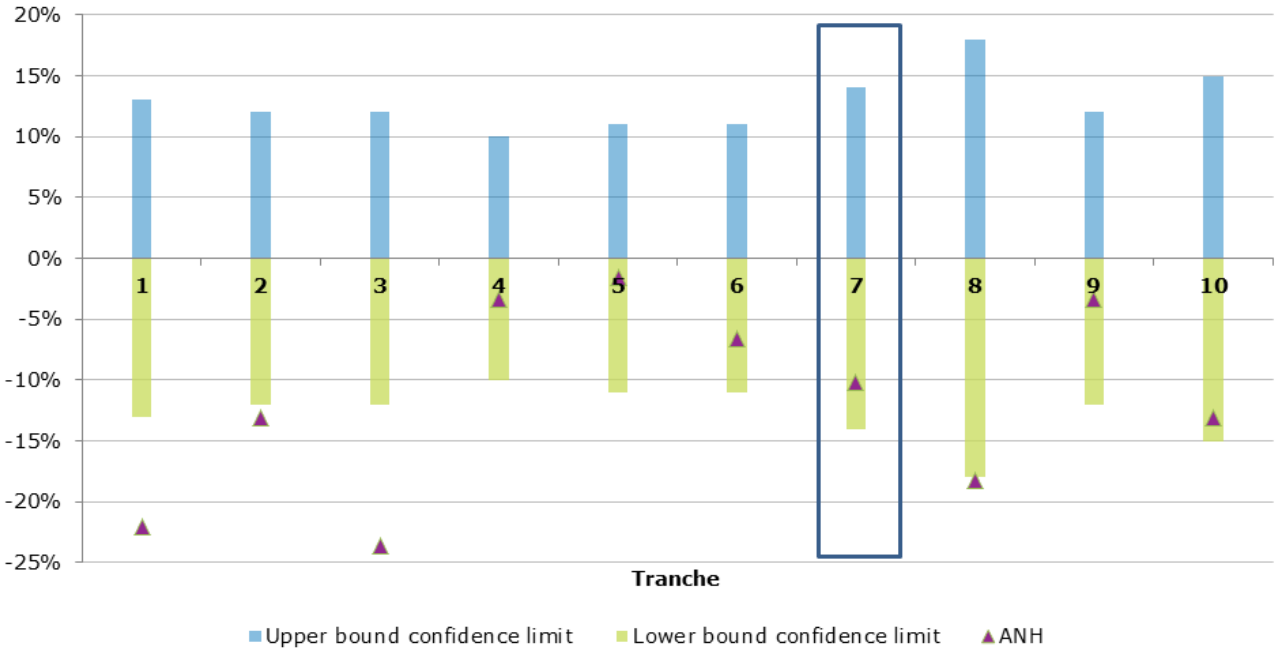
Is there persuasive evidence that the cost estimates are robust and efficient?

Our costs have been developed using our corporate cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency & Innovation* chapter of our Plan. We are also making use of innovative solutions, such as digital design and modular build, to drive efficiency.

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Is there high quality third party assurance for the robustness of the cost estimates?

We have taken a sample of 9 investments from this portfolio and carried out benchmarking with Mott MacDonald using industry average cost from other water companies. We can therefore be confident that our costs are efficient.



Further details are published in the *Efficiency and Innovation* chapter of our Plan.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by the obligation to meet the requirements of WINEP, specifically, to ensure that we are compliant with the WFD. The need for this investment is driven by a statutory obligation from the Environment Agency (EA) in the form of the WINEP.

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

The costs of meeting this have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option.

We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this portfolio the protection consists of the following implications for non-delivery.

- If the consent was not achieved then underperformance penalty payments would apply under the Treatment Works Compliance performance commitment.
- Enforcement action from the EA for failure to meet revised effluent consents and to deliver an obligation.
- Customer complaints potentially to the Consumer Council for Water.
- Reputational damage that could be reflected through C-MeX performance.
- Reporting our contribution to improving the natural capital of our region through our Natural Capital performance commitment.
- In AMP7, for the first time we will introduce a new WINEP Performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

Key Assumptions

This assumes there are no further investment requirements introduced by the EA following confirmation of WINEP3.

Pluvial and Fluvial Flood Protection

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to our review of the Wastewater Resilience Model in Chapter 5 of our main IAP Response for our comments on the IAP assessment of costs.

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A33, B80

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A33	0.000	1.341	0.000	0.000	0.000	**Capex: 1.341**
Opex (£m)	B80	4.502	3.877	3.917	3.521	0.000	**Opex: 15.817**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £0.780m		
Whole life value (EAV)*: £0.151m					Whole life cost (EAC)*: £0.629m		

* Note: Annualised values over 40 years

Investment summary

We have had 159 externally promoted partnership funding requests. Of these, we have included the following in our Plan:

- support to 10 named schemes deemed to have high confidence of delivering benefits for our customers
- Support 115 unnamed schemes, based on the AMP6 demand profile.

Our experience from delivering AMP6 investments has demonstrated that by working collaboratively with partners to co-fund larger scale initiatives, that consider catchments and communities as a whole, we are able to deliver more cost-beneficial outcomes for our customers.

Need for Investment

What incremental improvement would the proposal deliver?

Funding for coastal, fluvial and pluvial flooding, as well as coastal erosion requires the lead organisation (usually a flood risk management authority such as the Environment Agency (EA), Lead Local Flood Authority (LLFA), District Council or Internal Drainage Board) to seek funding from beneficiaries of protection to supplement central funding allocations. As we are a Risk Management Authority (RMA) and potential beneficiary, this places an expectation on us to be open to partnership funding opportunities.

We first started working with local councils and LLFAs during AMP5. This has been extended during AMP6 with 52 schemes to reduce the impact of flooding or coastal erosion on both our assets and our customers.

We currently support 21 LLFAs across the region as well as working closely with the Environment Agency, Internal drainage board and local resilience forums.

Our AMP6 programme has demonstrated the value to our partners, customers and communities place on partnership funding through an increased appetite for Partnership working which often offers alternative solutions to environmental and community flooding issues.

Is there persuasive evidence that an investment is required?

There are now EA partnerships at national and local level and for long term plan prioritisation. Partners no longer include only Risk Management Authorities (as termed by the FWMA 2010).

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

The appetite for collaborative working to address community issues continues to grow and will increasingly become the expected way of working to resolve complex community flooding and environmental issues.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This expenditure is considered to be enhancement (rather than base) because it enhances the capacity of our region to manage and reduce flood risk. This expenditure will enhance the resource available for ourselves and partner organisations to run multiple schemes from the funding request received by partners to help protect customers in our region from flooding.

What does the expenditure enhance?

This will enhance our ability to deliver against our 'positive impact on communities' and 'resilient business' outcomes and support the long-term ambitions of our strategic direction statement to make the east of England resilient to the risks of drought and flooding and to enable sustainable economic and housing growth in the UK's fastest growing region. The expenditure does this by building on lessons learned from AMP6 that catchment and community-focussed partnership funding is the most effective way to deliver enhanced flood protection, and providing funding for those schemes which are most cost-beneficial for customers.

The bulk of the investment in this case is opex rather than capex because partnership funding does not create an asset that is owned by Anglian Water, and therefore cannot be capitalised.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Customers expressed support for investments that would enhance resilience to drought and flood, through various engagement channels, and supported collaborative approaches.

Through this approach we are able to deliver greater value to customers, by joint working and co-funding we are able to leverage significant benefits for our customers.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

As with all partnership projects the timing is dependent on many factors including approval by third parties. We work proactively with our partners to mitigate project risks.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Partnership working and partnership funding often offers alternative solutions to environmental and community flooding issues as we can take a broader view of risk and assess benefits across many stakeholder groups.

It is important to customers that the company cares about the communities it serves. Some evidence within our existing engagement programme suggests this is becoming increasingly important. Partnership funding promotes collaboration across Risk Management Authorities as well as with

communities and increasingly other organisations which may benefit from improved flooding resilience such as Tesco and Coca Cola. This approach ensures that our customers and their communities are at the centre of investment decisions.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Customers are generally supportive of a progressive surface water management strategy, and Anglian Water's goal to reduce unwanted water flow by 100%. However, some feel this is pushing more responsibilities on to customers to pay for improvements, the benefits may not be seen in their lifetimes, and more obvious solutions (such as clearing drains) should be tried first.

Has the impact on natural capital and the environment been considered?

All the investment planned will have a positive impact on customers and the environment.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

To ensure cost efficiency for our customers we have developed a Partnership Funding assessment process: the need to contribute is assessed through comparison of CBA (cost benefit analysis) against our own totex solutions: we will contribute if it is the most cost beneficial solution, or if an Anglian Water solution is more cost beneficial, we may still contribute with contribution limited to the cost needed to deliver our own solution.

In assessing the Equivalent Annualised Benefit (EAB) for our partnership funding programme, we have taken a conservative approach to assessing the benefits based on the uncertainty around future candidate partnership funding opportunities. In AMP6 our investments have been more cost beneficial than we have shown for future AMP7 investments. Our new approach to assessing and approving partnership funding in AMP7 will ensure we promote cost beneficial solutions.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. These costs have been reviewed by our external assurance providers (Jacobs).

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The costs of this enhancement are partly driven by an expectation on us, as a risk-management authority, to be open to partnership funding opportunities. Beyond this requirement, we have taken a number of steps to ensure costs are controlled and acceptable to our customers.

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

We have assessed each partnership funding request, and a comparison of the costs and benefits of partnership schemes against our own potential totex solution. We will only contribute to those schemes which clearly present the most cost-beneficial option.

We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

For this portfolio the protection consists of the following implications for non-delivery.

- Reputational damage that could be reflected through C-MeX performance.

- Under-performance payments for non-delivery of our performance commitments for both internal and external flooding
- Enforcement action for not delivering on our role as a Risk Management Authority under Section 19 of the Water Industry Act

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Should our assets be impacted this will cause a potential interruption to service and will cause the asset to deteriorate which has a linkage to asset health.

Affordability

Has the impact on affordability been considered?

Our partnership funding assessment process has been refined for PR19 and used to make sure this enhancement expenditure will only fund those schemes which are efficient compared to solutions we could deliver ourselves, and provide benefits that our customers would be supportive of, at a cost which they are willing to pay.

This is particularly important for partnership funding because the bulk of the spend in this case is opex. Opex is matched for funding through bills directly rather than via depreciation of an asset. It therefore has a more immediate bill impact than capex.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

Key Assumptions

For emergent schemes where we will be approached by third parties in our region for opportunities to co-fund schemes, it is assumed that the demand profile in AMP7 will follow the profile seen in AMP6.

Chemical Investigations Programmes (CIP)

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the review of the WINEP/NEP Chemicals removal model in chapter 5 of our main IAP Response for our comments on the IAP assessment of costs.

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A12, A13, B59, B60

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex	A12	0.181	1.631	0.309	3.787	5.958	11.867
(£m)	A13	0.825	0.825	0.826	0.827	0.828	4.132
							Capex: 15.999
Opex	B59	0.000	0.049	0.093	0.088	0.255	0.484
(£m)	B60	0.000	0.000	0.000	0.000	0.000	0.000
							Opex: 0.484

AMP7 carry over costs: £0.000m	Whole life benefit (EAB)*: £0.499m
Whole life value (EAV)*: £-0.890m	Whole life cost (EAC)*: £1.389m

* Note: Annualised values over 40 years

Investment Summary

Investment in this area will meet 57 obligations covering a combination of investigations and monitoring addressing multiple parameters under the WINEP WFD_INV_CHEM driver. This investment will continue throughout the AMP to ensure no deterioration in standards and will be used to inform PR24.

We will also invest at two Water Recycling Centres (WRCs) Tuddenham and Rayleigh East which were identified through studies in AMP6 to meet new dissolved copper limits. Our options to meet these limits involve the use of both Mecana and Blue Pro solutions, both of which are innovative new technologies that have been trialled collaboratively through an UKWIR study in AMP6.

Need for Investment

What incremental improvement would the proposal deliver?

This investment will both further the sector's knowledge and deliver two environmental improvements to meet new dissolved copper limits.

Is there persuasive evidence that an investment is required?

Investment is required under the following WINEP chemical drivers to achieve 'good chemical status' where an Environmental Quality Standard (EQS) is exceeded downstream of Tuddenham and Rayleigh East WRCs discharge points.

- WFD_NDLS_Chem1: Measures related to load standstill requirements for chemicals (above EQS).
- WFD_NDLS_Chem2: Measures related to load standstill requirements for chemicals (below EQS). These are set where a wastewater treatment works is discharging significant concentrations of a chemical, but the EQS is not threatened. Targets are set to ensure that current effluent quality does not deteriorate

The planned investigation programme is required under the following drivers:

- WFD_INV_CHEM 1 to 14 – various investigations including Anti Microbial Resistance (AMR) and microplastics.
- WFD_MON_CHEM: Trend monitoring to monitor the effectiveness of source control and other measures to an extent that ensures we have sufficient confidence in the data for understanding and for EU reporting.

An analysis by the University of East Anglia (UEA) shows that our region's biodiversity compares poorly to other parts of England. It found our region, which covers 23% of England has only 13% of the country's best biodiversity. This results in fragmented landscapes and rivers that threaten the long-term survival of our wildlife and undermines the services natural capital provides. WINEP investments required for AMP7 will help address these problems by improving water quality, which is key to maintaining and improving freshwater habitats and enhancing ecosystems.

There have been equivalent drivers in PR09 and PR14 for Chemical Investigations Programmes (CIP) 1 and 2. There has been no equivalent driver to WINEP WFD_IMP_CHEM driver pathway to good.

Drivers are aimed at informing this strategy, which aims to reduce or restrict the presence of hazardous pollutants or gather intelligence on hazardous pollutants in the environment from the wastewater network. In common with CIP 1 and 2 this will require collaborative work between water companies and the EA.

Under the Water Framework Directive hazardous pollutants with EQS may be described as Priority Hazardous Substances (PHS), Priority Substances (PS), Specific Pollutants (SP) and Other Pollutants (OP). PHS, PS, and OP are used to determine chemical status and SP are used in the determination of ecological status. In previous AMP periods there has been insufficient data to assess if chemicals are causing EQS failures and if sources of contamination are due to the Water Industry alone.

Collaborative work through the joint EA / Water Company UKWIR Chemicals Investigation Programme has identified candidate WRCs for investment to meet quality drivers.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

This is a legal obligation under WINEP.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

In our Strategic Direction Statement published in 2017, one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'.

This expenditure is considered to be enhancement (rather than base) as it enhances the quality of water courses down stream of the final effluent discharge locations at WRCs. It is also required to enhance the capacity of WRCs in order to cater for the new demand associated with the forecast population growth in our region over AMP7. This expenditure is a requirement of the WINEP.

What does the expenditure enhance?

This investment will prevent deterioration of ecological status of inland water bodies at these locations, maintaining the natural capital of our region.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

This expenditure is covered the obligations required under WINEP.

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our Plan is driven by the requirements of our customers.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Our Risk, Opportunities and value (ROV) process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

We have completed extensive engagement with customers on investment in environmental drivers. To save repetition, our findings are explained in more detail in the enhancement case relating to Phosphorus removal.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

A 'Risk, Opportunities and Value' (RoV) process to consider all investment alternatives which achieve compliance with directives has been used to arrive at appropriate solutions to meet WINEP obligations.

Has the impact on natural capital and the environment been considered?

For the treatment of specific parameters optioneering was undertaken to ensure best value solutions for customers were promoted to the business plan. For the achievement of solids and BOD compliance the costs of mechanical solids removal processes such Submerged Aerated Filters were compared with conventional settlement tanks. At this stage we don't believe natural capital solutions will deliver the required standards at these sites.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Our costs have been developed using our corporate cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency & Innovation* chapter of our Plan.

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Is there high quality third party assurance for the robustness of the cost estimates?

Our approach to WINEP has also been audited by our external assurance provider (Jacobs), who have confirmed to our Board that there are no material concerns. This has informed our Board's support for the assurance statement in the plan.

"We concluded that Anglian Water has dedicated projects and is developing innovative monitoring systems to ensure it makes good progress towards achieving regulatory requirements for WINEP and WISER. All types of project activity were recorded, logged and tracked within the WINEP3 project.

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models.

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The cost of this investment is outside of management control because it is driven by the obligation to meet the requirements of WINEP, specifically, to ensure that we are compliant with the WFD. The need for this investment is driven by a statutory obligation from the Environment Agency in the form of the WINEP.

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

The costs of meeting this have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option. We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

As a business we set out to honour our commitments. Customers can rightly challenge and ask what protection there is if we don't. For this portfolio the protection consists of the following implications for non-delivery.

- Underperformance penalty payments through the Treatment Works Compliance performance commitment.
- Enforcement action from the Environment Agency for failure to meet revised effluent consents and to deliver an obligation.
- Customer complaints potentially to CC Water.
- Reputational damage that could be reflected through C-MeX performance.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7, for the first time we will introduce a new WINEP Performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The costs for this expenditure are not material in the context of the wastewater enhancement programme. The cost have a minimal impact on customer bills.

Odour

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the review of the Odour model in chapter 5 of our main IAP Response for our comments on the IAP assessment of costs.

Price Control(s)	Wastewater Network Plus, Bioresources
Business Plan table and line(s)	Table: WWS2 Lines: A24, B71

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A24	2.379	2.764	2.383	2.385	2.387	**Capex: 12.298**
Opex (£m)	B71	0.132	0.263	0.352	0.437	0.522	**Opex: 1.706**
AMP7 carry over costs: £0.000m						Whole life benefit (EAB)*: £87.736m	
Whole life value (EAV)*: £87.101m						Whole life cost (EAC)*: £0.636m	

* Note: Annualised values over 40 years

Investment Summary

Our plans for AMP7 are to:

- employ a Strategic odour manager and Tactical odour manager to lead the business engagement on odour resolution
- focus on holistic catchment investigations that identify the root cause, not just the impact, of odour
- utilise innovative techniques to reduce the chemical and carbon impact of odour treatment.

The investment is targeted at reducing the 100+ written complaints and 2200+ (318 repeat) telephone contacts received each year.

Need for Investment

What incremental improvement would the proposal deliver?

This investment delivers improvements to air quality in our region. It will improve the lives of those customers who live near our water recycling centers.

Is there persuasive evidence that an investment is required?

The combination of population growth in our region increasing the potential for developers to build closer to our WRCs and pumping stations, alongside increasing customer expectations, mean there is greater potential for odour related complaints in the future.

We also consider odour as a type of pollution, and so this issue must be tackled to help us meet our ambition for zero pollution incidents. During AMP6 we plan to deliver 61 odour mitigation schemes which are primarily demand driven pumping station enhancements (primary chemical dosing) and WRC enhancements (primarily focussed on minimising the impact of odour to the receptor).

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

In 2016/17, 8.2% of our written complaints related to odour, these all arose following unsuccessful resolution to the initial odour alert. It is reasonable to assume that these complaints translate to very unsatisfied customers and would have been preventable if we had responded right, first time.

As we strive to become more efficient and strategic in our approach to odour investment, we will take a more holistic view of odour control. One of the challenges of better dealing with septicity & odour in the future is that although the problem usually manifests itself at the Water Recycling Centre (WRC), the root cause of the issue is often earlier on in the process, either in the sewerage network or pumping station. Because of this, we will adopt a catchment based approach to solving septicity and odour issues in the future, with the aim of treating the cause, rather than masking the symptom.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

This provides an incremental improvement to the air quality of our region and goes beyond our current levels of service and operating risks.

What does the expenditure enhance?

This expenditure will enhance the experience of our customers compared to AMP6. The change that customers will experience will be fewer odour issues from our water recycling assets. This will help us to deliver our outcome for a 'positive impact on communities' and 'delighted customers'.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our ROV process has been used to consider all investment alternatives.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Our costs have been developed using our corporate cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the *Efficiency & Innovation* chapter of our Plan.

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Is there high quality third party assurance for the robustness of the cost estimates?

The costs used are based on current out turn costs supplemented by information from our industry leading cost library of completed projects. Where we have developed costs for options that we have not previously delivered, we have gathered external data to develop new and updated cost models. These costs have been reviewed by our external assurance providers (Jacobs).

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

Our customers have informed us through business as usual channel that odour from our works are unacceptable, we are therefore responding to their issues.

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

The costs of meeting this have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option. We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

Failure or delay in delivering this investment this will increase our risk of exposure to penalties against the C-MeX performance commitment

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

Delivery of this enhancement should mitigate the issue of odours and thereby improve customer experience and perception of Anglian Water, thus having a positive impact on our C-Mex score. Failure or delay in delivering this investment this will increase are risk of exposure to penalties against the C-MeX performance commitment.

Affordability

Has the impact on affordability been considered?

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The impact on affordability has been considered in our enhancements to reduce odour issues. We have considered the costs and efficiency of delivering each of the potential options for customers against the benefits to be delivered.

Key Assumptions

Our preferred option mirrors the approach taken during recent years to reduce the number of pollution incidents. It is assumed that the benefits of this approach are transferable to odour management.

Addressing Flow in the Sewerage System

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the review of WINEP/ NEP Event Duration model and WINEP Storage schemes in the network to reduce spill frequency at CSOs in Chapter 5 of our main IAP Response for our comments on the IAP assessment of costs.

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A6 (sewerage collection column only), A11, B53 (sewerage collection column only), B58

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A6	0.994	0.995	0.996	0.997	0.998	4.980
	A11	1.601	5.038	1.727	0.000	0.000	8.366
							Capex: 13.347
Opex (£m)	B53	0.000	0.011	0.022	0.032	0.042	0.107
	B58	0.002	0.004	0.021	0.035	0.035	0.097
							Opex: 0.204
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £70.580m		
Whole life value (EAV)*: £69.723m					Whole life cost (EAC)*: £0.857m		

* Note: Annualised values over 40 years

Investment Summary

All of the investment in this enhancement business case relates to reducing the spill frequency in the network from Combined Sewer Overflows (CSOs) and the monitoring of intermittent discharges and includes:

- investment in event duration monitoring (infra) covering 249 sites (coded to lines 11 and 58)
- investment in event duration monitoring (non infra) covering 91 sites (coded to lines 6 and 53)
- activities to reduce the environmental impact at seven sites breaching Environment Agency (EA) spill triggers (coded to line 6 and 53), and
- a two-year investigation programme covering 40 high spilling Combined Sewer Overflows (CSOs) (coded to lines 6 and 53).

Need for Investment

Is there persuasive evidence that an investment is required?

These are legal obligations. Investment is required under WINEP U_MON2, BW_MON and U_INV drivers.

- U_MON2 - Event duration monitoring of storm discharges identified (under the Risk Based Approach to the Monitoring of Storm Discharges)
- BW_MON - Provision of event and duration monitoring on Combined Sewer Overflow and Storm Tank – all discharges impacting on bathing waters
- U_INV driver - UWWTR spill frequency reduction investigation and Cost Benefit appraisal.

There has been investment during PR14 under EDM1, 2 rB5 and S8 drivers for high and moderate amenity watercourses.

Is there persuasive evidence that an investment is required?

Investment in this area has become a priority following the publication of WINEP which has been driven by European legislation and public opinion. The two drivers are:

- U_MON2 and BW_MON – These drivers require us to reassess CSOs to confirm the amenity value of the receiving watercourse.
- U_INV – This driver relates to new EA guidance relating to compliance with the Urban Wastewater Treatment Regulations.

What incremental improvement would the proposal deliver?

The proposal will deliver improvements to river water quality by reducing the inputs of untreated waste water to rivers.

Where appropriate, is there evidence – assured by the customer challenge group (CCG) – that customers support the project?

The programme is a requirement of WINEP. Nonetheless, there is good support from our customers that they want us to protect the environment. Please see 'Best Option for Customers' section below for more detail.

Need for Enhancement Expenditure

Why is it enhancement (and not base) expenditure?

In our Strategic Direction Statement published in 2017, one of our four long term ambitions was to 'work with others to achieve significant improvement in ecological quality across our catchments'.

This expenditure is enhancement (rather than base) as it enhances the quality of water courses downstream of the final effluent discharge locations at WRCs. It is also required to enhance the capacity of WRCs in order to cater for the new demand associated with the forecast population growth in our region over AMP7.

This investment case is in response to meeting the requirements of WINEP3 defined by the Environment Agency.

What does the expenditure enhance?

This investment will prevent deterioration of ecological status of inland water bodies at these locations, maintaining the natural capital of our region.

Best Option for Customers

Does the proposal deliver outcomes that reflect customers' priorities, identified through customer engagement? Is there CCG assurance that the company has engaged with customers on the project and this engagement been taken account of?

Our Customer Engagement Forum has commended us for the length, breadth, depth, scale and innovative nature of our customer engagement programme for PR19 and notes that our plan is driven by the requirements of our customers.

We have completed extensive engagement with customers on investment in environmental drivers. To save repetition, our findings are explained in more detail in the enhancement case relating to phosphorus removal.

Is there persuasive evidence that the proposed solution represents the best value for customers in the long term, including evidence from customer engagement?

Spills from our network can result in pollution events and from our customer engagement we are aware that protecting local water bodies are key customer concerns. Further customer insight is referenced in the enhancement case for Phosphorous removal.

Did the company consider an appropriate range of options with a robust cost–benefit analysis before concluding that the proposed option should be pursued?

Detailed hydraulic modelling has been carried out to support our 'Risk, Opportunities and Value' (ROV) process and identify scope for the improvement drivers. This has enabled us to produce site specific solutions.

Our ROV process considers baseline and residual risk of each alternative considered, scored for both private and societal impact. The societal impacts are calculated using our extensive societal valuation work. This enables cost benefit analysis to be carried out on each option to choose the best value, lowest whole life cost solution, with the least impact on bills both in the short and long term.

Has risk been assessed? Have flexible, lower risk solutions been assessed?

Our ROV process has been used to consider all investment alternatives which achieve compliance with directives and arrive at appropriate solutions to meet WINEP obligations.

Has the impact on natural capital and the environment been considered?

Through this monitoring programme we will be able to assess the impact of CSOs have on the environment.

Robustness and Efficiency of Costs

Is there persuasive evidence that the cost estimates are robust and efficient?

Our costs have been developed using our corporate cost model library that has been developed over several AMPs using data from previously delivered projects, price adjusted to the relevant year. The costs used in the plan are based on outturn costs from AMP6 and include low carbon solutions. This means that efficiencies already achieved form the baseline for our future costs estimates as described in the Efficiency & Innovation chapter of our Plan.

Is there high quality third party assurance for the robustness of the cost estimates?

Our approach to WINEP has also been audited by our external assurance provider (Jacobs), who have confirmed to our Board that there are no material concerns. This has informed our Board's support for the assurance statement in the plan.

"We concluded that Anglian Water has dedicated projects and is developing innovative monitoring systems to ensure it makes good progress towards achieving regulatory requirements for WINEP and WISER. All types of project activity were recorded, logged and tracked within the WINEP3 project management system." *Jacobs Summary Report*

Management Control

Is the cost driven by factors beyond the control of Anglian Water?

The need for this investment is outside of management control because it is driven by the obligation to meet the requirements of WINEP, specifically, to ensure that we are compliant with the WFD. The need for this investment is driven by a statutory obligation from the Environment Agency in the form of the WINEP.

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

The costs of meeting this have been controlled as far as possible by conducting a cost benefit analysis on a range of alternative options to identify the best value option. We have also applied further totex stretch efficiency and productivity challenges, as described in the *Efficiency and Innovation* chapter of our Plan.

Customer Protection

Are customers protected if the investment is cancelled, delayed or reduced in scope?

For this investment the protection consists of the following implications for non-delivery.

- Underperformance penalty payment for the pollution incidents performance commitment.

- Enforcement action from the Environment Agency for failure to meet revised effluent consents and to deliver WINEP obligations.
- Customer complaints to CC Water.
- Reputational damage that could be reflected through C-MeX performance.
- Reporting our contribution to improving the natural capital of our region through our Natural Capital performance commitment.

Are the customer benefits that relate to the claim linked to outcomes and to a suitable incentive in the company's business plan?

In AMP7, for the first time we will introduce a new WINEP performance commitment (described in the main narrative). This performance commitment is designed to incentivise faster delivery of the WINEP, to unlock benefits for customers and the environment early.

Affordability

Has the impact on affordability been considered?

The cost benefit analysis that has been undertaken on each option allows the best value, lowest whole life cost solution to be identified that has the least impact on bills both in the short and long term.

The output profiles for this work as described in WWS4 align to the optimised investment profile rather than the obligation dates agreed with the EA. The optimised profile is designed to achieve a deliverable programme with smooth bill impacts whilst achieving obligation dates, hence the difference between the cost profile and output profile.

For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?

The scale of this programme is not material and therefore a minimal impact on customer bills.

Key Assumptions

This assumes there are no further investment requirements introduced by the EA following confirmation of WINEP3.

Security of Network & Information Systems (NIS) Compliance

IAP Response

We have made no changes to this enhancement business case as there was no specific feedback in IAP in this area.

We refer Ofwat to the model review on Wastewater Security and Emergency Measures Directive (SEMD) and non-SEMD in chapter 5 of our IAP Response document for comments on the IAP assessment of costs.

Price Control(s)	Bioresources
Business Plan table and line(s)	Table: WWS2 Lines: A34, B81

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A34	0.254	0.254	0.255	0.255	0.255	**Capex: 1.019**
Opex (£m)	B81	0.036	0.035	0.035	0.034	0.034	**Opex: 0.174**
AMP7 carry over costs: £0.000m					Whole life benefit (EAB)*: £0.079m		
Whole life value (EAV)*: £-0.170m					Whole life cost (EAC)*: £0.250m		

* Note: Annualised values over 40 years

Investment Summary

Please see the WS2 Security of Network and Information Systems (NIS) Compliance enhancement case for details relating to this investment.

ORIGINAL ENHANCEMENT BUSINESS CASE AS AT 1 SEPTEMBER 2018

Water Resources Environmental Measures

Price Control(s)	Wastewater Network Plus
Business Plan table and line(s)	Table: WWS2 Lines: A4, B51

Best Value Option

Totex expenditure 2017/18 prices including RPE and post-productivity

	Line	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 total £m
Capex (£m)	A4	0.000	0.000	0.000	0.000	0.000	**Capex: 0.000**
Opex (£m)	B51	0.043	0.087	0.000	0.000	0.000	**Opex: 0.130**
AMP7 carry over costs: £0m					Whole life benefit (EAB)*: £0m		
Whole life value (EAV)*: £0m					Whole life cost (EAC)*: £0m		

* Note: Annualised values over 40 years

Please see the WS2 Water Resources Environmental Enhancements enhancement case for details relating to this investment.

WWS2A - WHOLESALE WASTEWATER CUMULATIVE CAPITAL ENHANCEMENT EXPENDITURE BY PURPOSE

SECTION A: CUMULATIVE CAPITAL ENHANCEMENT EXPENDITURE BY PURPOSE

Lines 1 to 45: Cumulative capital enhancement expenditure by purpose

The derivation for the core data and the allocation to the purpose for this table is described in the WWS2 Table Commentary. The tables are completed by using the outputs from our C55 System which contain project level investment details. We have excluded any additional on-going operational and maintenance expenditure to ensure the assest maintain their required function. We have excluded any projects that are booked to operational costs as part of IFRS for example Partnership Funding.

This table identifies the cumulative capital enhancement projects (schemes and investigations) delivered in the report year. We have noted the reporting requirements that this table does not collect historic data. References to AMP5 and AMP5 driver codes in the line definitions are therefore redundant but have been retained for simplicity.

Where a quality enhancement scheme (or the proportionally allocated component of a quality enhancement scheme) has more than one cost driver, we have allocated the expenditure attributable to the primary driver to the relevant line. This has been undertaken by using our Business Investment Codes (BIC). Any net additional cost for delivering any further drivers have been included in the (different) relevant line.

We have therefore assumed the costs of the project are proportional allocated against drivers not total project costs against a single primary driver, and example is given below. We have conformed with the requirements the costs in the table are the cumulative total.

Capital Expenditure - Proportional Allocation Example

Example	£m	Business Investment Code 1 Allocation	Business Investment Code 2 Allocation	Business Investment Code 3 Allocation
Wastewater Treatment Works	%	60	30	10
For a £10m Project	£m	6	3	1

Line 11: WINEP / NEP ~ Storage schemes in the network to reduce spill frequency at CSOs, etc

For clarity we have allocated all of our U_INV and U_IMP investment relating to high spilling CSOs to line 11 in WWS2a. As part of our drive to reduce carbon and reduce cost we have agreed with the Environment Agency that one of the investments does not require storage and can instead resolve the issue with upgrades to the screen. This is the reason for the absence of a figure in 20-21 on line 11 in WWS4 'Volume of new or additional storage provided in the sewerage network'.

Line 21: WINEP / NEP ~ UV disinfection (or similar)

The population equivalent outputs in WWN4 Line 24 have been checked to line up with the sewage treatment capex.

This validation flag looks at the total spend for each year. The outputs in WWN4 line 24 only relate to sewage treatment. However the flag is capturing all spend for sewage collection, creating a flag on years 18-19, 22-23 and 23-24

WWS3 - WHOLESALE WASTEWATER PROPERTIES AND POPULATION

SECTION A: PROPERTIES AND POPULATION

Line 1: Residential properties connected during the year

2017/18 data is derived from recorded connection numbers.

Forecast data is as provided by the Local Planning Authorities in line with the requirements set out in our Water Recycling Long Term Plan (WRLTP) and Water Resources Management Plan (WRMP). This data has been collated by an external demographic consultant (Edge Analytics) and indicates an increase in housing in our region, reflecting the government need to increase house building, especially along the Oxford to Milton Keynes to Cambridge corridor which is pre-dominantly in the Anglian Water region.

The forecast has been developed reflecting the near term Local Authority Plans, in alignment with the WRMP, the WRLTP and Environment Agency (EA) / Ofwat guidance.

The validation flag for line 1 is in units, however it appears that the validation flag has not converted to (000). We believe it should be 4.000 to 60.000.

Line 2: Business properties connected during the year

2017/18 data is derived from recorded connection numbers.

Forecast data is as provided by the Local Planning Authorities in line with the requirements set out in our WRMP.

This is in alignment with the WRMP and WRLTP.

Line 3: Residential properties billed unmeasured sewerage

Baseline data has been derived from recorded out turn information, and the projected forecast for customers switching from unmeasured to measured and new build properties, in alignment with the WRMP and WRLTP.

Metering data has been used to inform the forecast.

The forecast for 2018/19 has been updated to reflect better information now that we are further through the report year.

Line 4: Residential properties billed measured sewerage

Baseline data has been derived from recorded outturn information and the projected forecast for customers switching from unmeasured to measured and new build properties, in alignment with the WRMP and WRLTP.

Metering data has been used to inform this forecast.

The validation flag on this line is highlighted because our data is above the value rule allocated by Ofwat to this line.

The forecast for 2018/19 has been updated to reflect better information now that we are further through the report year.

Line 5: Residential properties billed for sewerage

This totals residential properties for measured and unmeasured customers for the Anglian Water Recycling Region.

Line 6: Business properties billed unmeasured sewerage

Unmeasured non-household (business) properties have been forecast in line with recent trend evidence and in alignment with the WRMP and WRLTP.

Line 7: Business properties billed measured sewerage

Measured non-household (business) properties have been forecast in line with recent trend evidence and in alignment with the WRMP and WRLTP. WRMP regression analysis suggests a marginal decrease in non-household properties over time.

Line 8: Business properties billed for sewerage

This totals business properties for measured and unmeasured customers served by Anglian Water.

Line 9: Void properties

Void property totals have been derived from outturn data and 'Local Authority' Plan based projections.

Line 10: Total number of properties

This value aggregates household (residential) and non-household (business) properties served by Anglian Water.

The forecast for 2018/19 has been updated to reflect better information now that we are further through the report year.

Line 11: Resident population

Population is calculated based upon SAP (our corporate system), customer information, Office for National Statistics (ONS) population data and 'local authority' household data. Population is derived using the estimation of households served by us as a percentage of the Department of Communities and Local Government (DCLG) totals, applied to the ONS Local Authority Unitary Authority (LAUA) population assessments. Occupancy rates are used in addition to this to generate plan based population projections. Additional account is taken of communal population, which is derived from Census data. The population figures have been aligned with the WRLTP forecast.

Data referenced:

- ONS snpp (sub national population projections)
- DCLG Household projections
- Local Authority Plan projection data
- ONS mid-year estimates
- Census data - re Communal population data
- SAP baseline AWS household data.

Line 12: Non Resident population

Non resident (holiday) population has been assessed for the WRLTP in order to provide a determination of associated Population Equivalent and biological load.

- Outturn – Derived in accordance with year-end reporting processes.
- Forecast – This is derived in accordance with the WRMP / WRLTP methodology, utilising historic out-turn data to derive a regression based forecast projection.

WWS4 - WHOLESALE WASTEWATER OTHER (EXPLANATORY VARIABLES)

Lines 1 to 3: Energy consumption wastewater network plus, sludge and wholesale

The estimated energy consumption forecast for water recycling operations at the end of AMP7 has been set at 571,640 MWh, a 9% increase from the forecasted baseline year 2019/20 of 524,611 MWh. For network plus, the movement is primarily explained by the expected delivery profile of OC01 AMP7 schemes, in particular those in the Water Industry National Environment Programme (WINEP) portfolios. For sludge, the movement comes mainly in 2019/20 as a result of increased biosolids haulage and sludge processing.

A number of assumptions have been made in calculating the forecasted energy consumption for water recycling wholesale business unit:

- The data for all periods has been updated in line with the methodology used in the 2017/18 Annual Performance Report. This reflected the change in Ofwat guidance and a methodology that used the financial split for electricity consumption
- We have applied a financial split from regulatory accounts between sludge and network plus for grid electricity consumption
- For existing data, we have applied a confidence grade of A2 as the majority of raw data is based on metering and has been audited as part of the ISO-14064 certification process. For forecast data we have applied a confidence grade of C4 as this is based upon extrapolation of metered data
- Forecast electricity consumption (both imported from the grid and on-site generation) for 2019/20 and AMP7 uses the 2018/19 power budget as a baseline, with the incremental change in Revenue Impact Of Capital Schemes (RICS) on enhancements and OC01 (Annual Net Change in Electricity Use) factored into each year
- Forecast RICS reporting up to 2019/20 provides an anticipated date of delivery and as a result we can determine the kWh change in each year. For OC01 for AMP7, rather than a forecast delivery date we have the final year of capital spend and so a straight line projection approach has been used. This assumes that all schemes are delivered midway through the delivery year, i.e. half of the total change in kWh for a scheme is assumed in the delivery year and for subsequent years, 100% of the scheme is included
- We have included electricity from renewable sources generated and used on site, including Combined Heat and Power (CHP), wind and solar
- Grid electricity and fuel (oil and natural gas) used in offices has been included and split equally between water and water recycling
- Fuel oil is not recorded on our corporate systems in the categories required. This is with the exception of gas oil consumed within CHP boilers which has been allocated entirely to the Sludge line. For the remaining fuel oil, the same split used for electricity has been assumed
- An assumption has been made that 90% of gas oil delivered to water recycling sites is used for CHP boilers. For 2017/18 and previous Annual Performance Reports (APRs), fuel oil delivered to water recycling operations has adopted the same split as electricity (83% network plus and 17% to sludge). However, this has now been updated to reflect a more accurate approach recently adopted by our Management Accountants. A revised split of 10% network plus / 90% sludge has been used. Accordingly there is a difference in the data reported in our 2017/18 APR and these lines for PR19
- Transport is not recorded on our corporate systems in the categories required. This is with the exception of RTS fleet biosolids haulage which has been allocated entirely to the Sludge line. For the remaining transport, the same split used for electricity has been assumed
- For transport (fleet fuel) the split between water and water recycling is not measured and therefore we have assumed a 50 / 50 split

- Sub contracted transport (sludge and cake) has not been included, only fleet (directly operated) vehicles
- We have assumed a 35% thermal efficiency for natural gas consumption in converting to energy output (boilers and CHP)
- For forecasted RTS biosolids haulage for AMP7, we have converted a forecast of miles into volume of fuel using 'The Department for Transport statistics – Average heavy goods vehicle fuel consumption, Great Britain: 2003 to 2016'
- Transport for company cars is collected as mileage. We have converted mileage into kWh through using the UKWIR carbon accounting workbook Version 12 through calculating miles to carbon dioxide equivalent to litres.

Line 4: Population Resident in National Parks, SSSIs and Areas of Outstanding Natural Beauty (AONB)

Approach:

1) National Parks: Within our appointed area, there is only one National Park, the Broads. The Broads Authority, on its web-site, estimates the population of the area covered by the Authority. We have used that forecast to populate the National Park element of line 4. As the web-page has a copyright date of 2014, the population quoted is believed to be taken from the 2011 National Census. Given the nature of National Parks and the consequent improbability of any significant property development within the designated Park area, we have assumed that the reported population remains static over the entire forecast period.

2) Sites of Special Scientific Interest (SSSIs): There is no central record of population within SSSIs. SSSIs are generally designated such that they do not include dwelling places. As such we have estimated the resident population as a notional nominal figure.

3) Areas of Outstanding Natural Beauty (AONBs): There are four AONBs within our appointed area: Lincolnshire Wolds, Norfolk Coastal, Suffolk Coastal and Heath and Dedham Vale. Each individual AONB has its own web-site. On each site there is a document which estimates the population within the AONB. We have used those figures to populate the AONB element of line 4. The AONB element of line 4 represents around 90% of the total for the line. We have assumed that AONBs will not see significant property development and as such can be assumed to have a static population over the forecast period.

Line 5: Total sewerage catchment area

We keep GIS records of each of the 1,138 sewer networks within our appointed area. The area data (in square metres) is summed for all sewer networks and divided by a million to give the area in square kilometres as of 2017.

To allow for growth over the forecast period we have taken the following approach based on:

a The area accounted for under new s101a schemes
b The area accounted for by non-s101a scheme additional properties

For s101a schemes we assumed:

- An average population density for Anglian Water's Appointed Area of 194/sq km (as of 2017)
- An average household size of 2.5.

We used that factor along with the number of properties served per year by S101a schemes to compute the population served by new s101a schemes over the forecast period. Finally, working back from the population density and the new population, we calculated the additional area covered.

For non-s101a schemes, using the forecast new properties (net of s101a properties), we increased the current sewered area pro rata with the aggregate increase.

Line 6: Designated bathing waters

Figures are based on the number of designated bathing waters in 2017, which is 49, to be consistently held next AMP. This assumes that no additional bathing waters will be designated in AMP7 and includes Clacton Groyne 41, which may or may not be de-designated in 2019. The designation of new bathing waters is undertaken by the Local Authority and we have no control over designations.

Line 7: Number of intermittent discharge sites with event duration monitoring

The original EDM1, rB5, s8 obligation required 177 Event Duration Monitors (EDMs) to be installed in 2017/18. The number of EDMs actually installed or upgraded was 158 as, during site surveys, 19 overflows were found to be blocked off or the network found to have been redesigned meaning they no longer spill to the environment. There has been capital spend associated with surveying and investigating all 177 discharge locations and this cost has been included in table WWS2, line 6. All 177 obligations have been signed off as outputs by the EA and therefore 177 has been entered for this line 7.

Figures for 2018/19 and 2019/20 include the forecast for the EDM2 outputs according to the Water Industry National Environment Programme (WINEP). There are no EDMW obligations identified for Anglian Water.

From 2020/21 onwards the U_MON1, U_MON2, SW_MON, BW_MON and UMON3 figures are based on the EA's PR19 guidance. However, these forecast figures are not based on EA obligation date but on phasing of finance for the PR19 business plan, assuming that the EA will agree to the list of new EDMs required in AMP7.

	EDM1, rB5, s8, EDM2, U_MON1, U_MON2, SW_MON and BW_MON							
	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
EDM Infra and Non-infra	177	336	336	68	68	68	68	68
	U_MON3							
WRC EDMs				194	224	2		
	Total							
Total	177	336	336	262	292	70	68	68

Line 8: Number of monitors for flow monitoring at STWs

There are no sites under the AMP6 Driver code Flow 3. The sites included for this line are under the AMP7 U_MON4 driver. These consist of overflows at the WRC as detailed in the EA's PR19 Guidance.

There are no sites under the U_MON5 driver.

It is noted that the expectation is we would provide fewer than 100 monitors per year. However these forecast figures are not based on the EA obligation dates, but on phasing of finance for the PR19 business plan, assuming that the EA will agree to the list of new EDMs required in AMP7.

Line 9: Number of Odour related complaints

The number of odour related complaints for 2017/18 are calculated from a combination of odour related work orders raised following telephone complaints and written correspondence figures received for this time period. Trends for the previous three years were used to forecast odour complaints up to 2020.

From years 2020 to 2025, the adoption of CMEX will mean that social media contacts will need to be included as part of odour complaint data. Analysis in current trends in social media contacts have been used to estimate the impact of social media on odour compliants. This has then applied to the figures for years 2020 to 2025, which is why we are predicting an increase in odour complaint as we move into AMP7.

Our forecast data predicts that, without investment the average annual number of odour complaints would increase to 3,373 for the period 2021 to 2025. Our investment strategy for this period has identified that, with enhanced response to initial customer complaints (including communication, ownership, root cause analysis and catchment investigations) all repeat complaints are avoidable. For the period 2016/17 there were a total of 430 written complaints and repeat telephone complaints. This number has therefore been removed from our forecasts for 2021 to 2025, on the assumption that our investment case will be approved.

Line 10: Volume of storage provided at storm tanks, etc to meet spill frequency objectives

The updated data in this line reflects discussions with the EA to agree phasing of 40 investments with current obligation dates before 31 March 2025 to move them into AMP8 as described in our enhancement case shown in the commentary to WWS2. Written confirmation of these changes is being sought from the EA. Re-sizing of storm tank volumes is in line with EA guidance and re-profiling of delivery through the AMP7 period.

Line 11: Volume of new or additional storage provided in the network.

The figures provided are based on the volume of storage tanks identified in planned investments for NEP in AMP6 or WINEP in AMP7. Schemes with a WINEP status of green and amber were included within this line as the most likely schemes to be going ahead. Only investments that included storage within the network have been reported (three investments that include storage at WRCs have been excluded). Permit conditions have not yet been specified for future investments under WINEP so volume of storage specified within each investment has been used.

For clarity we have allocated all of our U_INV and U_IMP investment relating to high spilling CSOs to WWS2 line 11. As part of our drive to reduce carbon and reduce cost we have agreed with the Environment Agency that one of the investments does not require storage and the issue can instead be resolved with upgrades to the screen. This is the reason for the absence of a figure in 2020/21 on WWS4 line 11 'Volume of new or additional storage provided in the sewerage network'.

Line 12: Number of sewage treatment works at which the new or additional storage reported in WWS4 line 10 is provided

The updated data in this line reflects discussions with the EA to agree phasing of 40 investments with current obligation dates before 31 March 2025 to move them into AMP8 as described in our enhancement case shown in the commentary to WWS2. Written confirmation of these changes is being sought from the EA. Re-sizing of storm tank volumes is in line with EA guidance and re-profiling of delivery through the AMP7 period.

Line 13: Number of sites in network at which new or additional storage is provided

This is the number of sites where storage has been identified for the calculation of line 11. Any schemes with a WINEP status of green and amber were taken forward for this investment as the most likely schemes to be going ahead.

Line 14: Total Volume of Network storage

The projected numbers for years 2018/19 and 2019/20 are taken from historical averages based on a new and improved process that ensures that we do not double-count any transferred sewer assets.

For years 2020 to 2025 planned volumetric increases have been extracted from Anglian Water's corporate investment system (C55) and applied to each year. This method aligns with that used for table WWn3, lines 21 and 22 (as required by the line definition). They also include s104 storage projections for AMP7.

Years 2022 to 2025 see some of the biggest increases due to a combination of schemes that deliver increased drainage capacity, new Strategic sewer schemes towards the end of AMP7, and a peak in numbers of projected new s104 connections during the reporting year 2022/23.

WWS5 - OTHER WHOLESALE WASTEWATER EXPENDITURE

SECTION A: OTHER TOTAL EXPENDITURE

Lines 1 and 3: Directly attributable employment costs and FTEs

Although some direct opex employment costs can be allocated to service, many front line employees work across operational boundaries and therefore, where not directly allocated, we have used a management assessment of time spent by service. We have nevertheless classed all employees within this category as direct.

The number of direct Full Time Equivalents (FTEs) is assessed from the total employment costs using an average cost per employee.

The only anticipated change in direct employment costs in 2018/19 and 2019/20 is through RPI.

Our AMP7 direct FTEs and costs take 2019/20 as a starting point and are increased to reflect additional resources required resulting from our capital programme during AMP7. Lines 1 and 3 have been amended to reflect our revised forecast of employment costs and FTEs resulting from the changes made in enhancement expenditure in table WWS2.

Lines 2 and 4: Indirectly attributable employment costs and FTEs

Indirectly attributed employment costs are made up of indirect operational employees, employees engaged on capital schemes and general and support employees. General and support employment costs are allocated by an appropriate cost driver as part of our regulatory accounts process.

Indirect operational employment costs and employment costs in relation to capex activity are allocated as a proportion of direct employment costs.

The number of indirect FTEs is assessed from the total employment costs using an average cost per employee.

The change in FTE and costs in 2018/19 is based on the change in establishment in the previous year and therefore our expected out-turn.

We expect indirect FTEs to reduce 2019/20 and the wastewater share has been apportioned by upstream service.

Our assumption is that indirect FTEs remain constant after 2019/20.

Line 5: Costs associated with the traffic management act

Reported costs reflect Traffic Management Act (TMA) costs principally charged to sewerage, including permits and fixed penalty notices.

SECTION B: SERVICE CHARGES

Line 7: Canal & River Trust service charges and discharge consents

Payments to British Waterways Canal & River Trust primarily for surface water discharges assumed to increase by RPI.

Line 8: Environmental Agency service charges / discharge consents

Payments to the Environmental Agency for pumping station and sewage treatment works discharge consents for Water Recycling Services. assumed to increase by RPI less any assumed efficiency from 2018/19.

The large increase in 2018/19 is due to a new charging structure introduced by the EA and notified to us in 2017/18.

WWS7 - WHOLESALE WASTEWATER LOCAL AUTHORITY RATES

Section A: Wastewater wholesale local authority rates

Our starting point is the reported charge for 2017/18 (line 9) which is then adjusted for recharges made as part of our annual reporting process to arrive at the charge received via the Valuation Office Agency (VOA) on line 3. The value of transition relief is a calculated number, intended to smooth the impact of the last revaluation in 2017. Our transition relief numbers to 2019/20 have been entered as positive numbers as we saw a reduction in our liability as a result of the 2017 revaluation.

In 2018/19 and 2019/20, the gross charge in line 1 assumes a CPI increase on the prior year with no further transition relief available after 2020/21. The total liability in line 1 also includes our assessment of the impact of new asset stock and efficiencies.

Based on the assessed use of our sites, we make a recharge to third party services which is included in the total recharge to third parties on table WWS1 line 10. These recharges are assumed to continue in line with the current levels during AMP7.

It is important to note that AMP7 straddles three separate revaluation periods and that the rateable value of the assets is subject to regular adjustment during each revaluation period as a result of stock additions and efficiencies as set out in Block B. The 2017 list is effective for the first year of the AMP and will then be followed by further revaluations in 2021 and 2024. There is currently no reliable information to project the likely rateable values at the 2021 or 2024 revaluations, or any information on rate poundage or transition relief arrangements. We have therefore adopted the 2019/20 liability in line 1 as the minimum liability payable in each year of AMP7. Line 1 has been amended to reflect our revised business rates forecast resulting from the changes made in enhancement expenditure in table WWS2.

Section B: Analysis of change in charge before transitional relief

Line 12: Change in wastewater wholesale business rates costs due to change in asset stock

This reflects our anticipated increase in our wastewater rates liability due to the impact of our capital investment programme through the construction of new sites or extension of existing ones. Line 12 has been amended to reflect our revised business rates forecast resulting from the changes made in enhancement expenditure in table WWS2.

Line 13: Change in wastewater wholesale business rates costs due efficiency and productivity challenge

Our efficiency challenge in AMP7 is shared across all cost headings and line 13 reflects the share allocated to business rates. We expect this to be achieved through on-going appeals and site optimisation activities. Line 13 has been amended to reflect our revised business rates forecast resulting from the changes made in enhancement expenditure in table WWS2.

Line 14: Change in wastewater wholesale business rates costs due CPIH

This shows the increase in liability in 2018/19 and 2019/20 based on assessed CPI and the adjustment in 2020/21 reflects the change to a 2017/18 price base in AMP7.

Line 15: Change in wastewater wholesale business rates costs due to in year changes to RVs through appeals process

This reflects the adjustment in 2020/21 to a 2017/18 price base in AMP7.

WWS8 - THIRD PARTY COSTS BY BUSINESS UNIT FOR THE WHOLESALE WASTEWATER SERVICE

Line 4: Bulk supplies

Included here are the two special agreements with Thames Water for the sewage and sludge treatment by our Water Recycling Centres (WRCs) at Chalton and Doddinghurst.

Line 5: Charges for reception and disposal of waste

No commentary required.

Lines 6 to 12: Other

No commentary required.

Line 13: Total third party waste water service costs - non price control (operating expenditure)

The total of Line 13 agrees to the total third party costs for waste water on table WWS1, line 10 (Wholesale wastewater operating expenditure).

Sections C and D: Capital expenditure

Reported costs are based on the guidance in RAG 4 Appendix 1 as per the guidance. Rationale for our completed tables are as per the below specific points:

Line 19: Contribution for capital expenditure at Doddinghurst WRC

We have two sites which treat wastewater flows for neighbouring water companies; Doddinghurst WRC and Chalton WRC, both of which treat flows from Thames Water customers. We have included in block D the spend relating to these sites, and included only the proportion of spend that Thames Water will contribute, not the full capital expenditure we will invest, on the basis that the costs of providing the third party service are only this proportion of the capital expenditure. Doddinghurst receives a 22% contribution to Capex.

Line 20: Contribution for capital expenditure at Chalton WRC

We have no planned investment at Chalton WRC for PR19 hence this line is forecast as zero for the whole of AMP7.

Line 21: Sewer and rising main diversions

The £2.4 million of expenditure forecast on wastewater diversions in AMP7 has been included in full as third-party expenditure on line 21 in accordance with RAG 4.07. This expenditure was previously recorded on WWS1, line 12 – Maintaining the long term capability of the assets ~ infra (£6.3 million over AMP7).

Net totex remains unchanged as a result of these changes to reporting of diversions.

WWS10 - TRANSITIONAL SPENDING IN THE WHOLESALE WASTEWATER SERVICE

In accordance with the published guidelines we have included transition expenditure for the wastewater network plus price control.

The programme and projects we have identified allow a smooth delivery from AMP6 to AMP7 and enable us to meet agreed completion dates with our quality regulators.

SECTION A: TRANSITION CAPITAL EXPENDITURE PURPOSES

Lines 1 to 49: Transition capital expenditure purposes

Our plans include for £27.498 million of transition expenditure in 2019/20 for the wastewater service. This represents 2.1% of our planned enhancement capital expenditure in the wastewater service.

In the transition into AMP6 we delivered 27% (£58 million) of the total amount of transition expenditure delivered by the Water Industry. This transition plan allows us to plan the more effective use of resources at the cross over of AMP periods rather than having a start stop approach. The scale of the transition plan has been mitigated by reinvest and release of shareholder funds into the business and through having mature long term alliances.

We have a significant challenge in the first two years of AMP7 in the delivery of our Wastewater Obligations.

By the end of year 1 we will need to have delivered:

- 278 Monitoring obligations across UWWTD flow and bathing waters (similar to EDM)
- 64 Investigation obligations across bathing waters, marine coastal zones and chemical investigations
- Eight Phosphorus improvements at Water Recycling Centres

By the end of year 2 we will need to have delivered:

- 448 Investigation obligations across eels, invasive species, groundwater and flow compliance
- 196 Monitoring obligations for UWWTD flow
- 10 Chemicals improvement obligations at Water Recycling Centres
- Six bathing water improvement obligations.

We have developed a set of Principles that align to the Ofwat Criteria as set down in the Guidance to WS10 and WWS10.

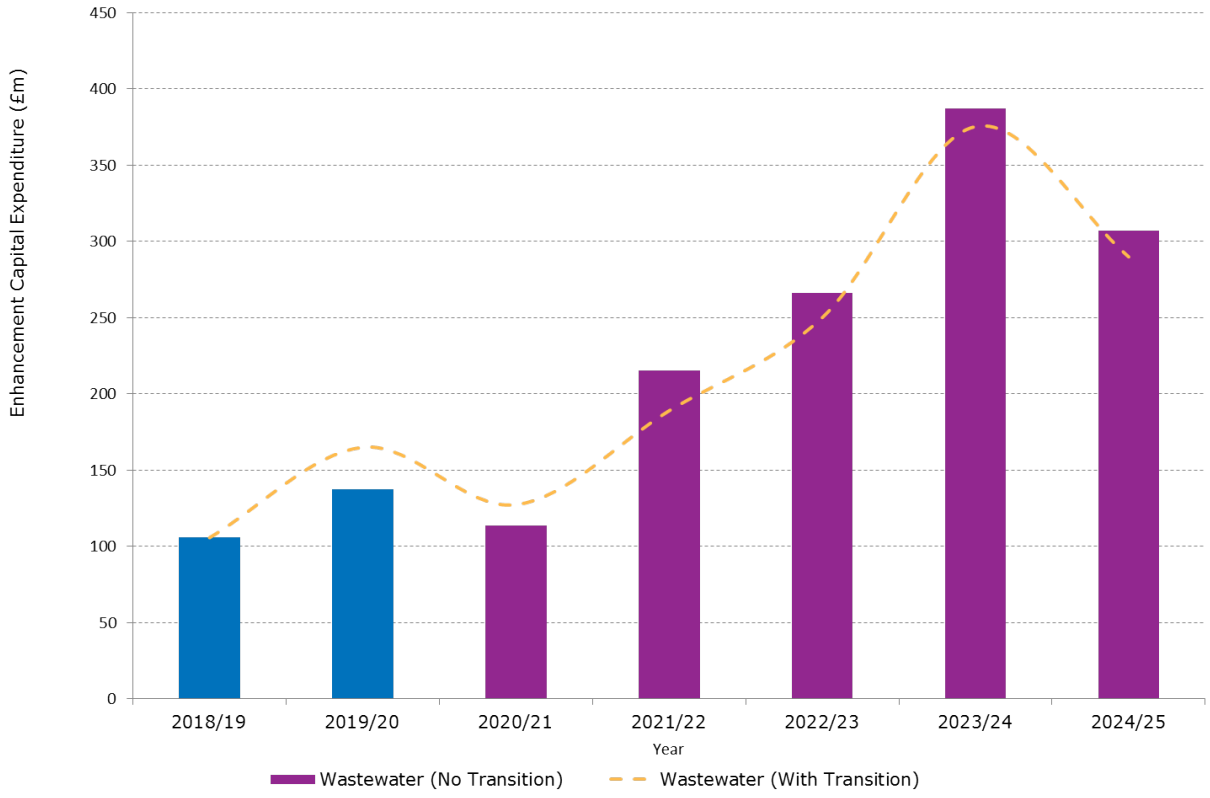
> **Principle 1:** Ofwat Compliance: All expenditure will need comply with the Ofwat guidance (Network+ only), except in exceptional circumstances.
>
> **Principle 2:** Smooth Expenditure Profile: Enabling a smooth ramp up of expenditure into AMP7, to enable smoothing of the expenditure profile (minimising the amplitude of expenditure) and enabling a smooth customer bill profile in AMP7.
>
> **Principle 3:** AMP7 Early Obligations: To ensure that we meet regulatory milestones for projects that will require delivery in years 1 and 2 of AMP7.
>
> **Principle 4:** Smoothed Resource Profile: Enabling continuity of work for resources across all alliances but particularly those with design resource. This principle also relates to major programmes of work that will be a challenge to complete in AMP7 such as growth, large diameter water mains and the water recycling quality programme.

The overall transition programme has been developed in conjunction with our existing alliance partners to minimise the impact of a down turn in design activity in 2019/20.

Our plans include for the following projects and programmes and align to table WWS2. The forecast expenditure is included in tables WWS1 and WWS2 as stated in the reporting requirements.

The positive impact of including this transition is detailed in the figure below and shows the smoothing effect on the enhancement programme in year 5 of AMP6 and the first two years of AMP7.

Figure 17 Wastewater enhancement capital expenditure profile (excluding G&C)



The table below give further details on the investment we are planning to include in our transition plan.

Wastewater Transitional Expenditure 2019/20

Ofwat Line Ref	Transition Capital Expenditure Purpose	AW Investment Ref	Project or Programme Name	Capital Expenditure 2019/20 (2017/18 Prices)
WWS10, A1	Commence the design on four schemes for customer who are not on the public sewerage system	Various	First Time Sewage Scheme - Section 101a	2.000
WWS10, A9	Early obligation set by the EA to be delivered in the first two years of AMP7	Various	WINEP Flow - Increase FFT	6.298
WWS10, A19	Enables early planning and design of this significant programme	Various	WINEP No Deterioration and GES	5.837

Ofwat Line Ref	Transition Capital Expenditure Purpose	AW Investment Ref	Project or Programme Name	Capital Expenditure 2019/20 (2017/18 Prices)
WWS10, A25	Enables early planning and design of the sewerage growth programme	I018745	SCS AMP7 Catchment Growth	9.174
WWS10, A26	Enables early planning and design of wastewater treatment centres growth programme	Various	WRC Growth Capacity	4.189
	Total Transition Expenditure			27.498

SECTION B: TRANSITION SUMMARY TOTALS

Line 51: Total gross transitional expenditure

This block is a total of lines 1 to 50.

Line 52: Grants and capital contributions for transitional expenditure

There will be no receipts of grants and contributions.

Line 53: Total net transitional expenditure

The total planned transition for the wastewater service is £27.498 million as detailed above.

WWS12 - RCV ALLOCATION IN THE WHOLESALE WASTEWATER SERVICE

Bioresources RCV overview

This commentary provides an overview of our proposal for the allocation of the wastewater RCV between bioresources and wastewater network plus business units. We provide more detailed information in the supporting information below.

We have drawn heavily on the extensive analysis we carried out for our submission to Ofwat in September 2017. Our approach to this provisional submission was to apply the economic value methodology set out in the Ofwat guidance. Our core team comprised Anglian Water staff with a range of expertise and knowledge of our bioresources business, together with support from Reckon LLP and Mott MacDonald. We carried out extensive supporting analysis, which drew on granular data and estimates, and produced a detailed report for Ofwat explaining our approach. The outcome of this process was a fresh and detailed valuation of our bioresources assets, alongside further cross checks and analysis.

We have built on the September 2017 valuation with targeted updates to the bioresources asset valuation in three key areas:

- Making use of more up-to-date information that has become available
- Checking consistency with the further guidance and clarification provided in Ofwat's feedback report from February 2018
- Using the comparative information from Ofwat's feedback report to further test our valuation.

At the same time, we have kept the update proportionate and not sought to repeat the scale and scope of the exercise that we carried out last year.

In terms of updated information, the main contribution has been the use of our PR19 cost models for the bioresources asset valuation. The timing of the September 2017 submission meant that we had to use the PR14 models and we stressed in that submission that we would seek to update the valuation when the new models became available. The update for the PR19 models has decreased the estimated gross value of our bioresources assets, mainly for thickening sites where our updated PR19 cost model for sludge mixers made use of recent Anglian Water cost data and this showed significantly lower estimates of new-build costs than the more externally-driven benchmarks from our PR14 models.

We have sought to ensure consistency with the guidance in Ofwat's feedback to companies on the September 2017 valuations. One significant change concerns ROCs. We had previously proposed an RCV allocation for bioresources that was based on the economic value of bioresources assets excluding the valuation of the future income from ROCs that would not be available to a hypothetical new entrant. We identified that there were arguments for and against the inclusion of this element of the valuation and said that this was an industry-wide issue for which we sought guidance from Ofwat. Following guidance and clarification from Ofwat's feedback report, we have included the future income from ROCs as part of the valuation to be used for RCV allocation purposes.

We retain our view that only assets that form part of the bioresources business unit under the principal use rule should be included in the valuation used to determine the bioresources RCV. It seems important to exclude the valuation of any shared use assets (e.g. corporate IT systems) that form part of other business units such as wastewater network plus; the costs of these shared assets will be recovered through recharges to the bioresources business unit and including an allocation of the value of these assets in the calculation of RCV for bioresources would represent double counting and risks unduly high charges for bioresources services. We welcome the flexibility that Ofwat's feedback report offered companies on this issue.

One of the comparisons in Ofwat's feedback report implied that Anglian Water's asset life assumptions were generally lower than those of other companies. We gave further review to our asset life estimates in the light of the feedback report and also the further information that is now available to us. More generally, we used the comparative information in the feedback report to help guide areas for further consideration as part of the update to our valuation.

We provide in the supporting information below a list of the key issues that we identified for further investigation or action following Ofwat's feedback report, together with information on how we addressed them in our updated valuation. We also provide an explanation of the changes to our valuation since the September 2017 submission.

A number of parties provided assurance in relation to the data tables and accompanying report that we submitted in September 2017. Jacobs, Deloitte, Reckon LLP and Mott MacDonald all undertook assurance activity to ensure the submission was accurate and complete. The Board approved the submission and our Chairman, Stephen Billingham, signed the Board Assurance Statement.

Jacobs carried out a further review of our approach to the valuation of our bioresources assets following feedback received from Ofwat in February 2018. This included a review of the data table WWS12 and the data tables which we updated following the original submission in September 2017.

Overall, our updated estimate of the economic value of our bioresources assets at 31 March 2020 is £312.6 million (March 2018 prices), and our proposed allocation of the wholesale wastewater RCV is 6.4% to bioresources and 93.6% to wastewater network plus.

Bioresources asset valuation and RCV allocation

The table below provides an overview of the main changes to our estimation of the net MEAV of bioresources assets since the provisional valuation we submitted to Ofwat in September 2017. We provide more detailed explanation of the various changes we have made in Our Bioresources RCV Information annex and in our table commentary below.

Overview of changes to estimated net MEAV of bioresources assets since September 2017 submission

Item	Main factors driving changes	£ million
Net MEAV of bioresources assets at 31 March 2020 submitted in Sept 2017		326.0 [1]
RPI inflation from March 2017 to March 2018 prices		10.9
Changes to the allocation of assets between business units	Exclusion of net MEAV of M&G assets that do not form part of bioresources under principal use rule	(8.9)
Changes to the gross cost of hypothetical new assets	Update and improvement to gross new-build cost estimate, now using our PR19 cost models	(37.8)
Changes to the adjustment for the remaining economic life of existing processes	Consequential effects of lower gross cost of hypothetical new assets; update for latest information; minor improvements to methodology for adjustments; and update to discount rate used	22.9
Other changes	Minor updates relating to land valuation and to discount rate used for other calculations	(0.5)
Net MEAV of bioresources assets at 31 March 2020 submitted for PR19 business plan (March 2018 prices)		312.6

1 The figure of £326.0 million included a valuation of future income from ROCs and a pro rata allocation of the value of shared assets used by the bioresources business unit, but these were excluded from the provisional RCV allocation of £273.8 million from our September 2017 submission

Table commentary

Table WWS12 concerns the application of an economic value methodology to estimate the value of our bioresources assets at 31 March 2020, for the purposes of allocating the wastewater RCV between bioresources and wastewater network plus price control business units.

We have used the guidance provided in Ofwat (2017) "Economic asset valuation for the bioresources RCV allocation at PR19" and the further guidance, clarification and amendments provided in Ofwat (2018) "Economic value of bioresources assets – feedback to companies' on their September 2017 proposals".

For table WWS12, we have drawn heavily on the extensive analysis we carried out for our submission to Ofwat in September 2017. We have built on our September 2017 valuation with targeted updates to the bioresources asset valuation in three key areas:

- Making use of more up-to-date information that has become available
- Checking consistency with the guidance and clarification provided in Ofwat's feedback report from February 2018
- Using the comparative information from Ofwat's feedback report to further test our valuation.

The figures reported in table WWS12 reflect the extensive and detailed assessment we have carried out in our original submission on the bioresources asset valuation and RCV allocation as well as the targeted update. We describe our approach and data sources in detail in our original submission (which included a commentary on the data tables used for the 2017 submission) and in our Bioresources RCV Information annex.

The commentary below is intended to further elaborate on table WWS12 but does not seek to repeat the level of detail on the approach and data sources that is provided in these supporting documents, which should be read in conjunction with this commentary.

Ofwat's data tables guidance states that is a company makes significant changes to the valuation it proposed in September 2017, or otherwise does not have confidence that Ofwat will be able to understand the changes it has made from this business plan table, it should also submit the full set of updated detailed tables alongside its business plan. Therefore we have included in our submission an updated set of tables.

Line 1: Net MEAV submitted in September 2017

This line is taken directly from the corresponding data in the bioresources RCV data tables from the September 2017 submission. It is in March 2017 prices.

Line 2: Proposed RCV allocation in September 2017 (prior to midnight adjustments)

This line is taken directly from the corresponding data in the bioresources RCV data tables from the September 2017 submission. It is in March 2017 prices.

Our proposed RCV allocation from the September 2017 submission differed from our estimate of net MEAV of bioresources assets (line 1) due to two factors: (a) we excluded an estimate of the value of shared use assets that would not form part of the bioresources business unit on a principal use basis; and (b) we did not include an adjustment to reflect the value of ROCs held by our bioresources business that would not be available on a hypothetical new-build basis from 1 April 2020 (we identified arguments in either direction and saw this as an industry-wide issue for which we sought guidance from Ofwat).

Note that we did include the valuation of shared use M&G, and the adjustment for ROCs, within our net MEAV estimate submitted in September 2017, which is reproduced in line 1 above. In line with the structure of data table WWS12, it is this net MEAV figure which is the basis for comparisons against the September 2017 submission in Section B below.

Line 3: RCV (% of total wastewater wholesale)

This is calculated using the figures from lines 1 and 2.

Line 4: Inflation from March 2017 to March 2018 prices

This line is calculated by taking the net MEAV figure for bioresources from line 1, multiplying by the RPI in March 2018 and dividing by the RPI in March 2017.

Line 5: Changes to the allocation of assets between business units

The change in line 5 concerns change to the allocation of the management and general assets for the purposes of the estimation of the net MEAV of bioresources assets.

The net MEAV figure submitted in September 2017 included a proportionate allocation of M&G from across the appointed business (this followed Ofwat guidance at the time, though we excluded this from our proposed RCV allocation due to the issues raised below about double counting).

For our updated valuation, and following Ofwat's feedback report, we adopted the approach of only including in net MEAV the value of M&G assets that form part of bioresources under the principal use rule, which reduces the total net MEAV for M&G compared to the net MEAV figure in line 1 above.

Ofwat's feedback report acknowledged this potential issue and gave companies an option of inclusion or exclusion of the cost of shared assets in the valuation, provided this was explained with appropriate reasoning. We have given this issue further consideration following the Ofwat feedback report. Our reasoning is below.

Our view is that it is necessary to exclude from the bioresources asset valuation the value of any assets that do not form part of the bioresources business unit under the principal use rule, to avoid double counting the costs of shared use assets and risks of overcharging customers for bioresources services.

To the extent that the bioresources business unit make use of such assets, their costs are to be recovered through recharges from other business units (typically wastewater network plus). These recharges form part of the operating expenses of the bioresources business unit. Our 2017/18 APR shows that there is a significant recharge from wastewater network plus to bioresources (table 2A).

Once a system of principal use reporting and recharges has been established between business units, it is no longer internally consistent to value bioresources assets according to pro rata allocations of shared use assets.

For our updated valuation, we have only included M&G for assets that form part of the bioresources on a principal use basis and we have produced an updated estimate of the net MEAV of these assets for this valuation.

Line 6: Changes to sludge assets in existence

The value for this line is zero. We did not identify any changes to the nature or scale of the bioresources assets that we will have in existence on 31 March 2020, compared to the forecasts and assumptions used for our bioresources RCV data tables from 2017.

Line 7: Changes to the gross cost of hypothetical new assets (excluding land)

The valuation submitted in September 2017 used cost models that we had developed for PR14. We said in our submission that, for our business plan, we expected to be able to draw on updated cost models developed for PR19. We have now had opportunity to update our analysis to use the PR19 models.

As we had anticipated, the update for the PR19 cost models had a material impact on the estimates. The main area of new-build costs is the STCs. Our updated cost models reduced the estimated new-build cost value for STCs (adjusted to March 2018) by around £2 million.

The bulk of the change was for dewatering sites (thickening sites), where the new-build cost reduced by £33 million. The change for dewatering sites was mainly influenced by the change in the cost model for sludge mixers. This model is now based mainly on Anglian Water actual cost data captured in the last four years, which is in contrast to the PR14 cost model for sludge mixers that it was based on external and less up-to-date cost data. We also carried out a top-down sense check of the gross costs for dewatering sites and are confident that the revised figures represent a more-up-to-date and reliable estimate of new-build costs for our dewatering sites. We also note that Ofwat's feedback report had identified that our gross costs for "other sites" (dewatering sites) was relatively high compared to other companies (figure 4.1 and para 4.10).

The economic value of transport assets has decreased as a result of up-to-date information and AMP6 expenditure forecasts being used for this revised submission.

Line 8: Changes to differences in revenue and costs between hypothetical and actual assets

Our estimate of the economic value of our bioresources assets at 31 March 2020 includes adjustments to reflect differences in the income (e.g. from energy and ROCs) and operating costs between actual and hypothetical assets.

Our updated estimate of this adjustment is £0.5 million smaller than the corresponding adjustment from our September 2017 submission (since the adjustment is negative, this update acts to increase the net MEAV of bioresources assets by £0.5 million). It is made after updating the relevant income and operating cost assumptions from March 2017 and March 2018 prices, consistent with the change in line 4 above. The change of £0.5 million is attributable to a change in the discount rate used for the calculation of the adjustment: for the update we used a 3.3% real CPIH WACC in the NPV calculations, following guidance in the Ofwat feedback report.

Line 9: Changes to the adjustment for the remaining economic life of existing processes

Our estimate of the economic value (net MEAV) of our bioresources assets involves taking the estimated gross MEAV (hypothetical efficient new-build costs) for those assets and applying an adjustment to reflect the difference in economic value arising from the remaining economic life of the actual bioresources assets we will have at 31 March 2020 being shorter than the economic life of the hypothetical assets assumed for the gross MEAV.

The adjustment is around £23 million smaller (which means a smaller deduction from gross MEAV) than we had estimated for our submission in September 2017. This change reflects the combined effect of the following factors:

- Revisions to the gross value of assets to which adjustment applied (see line 7 above): lower gross value means a smaller negative adjustment
- Use of 3.3% real CPIH WACC in the calculation of the adjustment, following Ofwat guidance
- Revision to the remaining economic life of the Hitchin WRC indigenous sludge dewatering site to take account of changes to our AMP6 plan since the September 2017 submission: the replacement of the assets at this sight have been deferred to AMP7, which means that the assets in place at 31 March 2020 at Hitchin WRC will have a shorter remaining life than we had previously expected.
- Some minor changes to remaining life estimates based on improvements to methodology for taking account of asset usage at dewatering sites.

Line 10: Changes to land valuation

In the case of land valuation, our latest valuation information is that market prices have been approximately flat in nominal terms between the two valuation dates, so we have used the same figures from the September 2017 submission. This means that there is a small reduction (£1 million) in land value relative to the inflation adjustment applied to the net MEAV figure in line 4 above.

Lines 11 to 17: Other changes

We made no other changes to the valuation beyond those captured in our entries for lines 4 to 10.

Line 18: Net MEAV

This line provides our updated assessment of the economic value (also referred to as net MEAV under Ofwat's guidance and data tables) of our bioresources assets at 31 March 2020, expressed in March 2018 prices. Our estimation of economic value follows the Ofwat methodology, including clarification and amendments from Ofwat's 2018 feedback report. We explain our approach to the assessment of economic value in our *Bioresources RCV Information* annex.

In line with the guidance in Ofwat's feedback report from March 2020, we have considered the appropriate treatment of shared use assets (for example, some management and general assets) that do not form part of the bioresources business unit under the principal use rule. As explained under line 5 above, and in our supporting documents, we consider it appropriate to exclude shared use assets that are not part of bioresources on a principal use basis.

Line 19: RCV (prior to midnight adjustments)

We have proposed an RCV allocation to the bioresources business unit that is equal to the net MEAV for bioresources provided in line 18.

The allocation to the wastewater network plus business unit is calculated as the residual having deducted this bioresources allocation from the forecast total wholesale wastewater RCV at 31 March 2020 (prior to midnight adjustments), in March 2018 prices, which is provided in table APP8.

Line 20: RCV (% of total wastewater wholesale)

This line provides the percentage allocation of the wholesale wastewater RCV between the bioresources and wastewater network plus business units and is calculated using the figures from line 19.

Section D: Net MEAV at 31 March 2020 by asset type

Lines 21 to 28 provides estimates derived from our updated assessment of the economic value of our bioresources assets, in March 2018 prices, broken down between different types of bioresources assets.

We explain our approach and data sources for each of the areas below in our original submission document, as updated and revised in our Bioresources RCV Information annex. We provide some brief comments on specific lines below, but do not seek to reproduce the detailed explanations of our approach and data source provided in those documents.

We explain the main reasons for changes to the net MEAV figures for bioresources assets since the 2017 submission in section B above.

Line 21: Sludge transport plant

This line provides our updated estimate of the economic value of the liquid sludge haulage (tankering) assets of the bioresources business unit.

Line 22: Sludge transport management and general

On a principal use basis, we identify no management and general assets for sludge transport and the entry for this line is zero.

Note that, in contrast, the corresponding figure in the bioresources RCV data tables from 2017 was non-zero because, under the Ofwat guidance which has subsequently been amended, the latter included an allocation of part of the value of shared management and general assets from other business units.

Line 23: Intermediate sludge thickening plant

The line provides our updated estimate of the economic value of the dewatering sites that form part of the bioresources business unit. These sites include both dewatering hub sites and sites that provide indigenous dewatering only. It includes the value of land for these dewatering sites.

Line 24: Thickened sludge transport plant

The line provides our updated estimate of the economic value of the dewatered (raw cake) haulage assets that form part of the bioresources business unit.

Line 25: Sludge treatment plant

The line provides our updated estimate of the economic value of the various sludge treatment assets at the ten sludge treatment centres that we will have at 31 March 2020. It includes the value of land for the sludge treatment centres.

Line 26: Sludge treatment management and general

The line provides our updated estimate of the economic value of the management and general assets at our sludge treatment centres and which form part of the bioresources business unit on a principal use basis.

Note that the corresponding figure in the bioresources RCV data tables from 2017 included, under the Ofwat guidance which has subsequently been amended, an allocation of part of the value of shared management and general assets from other business units.

Line 27: Sludge disposal plant

The line provides our updated estimate of the economic value of the biosolids (digestate cake) haulage and recycling assets that form part of the bioresources business unit.

Line 28: Sludge disposal management and general

On a principal use basis, we identify no management and general assets for sludge disposal and the entry for this line is zero.

Note that, in contrast, the corresponding figure in the bioresources RCV data tables from 2017 was non-zero because, under the Ofwat guidance which has subsequently been amended, the latter included an allocation of part of the value of shared management and general assets from other business units.

Line 29: Bioresources net MEAV at 31 March 2020

The line provides our updated estimate of the economic value (also referred to as net MEAV under Ofwat's guidance and data tables) of our bioresources assets, on a principal use base. It is calculated as the sum of the valuations in lines 21 to 28 and matches the corresponding figure in line 18.

Lines 30 to 40: Adjustments from Gross MEAV to Net MEAV

Lines 30 to 40 provide a summary of our updated assessment of the economic value of our bioresources assets, in March 2018 prices, which shows the movement from gross MEAV to net MEAV. This is based on the assessment we made for our September 2017 submission, combined with targeted updates.

We explained our approach and data sources for each of the items below in our original submission document from 2017, as updated and revised in our *Bioresources RCV Information* annex. We provide some brief comments on specific lines below, but do not seek to reproduce the detailed explanations of our approach and data source provided in those documents.

Line 30: Gross MEAV of assets at 31 March 2020 excluding shared assets

This line provides our updated estimate of the gross MEAV, or hypothetical new-build cost, of the bioresources assets we will have at 31 March 2020. The updated estimate draws on our updated PR19 cost models for bioresources assets, which make use of more up-to-date data on costs incurred in our past projects.

This line excludes the value of shared assets which do not form part of the bioresources business unit on a principal use basis.

Line 31: Adjustment for remaining economic life

This line provides our adjustment to Gross MEAV to reflect the difference in economic value arising from the estimated remaining economic life of the actual bioresources assets we will have at 31 March 2020 being shorter than the estimated economic life of the hypothetical modern equivalent assets assumed for the gross value in line 30 above.

Line 32: Adjustment for gross operating costs on bioresource treatment sites

This line provides our adjustment for the difference between actual and modern equivalent assets in terms of the gross operating costs on bioresource treatment sites (we used Ofwat's definition of gross operating costs to mean the cost if no electricity was generated on bioresource sites and no income is received from other business units or third parties). As explained in the supporting document to our 2017 submission, we calculated this adjustment using detailed site-level data and modelling.

Line 33: Adjustment for capital maintenance costs on bioresource treatment sites

We considered whether capital maintenance costs are likely to be different between the actual and hypothetical modern equivalent assets, and did not identify significant differences that should be captured through an adjustment in the calculation of economic value. The entry for this line is zero.

Note that some differences in asset replacement spend are already captured in our adjustments for remaining economic lives (the costs of needed to replace actual assets before the end of the economic life of hypothetical assets is reflected in the adjustment shown in line 31).

Line 34: Adjustment for non-treatment site costs

We considered whether costs beyond those incurred directly at treatment sites (see line 32) were likely to be different between the actual and hypothetical modern equivalent assets. In principle, such differences might arise from differences in the operating costs of transport, thickening at intermediate sites or disposal costs. We did not identify significant differences that should be captured through an adjustment in the calculation of economic value. The entry for this line is zero.

Line 35: Adjustment for income from electricity and gas produced

Line 35 provides our adjustment for the difference in economic value that arises from slightly lower energy-generation capabilities for our actual assets (at 31 March 2020) compared to the hypothetical efficient modern equivalent assets assumed for the gross cost in line 30.

As explained in the supporting document to our 2017 submission, we calculated this adjustment using detailed site-level data and modelling. The adjustment is made for a subset of the sites where the type of processes in place are not quite as efficient in terms of energy generation for given sludge input as for a hypothetical new-build asset (and as for our newer sites).

We confirm that in line with the guidance in the Ofwat feedback report and for the purposes of our estimate of the economic value of our bioresources assets:

- We used an estimate of the average import price for the value of the energy which is generated by the bioresources business unit and used by the appointed business (regardless of whether it is used on a bioresources site or "sold" to any co-located wastewater treatment works).
- We used an estimate of actual export prices for the value of energy generated by the bioresources business unit and exported to the GB electricity system and sold to other parties.

Line 36: Adjustment for income received from renewable obligation certificates (ROCs)

Line 36 provides our adjustment to reflect differences between the actual assets at 31 March 2020 and hypothetical new-build assets in relation to income received from ROCs.

Ofwat confirmed in its feedback report that an adjustment for the economic value of ROCs should be included in the estimate of net MEAV of bioresources assets and we have followed this guidance.

For each site, we calculated a profile of ROC income over time, for the actual site assets. We took account of the date at which the ROCs for each site reduce or expire, which reflects the timing at which various CHP equipment were installed. Across the sites, the ROCs are due to expire at dates between 2027 and 2036. We assumed a ROC price of approximately £45 / MWh in March 2017 prices in future years (for our update, we inflated by RPI to get to March 2018 prices). We considered that a hypothetical new-build asset in 2020 would not have access to ROCs (or any corresponding renewable income stream).

Line 37: Adjustment for the income received from other incentives

We did not identify any other differences in economic value between actual and hypothetical assets relating to government energy incentives or subsidy schemes, beyond those relating to ROCs in line 35 above.

Line 38: Adjustment for other income including income from sale of biosolids

Line 38 provides for a small adjustment (£-0.2 million) to reflect differences between the actual assets at 31 March 2020 and hypothetical new-build assets in relation to income received from the sale of biosolids; this income is estimated to be slightly lower for our actual assets compared to hypothetical assets. Although this adjustment is small (and arguably insignificant) it was included in the overall valuation as it is calculated from the same site-level modelling analysis that we used for the more significant adjustments for operating costs and electricity income shown in lines 32 and 35 above.

Line 39: Other adjustment

We did not make any other adjustments, beyond those captured in lines 31 to 37 above, as part of the calculation of the economic value (net MEAV) of our bioresources assets.

Line 40: Net MEAV of assets at 31 March 2020 excluding shared assets

The line provides our updated estimate of the economic value (also referred to as net MEAV) of our bioresources assets, excluding the value of shared assets that do not form part of the bioresources business unit on a principal use basis. It is calculated by taking the gross value from line 30 and applying the series of adjustments from lines 31 to 39. It matches the corresponding figure in line 18.

Line 41: Proportional allocation of the net value of shared assets

In line 41 we show a proportional allocation of the net MEAV of shared assets where the bioresources business unit is not the principal user. These are assets that are part of the wastewater network plus business unit on a principal use basis, but are used to some degree by the bioresources business unit.

The allocation percentage used to make an allocation to the bioresources business unit is the same as the percentage applied for the purposes of the recharges that are made for use of shared use assets from the wastewater network plus business unit to the bioresources business unit.

Since the 2017 submission, we have produced an updated estimate of the gross and net MEAV of the wastewater network plus M&G assets that the bioresources business unit make use of.

We do not use the figure in line 41 for our estimation of the net MEAV of our bioresources assets (line 18) or our proposed RCV allocation (line 19).

Review of our approach to the allocation of shared use assets formed part of our external assurance process.

Line 42: Net MEAV of assets at 31 March 2020 including shared assets

Line 42 is calculated by taking the net MEAV figure for our bioresources assets from line 40 and adding the proportional allocation of the net value of shared assets from line 42.

Note that there is a validation error reported in line 42 of data table WWS12: it says that the figure "Must match line 18 to 1dp". However, we consider that this reported validation error reflects an error in table WWS12 as a requirement for line 42 to match line 18 is inconsistent with Ofwat's stated policy. In particular, Ofwat's bioresources RCV feedback report (paragraph 8.8) gives companies flexibility as to whether or not an allocation of the value of shared used assets should be included in the net MEAV estimated for the bioresources business unit (line 18). For transparency we have not deleted the validation error but consider that it should be ignored.

For the avoidance of doubt, and as permitted by the guidance in Ofwat's feedback report, we do not consider that the figure in line 42 provides a reasonable basis for the allocation of the wastewater RCV (see comment under line 5 above and also the supporting documents).

TARIFF IMPACT

Impact of proposal of RCV allocation on customers

The allocation of the wastewater RCV between bioresources and network plus has the potential to affect customers' tariffs. Indeed, some degree of tariff impact is to be expected. Ofwat's focused approach to the RCV allocation involves the creation of a separate RCV for bioresources that reflects a forward-looking estimate of the economic value of bioresources assets while any historical "privatisation discount" (embedded in the RCV) is to be focused on network plus activities. This represents a new allocation of value between bioresources and network plus which differs to that reflected in Anglian Water's current wastewater tariffs.

In this context, we consider a tariff impact analysis an important part of the overall process. We set out our approach and results below.

Approach to the tariff impact analysis

To assess the impact of the RCV allocation on different customer classes, we took an estimate of the economic value of our bioresources assets at 31 March 2020, deducted this from the total wastewater RCV and then allocated the balance to the other elements of the wastewater service chain (network plus) based on their Modern Equivalent Asset Value.

The impact of the change was assessed by tracking movements in the Revenue Requirement unit cost for each customer class. This revenue requirement represents the total costs of the business and includes operating costs, capital maintenance costs and current cost operating profit. To split the revenue requirement between customer classes we use activity based cost allocation. This uses cost drivers to provide the link between cost data and the measurable element of customer behaviour (e.g. demand). Drivers therefore not only explain costs but also provide a measure for each customer class to explain their contribution to that cost.

In calculating the revenue requirement across customer groups for charge setting, our cost allocation work utilises three principle cost drivers; Volume, the Chemical Oxygen Demand (COD) of settled sewage and the Suspended Solids content of settled sewage. Each cost driver has a different contribution to each element of the service chain, with bioresources principally affected by the Suspended solids content.

The proposed change in asset valuation results in an increase in bioresources assets and a decrease in sewage collection and treatment assets as illustrated in the following table:

Proportion of Revenue Requirement

Asset Valuation	Sewage Collection	Sewage Treatment	Sludge Collection, Treatment and Disposal
Gross MEAV	50.6%	34.4%	15.0%
Economic Value	49.3%	33.9%	16.8%

As there is a strong correlation between bioresources and the suspended solids cost driver, then those customers with above average Suspended Solids loads will be most impacted by the change in valuations.

However, as our September 2017 submission detailed, although the reallocation of the RCV results in a variable impact on different customer classes, these are considered overall to be immaterial, particularly when compared to the potential impact of CPI+K and is well within the 5% threshold set out in the Ofwat charging rules. Any incidence effects arising would be managed in the normal course of business.

Results from tariff impact analysis

Customer Class	Impact on average Foul Water Unit Price	Impact on average Surface Water and Highway Drainage Unit Price
Household - domestic sewage	+1.2%	-32.%
Non-household - domestic sewage	+1.2%	-3.2%
Non-household - trade effluent (SME)	+0.6%	N/A
Non-household - trade effluent (LU)	+0.7%	N/A
Total	**+1.2%**	**-3.2%**
Combined Service Total	0.0%	

Balance between Foul Water and Surface Water and Highway Drainage

An increase in the RCV allocation to bioresources results in a higher revenue requirement for this service element. Given the correlation between bioresources and the suspended solids content of the discharge, the high suspended solids content of foul water results in a higher unit cost for this service element. Nevertheless, the positive increase in the unit charge of the foul water service of 1.2% is offset by a decrease in the unit charge of surface water and highway drainage of 3.2% reflecting their respective low pollutant loads.

Due to the constituents of domestic sewage not varying by customer class there is no materially variable impact by size of customer.

Balance between Foul Water and Trade Effluent

There is a variation in the impact on customer classes receiving a foul water 'domestic' service versus those receiving a trade effluent service. This due to two reasons. Firstly, the pollutant load of domestic sewage for both households and non-households is assessed to be 650 mg/l for the Chemical Oxygen Demand (COD) and 450 mg/l for Suspended Solids (SS). Therefore on a unit cost basis households and non-households are impacted in a similar way for domestic sewage.

However, in relation to average revenue for trade effluent whilst the unit price for domestic sewage is set to ensure broad parity with the unit price for trade effluent at the same pollutant load of domestic sewage, Trade Effluent customers on the whole have a higher Chemical Oxygen Demand pollutant load than domestic sewage but lower Suspended Solids. Consequently, given there is a

strong correlation between Bioresources and Suspended Solids, customers with above average Suspended Solids pollutant load will see above average increases in their unit price and vice versa. Although these increases would be partially offset or eliminated entirely, if these customers also had a high Chemical Oxygen Demand pollutant load due to the decrease in treatment asset valuations.

We explored this conclusion further by considering the tariff impacts at a more granular level, to capture differences between individual Trade Effluent customers with different effluent characteristics. Due to the different impact that the change has on the cost drivers 'Chemical Oxygen Demand' and 'Suspended Solids', we identified that those customers likely to see the biggest impact on their bills would have:

- A high Suspended Solid pollutant load but low Chemical Oxygen Demand pollutant load; or
- A very high Suspended Solid pollutant load and broadly average Chemical Oxygen Demand pollutant load

Based on historic data there are approximately 1.7% of Trade Effluent customers (c.50 customers) falling within these categories; these customers would see increases in their unit price up to approximately 2.7%.

Combined Foul Water and Drainage Service

For customers receiving both foul water and drainage services the changes in unit price varies between -0.3% for measured households and 1.2% for medium sized non-households with domestic sewage. This is not considered material in the context of the 5% threshold set out in the Ofwat charging rules.

Bulk supplies

Wholesale revenue from bulk supplies includes new supplies to New Appointments and Variations (NAV's) and two cost sharing agreements negotiated between the parties.

The NAV supplies are all based on standard wholesale tariffs. The impact of the change is therefore as described above.

The cost sharing agreements are designed to provide an appropriate allocation of operating, capital and financing costs between the parties. The costs are allocated based either on the proportion of the capacity reserved to each party or on whether assets are separately identified and their use specific to one party or the other, as a result they are not impacted by the proposed RCV allocation.

WWS13 - PR14 WHOLESALE REVENUE FORECAST INCENTIVE MECHANISM FOR THE WASTEWATER SERVICE

Ofwat action ref ANH.PD.A5 PR14: Wholesale revenue forecasting incentive mechanism - Anglian Water is required to provide evidence to explain its forecast performance in tables WWS13

For report year 2018/19 in the table submitted the recovered revenue was forecast to be in line with allowed revenue, therefore no revenue adjustment and no penalty was forecast. The evidence was not available at the time to conclude that the outcome would be other than we recovered the level of allowed revenue.

We set charges for a Charging Year in the preceding December, using the latest forecast of charge multiplier data in order to calculate charges to recover the revenue allowed under the control. We were required to submit WWS13 before 28 July 2018. Given the constraints of the assurance and board sign-off process we finalised our data table submission using data up to Period 2 (May) in the financial year. At that point in the year it was too soon to determine whether revenue recovery for the report year 2018/19 would vary materially from the allowed revenue used to calculate charges. The main elements that historically have been seen to affect variations in revenue are summer demand, optant metering, prior year accounting adjustments and the level of connection charges. Being only 1/6 of the way through the year after Period 2, whatever the early indications may have suggested, we have experience of those reversing before the end of the year (and in the case of summer demand, with a wet July/August quickly reversing any earlier increases in year to date demand), and so took a neutral position as the most reasonable for that point in time.

The PR19 Reconciliation Rulebook notes that for the report year 2018/19 Ofwat will have complete information on actual recovered revenues and RPI at the time of setting allowed revenues at PR19, therefore, it will make an adjustment to allowed revenues for the incentive calculated through the WRFIM formula for PR19. We therefore understood that the figure for report year 2018/19 was in any event indicative for the purposes of WWS13; and the indications at the time of submission were inconclusive as to the level of any variation in recovered revenue as compared to the level of allowed revenue.

Prior to the year end for 2018/19, we have updated our forecast for recovered revenue. This shows an over-recovery of £3.0 million, representing 0.4% of allowed revenue (£709.8 million).

This reflects an over-recovery of main charges against allowed revenue of £1.4 million. This resulted from prior year accounting adjustments. Actual recovery of grants and contributions revenue is £1.6 million higher than the revised forecast, reflecting increased levels of connection charges compared to the available forecast when setting charges.

For report year 2019/20 we have not updated our forecast.

SECTION C: ALLOWED REVENUE

Line 9: Allowed revenue - wastewater

Allowed 2014/15 wholesale wastewater revenue as set out in the letter, "Final determination of price controls" addressed to Peter Simpson from Cathryn Ross, dated 12 December 2014.

Line 11: K - wastewater

Wholesale wastewater revenue K factor for each year of AMP6.

The K factor for report year 2015/16 was set at zero, and for report years 2016/17 to 2019/20 reflects the figures set out in the the letter, "Final determination of price controls" addressed to Peter Simpson from Cathryn Ross, dated 12 December 2014.

Line 12: Total revenue forecast - wastewater

The total allowed wholesale revenue for each year of AMP6 reflects the revenue before any adjustment for under/over recovery of revenue from prior years (year *t-2*) or AMP5 blind year adjustment is taken into account.

The subsequent adjustment for under/over recovery of revenue from prior years is as per the WRFIM mechanism set out in the PR14 Rulebook.

SECTION D: AMP5 RCM BLIND YEAR ADJUSTMENT

Line 13: RCM blind year 14/15 adjustment for implementing via WRFIM ~ wastewater

Pre-populated cell.

The RCM adjustment as notified to us by Ofwat in their document "Consultation on the final 2010-15 reconciliation - company-specific index - Anglian Water", published October 2016

Line 14: Percentage of RCM adjustment by year ~ wastewater

Ofwat were informed in a letter dated 4 November 2016 that we would apply 100% of the bind year adjustment to our 2017/18 allowed revenue.

SECTION E: REVENUE RECOVERED

Lines 15 to 18: Revenue recovered

The data reported is household and non-household measured and unmeasured wholesale revenue.

Report year 2015/16 to 2017/18

Data is taken from table 2I of the APR.

Report year 2018/19

Data is taken from the management account forecast of the year end out turn position as at Period 11 (February) 2018/19.

Report year 2019/20

Data is taken from the spread sheet model used to calculate forecast revenue. This is consistent with the customer projections reported in WWS3 and the revenue cap.

Line 19: Wastewater: Third party revenue - household

We have no third party revenue from households.

Line 20: Wastewater: Third party revenue - non-household

We have no third party revenue from non-households.

Line 22: Wastewater: Grants and contributions

Report years 2015/16 to 2017/18

The data is taken from table 2I of the respective APR.

In relation to report years 2015/16 and 2016/17 the RAG Guidelines for the respective APR set out that the calculation of "Grants and Contributions – Wastewater" for Table 2E required sewer adoption supervision fees to be included in line 2E.10 "Other contributions". However, Table 2I, which reconciles recovered revenue to the revenue governed by the price control, set out that line 2I.19 "Grants & contributions (price control)" should be equal to lines 2E.7 and 2E.8, and so excluded

these supervision fees. However, the sewer adoption supervision fees were included in the calculation of allowed wholesale revenue set out in FD14. Therefore, on the basis of their exclusion from the revenue recovered as set out in Table 2I line 2I.22, revenue will incorrectly appear under-recovered by the relevant amount.

We raised this issue with Ofwat in an email to Peter Jordan dated 13 September 2016.

These sewer adoption supervision fees amounted to £2.0m for report year 2015/16 and £2.1m for report year 2016/17 (out-turn prices).

The PR14 reconciliation rulebook sets out at section 3.6 that the WRFIM calculation for year t is based on the output of Table 2I for year t-2. On this basis the allowed revenue for report years 2017/18 and 2018/19 would be increased to true-up for the under-recovery of grants & contributions in the respective year t-2 as reported in table 2I. However, because an element of this reported under-recovery results from excluding the sewer adoption supervision fees, for each year impacted (report years 2017/18 and 2018/19) we made an adjustment to the WRFIM model to reduce the allowed revenue by the appropriate amount. This is reflected in our submission of PR14 Reconciliation Information,

Prior to the year end for 2018/19, we have updated our forecast out turn for the current year. This is consistent with the data in App28.

SECTION F: VARIANCE ANALYSIS OF GRANTS AND CONTRIBUTIONS

Line 24: Wastewater: Capital contributions from connection charges and revenue from infrastructure charges (PR14 FD)

Grants and contributions allowed revenue as set out in the FD in 2012/13 prices.

SECTION G: PENALTIES

Line 27: Main revenue adjustment as incurred - wastewater

Report year 2017/18

The main revenue adjustment incurred of £4.2m relates to report year 2015/16 revenue under-recovery of £3.8m (out-turn prices) compared to allowed revenue. This adjustment takes account of the exclusion of £2.0m of sewer adoption supervision fees from grants and contributions revenue as noted above in relation to line 22.

This reflects primarily an under recovery of grants and contributions revenue compared to that forecast.

Report year 2018/19

The main revenue adjustment incurred of £1.0m relates to report year 2016/17 revenue under-recovery of £0.9m (out-turn prices) compared to allowed revenue. This adjustment takes account of the exclusion of £2.1m of sewer adoption supervision fees from grants and contributions revenue as noted above in relation to line 22.

This reflects main charges revenue over-recovery of £2.1m (primarily due to prior year accounting adjustments) off-setting under recovery for grants and contributions revenue compared to forecast.

Report year 2019/20

The main revenue adjustment incurred of -£3.1m relates to report year 2017/18 revenue over-recovery of £2.7m (out-turn prices) compared to allowed revenue.

This reflects an over-recovery of main charges driven by a combination of reduced optant metering (where unmeasured charges are higher than the average measured bill) and higher household demand, together with prior year accounting adjustments (£2.5m).

Actual recovery of grants & contributions revenue was in line with forecast.

The calculation of allowed revenue for the report year 2017/18 reflects the FD14 updated for RPI plus K, adjusted for the following :

- The report year 2014/15 blind year adjustment of -£3.3m (repriced to -£4.1m); and
- The report year 2015/16 revenue under-recovery of £3.8m (re-priced to £4.2m).

Line 28: Penalty adjustment as incurred - wastewater

Report year 2017/18

The under-recovery in report year 2015/16 of £5.8m set out in APR table 2I represents 0.9% of the allowed wholesale revenue of £649.7m. This is within the 2% dead-band and therefore no penalty arises.

The under-recovery for report year 2015/16 of £3.8m reflected in the WRFIM model (allowing for the exclusion of sewer adoption supervision fees of £2.0m from table 2I) represents 0.6% of the allowed wholesale revenue.

Report year 2018/19

The under-recovery in report year 2016/17 of £3.0m set out in APR table 2I represents 0.4% of the allowed wholesale revenue of £662.1m. This is within the 2% dead-band and therefore no penalty arises.

The under-recovery for report year 2016/17 of £0.9m reflected in the WRFIM model (allowing for the exclusion of sewer adoption supervision fees of £2.1m from table 2I) represents 0.1% of the allowed wholesale revenue.

Report year 2019/20

The over-recovery in report year 2017/18 of £2.7m represents 0.4% of the allowed wholesale revenue of £681.5m. This is within the 2% dead-band and therefore no penalty arises.

Line 29: WRFIM adjustment as incurred - wastewater

Report years 2017/18 to 2019/20

The line reflects the sum of the main revenue adjustment and the penalty adjustment from the lines above.

Line 30: WRFIM Total reward / (penalty) at the end of AMP6 - wastewater

The value of the aggregated year 4 (report year 2018/19) and year 5 (report year 2019/20) main revenue adjustment and penalty adjustment, priced at report year 2019/20 outturn prices.

Report year 2018/19

Prior to the year end for 2018/19, we have updated our forecast for recovered revenue. This shows an over-recovery of £3.0 million, representing 0.4% of allowed revenue (£709.8 million).

This reflects an over-recovery of main charges against allowed revenue of £1.4 million. This resulted from prior year accounting adjustments. Actual recovery of grants and contributions revenue is £1.6 million higher than the revised forecast, reflecting increased levels of connection charges.

Report year 2019/20

Recovered revenue is forecast to be in line with allowed revenue, therefore no revenue adjustment and no penalty arises.

The calculation of allowed revenue reflects the FD14 updated for forecast November 2018 RPI of 3.4% plus K as per the Final Determination letter, adjusted for the following:

- Over-recovery of revenue in report year 2017/18 of £2.9m (re-priced to £3.1m); and
- The accelerated repayment in report year 2018/19 of £4.0m of report 2017/18 over-recovery (re-priced to £4.3m).

Line 31: WRFIM Total reward / (penalty) at the end of AMP6 - wastewater

This line reflects the outputs of the Revenue adjustments feeder model (PR19-Revenue-adjustments-feeder-model-01h).

WWS15 - PR14 WHOLESALE TOTAL EXPENDITURE OUTPERFORMANCE SHARING FOR THE WASTEWATER SERVICE

SECTION B: MENU CHOICES

Line 6: Sewerage: Final menu choice

In the pre-populated tables this has only been entered to one decimal place. We have corrected this to equal line 4 (Sewage: Implied menu choice). We notified Ofwat of this error and agreed it should be corrected.

SECTION C: TOTEX

Line 9: Sewerage: Actual Totex

The years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. The year 2017/18 is taken from the published Regulatory Accounts (Table 4E Line 24).

We have updated our totex forecast for 2018/19 and 2019/20, reflecting our latest view of opex and capex. Whilst for 2018/19 we have a reasonable view of the split of our costs between price controls, we do not do the actual split until after year end when we prepare our financial statements for the Annual Performance Report. For 2018/19 we forecast our Wastewater Totex expenditure to have decreased by £43.4 million, made up of an increase of £1.8 million in operating costs and a decrease of £45.2 million in capital expenditure. This reflects a timing of expenditure issue which is effectively deferred to 2019/20.

In addition we have also reflected higher Grants and Contributions receipts in 2018/19 of £1.7 million due to increased developer activity and assumed these result in offsetting higher capex in 2019/20. As a result there is no change to the cumulative net Totex forecast over the two years resulting from this change.

SECTION D: ADJUSTMENTS TO TOTEX

The years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. The year 2017/18 is taken from the published Regulatory Accounts (Table 4E Line 10).

Line 11: Sewerage: Third party services (capex)

The years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. We have made Ofwat aware that there is a minor restatement on line 11 on table WWS15 to reflect a revised position for 2015/16 and 2016/17. We had previously reported nil capital expenditure against third party services in the 2015/16 and 2016/17 APRs. However on review of prior-year third party expenditure, it was apparent that we had incurred third-party capital expenditure of £0.486 million in 2015/16 and £3.187 million in 2016/17.

The year 2017/18 is taken from the published Regulatory Accounts (Table 4E Line 18).

Line 12: Sewerage: Pension deficit recovery costs

Years 2015/16 and 2016/17 are pre-populated cells taken from the published Regulatory Accounts. The year 2017/18 is taken from the published Regulatory Accounts.

Line 13: Sewerage: Other cash items

Years 2015/16, 2016/17 and 2017/18 are taken from the published Regulatory Accounts. We do not anticipate any other cash items in the final two years of AMP6, but will report any that do occur in the relevant APR.

Line 14: Sewerage: Disallowables

Years 2015/16, 2016/17 and 2017/18 are taken from the published Regulatory Accounts. We do not anticipate any other cash items in the final two years of AMP6, but will report any that do occur in the relevant APR.

Line 15: TTT control: logging up / down of scope swaps

This is zero for all years as this relates to the Thames Tideway, which is not applicable for Anglian Water.

Line 16: TTT control: Land -100.0 (customer : company) cost sharing factor

This is zero for all years as this relates to the Thames Tideway, which is not applicable for Anglian Water.

Line 17: Sewerage: Transition expenditure

This line is pre-populated. Ofwat have recognised that the pre-populated figure has been incorrectly pre-populated with companies' business plan forecasts of transition expenditure rather than actual transition expenditure. The correct entry for this cell should be £26.964 million and has been corrected in our submission.

SECTION E: PAYG

Line 18: Sewerage: PAYG ratio

This line is pre-populated from the PR14 Final Determination.

SECTION G: TOTEX MENU ADJUSTMENTS

Lines 21 to 22

These lines reflect the outputs of the Revenue adjustments feeder model (PR19-Revenue-adjustments-feeder-model-01l-for-publication) and the RCV adjustment feeder model (PR19-RCV-adjustments-feeder-model-June-2018-update).

WWS18 - EXPLAINING THE 2019 FINAL DETERMINATION FOR THE WASTEWATER SERVICE

SECTION A: CUSTOMER SERVICE

Line 1: Number of external flooding incidents:

Following the Ofwat reporting guidance, we have excluded highways, public open space, agricultural land and car parks from our external figures.

We have not entered historic performance prior to 2016/17 as this is when the new definition was introduced. Our forecasts for 2018/19 and 2019/20 are consistent with our APR forecasts.

Our forecasts for 2018/19 and 2019/20 are based on at least maintaining the 2016/17 upper quartile level of performance. In line with our performance commitment level, our forecasts for 2020/21 to 2024/25 are based on a reduction of 50 incidents per from our forecast for 2019/20. Further detail for how we have set our performance commitment levels is available in the main business plan narrative.

The data for 2018/19 is subject to change.

Line: 2 Number of serious pollution incidents (category 1 and 2):

There was one category 1 sewerage pollution incident in 2017 (2016: one) and eight category 2 sewerage pollution incidents (2016: eight), made up of two WRC, one CSO, one foul sewer, one pumping station and two rising mains and one surface water outfall.

The forecast numbers for the remainder of AMP6 (zero) are based on our internal business targets. The reason for selecting these targets is to maintain a level of performance that is significantly below our performance commitment level and is consistent with our performance in 2017/18.

The forecast numbers for AMP7 are consistent with Ofwat's requirements for setting Performance Commitments. Future forecasts are zero for category 1 and 2 serious pollution incidents which reflects our ambition in this area.

Line: 3 Number of pollution incidents (category 3):

The number of category 3 incidents remained steady in 2017 at 218, 214 from pre-transfer assets and four from transferred sewers (2016: 217). We believe this is down to a number of factors including:

The increased importance of pollution prevention across the business

- "More volatile weather" with a number of high intensity storms
- Increased predictive and proactive approaches to pollution prevention and awareness campaigns.

This performance is ahead of our ODI target to have no more than 298 incidents by 2017/18. A similar year of weather resulted in a comparable ODI performance of 218 incidents, up one from 217 in 2016. We remain a 3 star (good) company in the Environmental Performance Assessment 2017, however performance improved across all three pollution metrics since 2016.

Performance is encouraging and our priorities remain the same: a continued focus on predictive analytics, which allow us to identify unusual trends in flow rates and performance of our assets to predict where we may have problems; and on proactive mitigation to quickly and efficiently resolve these problems to avoid any environmental impact.

The number of Category 2 incidents remained at nine, although there was one Category 1 incident during the year. We are working hard at reducing the risk of serious pollutions through predictive analytics and focused preventative maintenance.

We have continued to raise awareness and knowledge share amongst all operational teams in Water Recycling through detailed briefings, user guide and revised on-line training modules. We have launched an online solution (Pollution app) to help us to manage any discharge that has the potential to pollute. It will enable real-time information sharing during incident management and enable us to gather clear and consistent evidence about whether a discharge has an impact on the environment or not.

Our self-reporting performance increased from 66% to 71% of incidents being self-reported to the Environment Agency. The Pollution Watch campaign continues to raise public awareness about the causes of sewage pollution, the impact it has and the signs to look out for. The phone line for people to call if they spot any of these warning signs has been used to great success.

This year continued to see record-breaking penalties following prosecutions brought by the Environment Agency. The courts have made it clear that failure to bring improvements will lead to fines large enough to have a significant impact on water company finances. We had a fourth successive year without prosecution.

The forecast numbers for the remainder of AMP6 (219) are based on our internal business targets. The reason for selecting these targets is to maintain a level of performance that is significantly below our performance commitment level of 298 incidents and is consistent with our performance in 2017/18.

The forecast numbers for AMP7 are consistent with Ofwat's requirements for this specific Performance Commitment. Our future forecasts for category 3 pollution incidents is in line with our proposed performance commitment level to reach 165 by 2024/25. The basis for this target is comparative industry data for the other large water and sewerage companies.

SECTION B: RESILIENCE

Line 4: Asset Health total number of blockages

This total number includes 220 blockages which we have added in following investigations carried out after audit. The audit flagged a couple of areas where there was the potential for legitimate sewer blockages to be omitted unintentionally and so, given the complexity of identifying these blockages, and the timescales, we have assessed the likely impact of this (approximately 0.5% of the total), and added this number to our existing list of blockages. We have also agreed to review our processes to ensure that, as far as practically possible, these records are not missed in the any future reporting cycles.

Due to the number of variables which can influence this measure, we have calculated our forecast using the average of the previous four years data, which has been fairly stable over that period.

SECTION C: AFFORDABILITY

Line 5: Number of people receiving help paying their wastewater bill

Reported numbers exclude customers billed on our behalf by other water companies, such as Cambridge Water, Affinity Water, Thames Water and Severn Trent.

The historic volume is a unique count of customer accounts that benefited from one or more affordability scheme during the year. There was insufficient historic data to report 2015/16 on this basis.

Affordability schemes include:

1. Assistance funds
2. Back on track schemes
3. Breathing space
4. Concessionary tariffs, including Watersure, Aquacare Plus and our LITE Tariffs
5. Commitments to pay
6. Income maximisation assessments
7. Leakage allowances

8. Non-chargeables with zero consumption
9. Temporary installment arrangements, including installment plans, court plans, payment schemes with debt and Department for Work and Pensions (DWP) direct payments (see definition below).

Temporary installment arrangement definitions:

- Installment plans – temporary installment arrangement for customers in arrears who cannot afford to clear the current balance and ongoing charges before the next bill is due. Affordable installment amount and frequency agreed with customer after income and expenditure assessment
- Court plans – installment arrangements agreed with customers to clear their outstanding county court claim by affordable installments
- Payment schemes with debt – installment arrangements for customers in arrears who can afford to clear the current balance and ongoing charges before the next bill is due. Affordable installment amount and frequency is agreed with customer after income and expenditure assessment
- DWP direct payments – deductions made by DWP from customers in receipt of income related benefits.

The historic figures do not consider the following schemes when calculating the unique customer count: assistance fund, Breathing Space, income maximisation assessments and charges holidays with consumption. However, it is likely many of these customers would have also benefited from a scheme that was included.

With the exception of 'concessionary tariffs' and 'temporary installment arrangements' the analysis included schemes that were present at the start of the year, those created during the year, those that ended during the year and those that continued into the following year. Concessionary tariffs and temporary installment arrangements included those present at the end of the financial year only.

The increase in the number of customers assisted from 2018/19 through to 2024/25 reflects the growing scale of the assistance available to customers with affordability issues, with take-up driven by targeted promotion of the help available. This is set out in detail in the Affordability section of our Business Plan.

SECTION D: MARKETS

Line 6: Number of direct procurement wastewater service schemes

There are no schemes planned for direct procurement within the AMP7 period. Full details of our analysis is provided within our business plan document and supporting appendices.

SECTION E: ENVIRONMENTAL

Line 7: Length of rivers improved as a result of WINEP Water Quality schemes

Data has been taken from the National Environment Programme (NEP) for AMP6 for 2015-2020 and from the third release of the Water Industry NEP (WINEP3) for 2020-2025. Investigation schemes have not been included in the data set.

Only wastewater schemes with a current certainty status of amber or green in WINEP3 are considered as the Environment Agency has requested that only schemes with amber and green status are included in final business plans for PR19.

Line 8: Greenhouse Gas Emissions from Wastewater Operations

The estimated forecast for annual carbon emissions released from water recycling operations at the end of AMP7 has been set at 158,399 t/CO2e, a 10% decrease from the forecasted baseline year 2019/20, of 176,971 t/CO2e. This movement is primarily explained by a forecast increase in renewable electricity generated on-site, reducing the reliance upon grid electricity, in particular through a step-increase in solar and biogas CHP generation forecast for 2019/20 and the reduction in grid electricity emissions factors through AMP6 and AMP7.

A number of assumptions have been made in calculating the forecasted greenhouse gas emissions from water recycling operations:

- The data for all periods has been updated in line with the methodology used in the 2017/18 Annual Performance Report
- Forecasted greenhouse gas emissions are directly impacted by the energy consumption forecast in data table WWS4
- For existing data, we have applied a confidence grade of A2 as the majority of raw data is based on metering and has been audited as part of the ISO-14064 certification process. For forecast data we have applied a confidence grade of C4 as this is based upon extrapolation of metered data
- We have excluded forecasted energy from renewable sources generated and to be used on site, including CHP (combined heat & power), wind and solar
- There is no guidance on which emission factors to use to convert from litres to kWh for fuel consumption. We have used the Energy Consumption Calculator Spreadsheet (SEAI PS)
- We have used the UKWIR Greenhouse Gas Carbon Accounting Workbook Version 12 in calculating emissions for 2017/18
- An assumption that in 2023/24 and 2024/25, 30% of company owned vehicles and vehicles used on company business, and 15% of company vans will be electric has been adjusted within transport
- We have used the latest forecast from BEIS on future grid emission factors
- We have identified a discrepancy between BEIS forecasts and actuals for previous years and have, therefore, applied a correction factor.

Line 9: Number of designated bathing waters passing EU standards

Figures are based on current performance as of 2017 being maintained. 48 of the current 49 bathing waters are expected to attain the minimum EU bathing water standard of 'sufficient' or higher next AMP. The one bathing water failing to achieve EU standards is Clacton Groyne 41. The source of contamination at this bathing water is not believed to be derived from Anglian Water assets. It should be noted that future bathing water risks can occur at any time. These could be due to third party pollution sources and also there is the assumption that our assets will be maintained at the current level into the next AMP. It should also be noted that the 'Sufficient' classification may not be the minimum EU bathing water standard next AMP however it is this classification which has been used for the predictions on performance.

Line 10: Percentage discharge permit compliance (STW and WTW discharges compliant with numeric permits)

There has been an improving trend in Discharge Permit Compliance at Water Recycling Centres and Water Treatment Works from the beginning of the AMP. Figures are based on achieving and maintaining a 99.00% compliance. In 2017 the Discharge Permit Compliance achieved 98.74%. 2016 was an exceptional year for compliance.

SECTION F: BILL IMPACTS

Line 11: Change in the average residential customer wastewater bill over the period

Report years 2019/20 to 2024/25

This figure has been calculated based upon App7, line 40 (average total bill - wastewater).

SECTION G: TOTAL EXPENDITURE (REAL PRICES – 2017-18 FYA CPIH DEFLATED)

Line 12: Wastewater totex including cash items and atypical expenditure

The data for years 2017/18 onwards aligns to WWS1 line 36, with 2018/19 and 2019/20 deflated by CPIH to 2017/18 financial year average prices.

The data for 2015/16 and 2016/17 agrees to that reported in the 2017 Information Request, inflated by CPIH to 2017/18 financial year average prices.

Line 13: Total number of residential and business customers who receive a wastewater bill

This is the actual and forecast number of residential and business customers who receive a wastewater bill and is a calculated line from the sum of table WWS3, lines 5 to 8 (sum of lines 5 and 8 in table WWS3).

The forecast for these figures has been derived from the Water Recycling Long Term Plan (WRLTP) demand forecast model. Residential, household customer forecasts have been derived using Local Authority data according to EA / UKWIR methodologies. Non-business property forecasts have been derived using historic data to generate trend information (noting that non-household demand is an independent variable from the non-household premise total).

This aligns with the methodology used for table WWS3.

Residential properties billed unmeasured sewage

- Outturn - near-term figures have been derived from outturn - recorded connection numbers (SAP data and income and tariffs information)
- Forecast - data has been derived from the projected forecast for customers switching from unmeasured to measured status (included in the Water Resources Management Plan (WRMP) forecast model) and the forecast for new build properties, in alignment with the WRMP and WRLTP.

Forecast figures have been derived using the Local Planning Authority forecast figures (as analysed and collated by Edge Analytics) in accordance with the requirements set out in the WRMP.

The measured and unmeasured split has been calculated, using baseline outturn data. The derivation further relies on the extrapolation of meter installation / optant forecast, as used in the WRMP demand forecast.

Residential properties billed for measured sewerage

Data has been derived from recorded information and the projected forecast for customers switching from unmeasured to measured and new build properties, in alignment with the WRMP and WRLTP.

The data has been derived either through:

- Outturn - recorded property numbers. Total property numbers (water account) have been calculated as part of the year-end reporting process, based upon internal SAP premise data and data on income and tarifs. This allows the derivation of both measured and unmeasured property totals. Additional metering data allows the derivation of the numbers of internal / external connections.
- Forecast – the total number of measured properties has been derived using the regional and WRLTP household and population forecast model, baselined to year-end reporting totals. The measured and unmeasured split has been calculated, using baseline outturn data. The derivation further relies on the extrapolation of meter installation / optant forecast provided by the metering team, as used in the WRMP demand forecast.

Forecast growth has been aligned with planning information (collated by Edge Analytics) as provided by the Local Planning Authorities in line with the requirements set out in the WRMP and WRLTP.

Business properties billed unmeasured sewerage

Unmeasured non-household (business) properties have been forecast in line with recent trend evidence and in alignment with the WRMP assumptions and the WRLTP.

Unmeasured non-household (business) properties have been forecast in line with recent trend evidence (derived by Servelec analysis of the Sincon dataset) and in alignment with the WRMP, being forecast to decrease by 8.4% per year. This accounts for a very small proportion (approximately 0.5%) of the business (non-household) property total.

Note that this is now reported as a zero value due to retail separation.

Business properties billed measured sewerage

Measured non-household (business) properties have been forecast in line with recent trend evidence and in alignment with the WRMP and WRLTP. WRMP regression analysis suggests a marginal decrease in non-household properties over time.

- Outturn - initial figures have been aligned with income and tarifsf data (based upon SAP premise data)
- Forecast – measured non-household (business) properties have been forecast in line with recent trend evidence (derived by Servelec analysis of the Sincon dataset) and in alignment with the WRMP assumptions. WRMP regression analysis suggests a marginal decrease in non-household properties over time, by 0.3% per year.

The forecast for 2018/19 has been updated to reflect better information now that we are further through the report year.

WWN1 - WHOLESALE WASTEWATER SEWAGE TREATMENT OPERATING EXPENDITURE

SECTION A: OPERATING EXPENDITURE

The values reported for 2018/19 have been amended since submitting our Plan in September 2018, to reflect an updated forecast out-turn for the current year. The values in lines 1 and 7 for AMP7 have been amended to reflect minor changes in our enhancement programme, details of which are in the commentary for WWS2.

Lines 1 to 5: Direct costs of STWs by band size

This line includes direct costs for all Water Recycling centres for size bands 1 to 5. The direct costs Include service charges but exclude local authority rates. All sludge thickening (to >10% ds) and sludge treatment costs are excluded.

The cost of processing sludge return liquors by the sewage treatment assets from the sludge dewatering assets is included in these lines for AMP6 (2017/18 to 2019/20) but recharged to bioresources (sludge treatment) from 2020/21. The bioresource recharge reflecting direct costs for bands 1 to 5 is as shown below:

Return Sludge Liquor recharge - Direct Costs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Band Size 1	-	-	-	-	-	-	-	-
Band Size 2	-	-	-	-	-	-	-	-
Band Size 3	-	-	-	-	-	-	-	-
Band Size 4	-	-	-	-0.422	-0.438	-0.433	-0.442	-0.453
Band Size 5	-	-	-	-0.323	-0.335	-0.331	-0.338	-0.346
Total Band Size 1 to 5	**-**	**-**	**-**	**-0.745**	**-0.773**	**-0.764**	**-0.780**	**-0.799**

Line 6: General and support costs of STWs in size bands 1 to 5

This line includes all general and support costs attributed to Water Recycling Centres for size bands 1 to 5.

The general and support expenditure for 2017/18 differs from the 2017/18 Annual Performance Report (APR) submission (table 4N) due to the inclusion of a recharge to other business areas for the use of shared assets recorded under sewage treatment as the principle user. The adjustment for the shared asset recharge from sewage treatment bands 1 to 5 is as shown below:

Asset Use recharge - General and Support Costs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Bands 1 to 5	-6.990	-7.747	-7.460	-7.668	-7.713	-7.830	-6.338	-6.442

From 2020/21 the reported costs also include a fully costed recharge (including capital and financing charges) from bands 1 to 5 sewage treatment works for the treatment of return liquors general and support costs from the sludge dewatering assets in bioresources. The recharge to bioresources reflecting general and support costs for bands 1 to 5 is as shown below:

Return Sludge Liquor recharge - General & Support Costs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Bands 1 to 5	-	-	-	-1.094	-1.143	-1.191	-1.239	-1.306

Increases in other costs are set out in WWS1 and for sewage treatment these largely fall into general and support costs.

Line 7: Direct costs of STWs in size band 6

This line includes the direct costs for all Water Recycling Centres for size band 6 and includes service charges but excludes local authority rates. All sludge thickening (to >10% ds) and sludge treatment costs are excluded.

The costs for the processing of sludge return liquors by the sewage treatment assets are included in this line for AMP6 (2018/19 to 2019/20) and recharged to bioresources (sludge treatment) from 2020/21. The bioresources recharge reflecting the band 6 costs is as shown below:

Return Sludge Liquor recharge - Direct Costs	2017/18	2018/19	2019/20	2010/21	2021/22	2022/23	2023/24	2024/25
Band 6	-	-	-	-5.461	-5.664	-5.601	-5.725	-5.859

Line 8: General and support costs of STWs in size band 6

This line Includes all general and support costs attributed to Water Recycling Centres for size band 6.

The general and support expenditure for 2017/18 differs from the 2017/18 APR submission (table 4N) due to the inclusion of a recharge to other business areas for the use of shared assets recorded under sewage treatment as the principle user. The adjustment for the shared asset recharge from sewage treatment band 6 is as shown below:

Asset Use recharge - General and Support Costs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Band 6	-4.742	-6.558	-6.313	-6.489	-6.528	-6.627	-5.366	-5.452

From 2020/21 the reported costs include a fully costed recharge (including capital and financing charges) from band 6 sewage treatment works for the treatment of return liquors general and support costs from the sludge treatment and dewatering assets in bioresources. The recharge to bioresources reflecting general and support costs for band 6 is as shown below:

Return Sludge Liquor recharge - General and Support Costs	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/15
Band 6	-	-	-	-8.024	-8.390	-8.741	-9.081	-9.573

The negative reported costs from 2020/21 are as a result of the two recharge adjustments above for asset use recharges and bioresources sludge liquor treatment.

Increases in other costs are set out in WWS1 and for sewage treatment these largely fall into general and support costs.

Line 9: Service charges for STWs in size band 6

This line Includes all Environmental service charges and discharge consents for size band 6 Water Recycling Centres.

Line 10: Estimated terminal pumping costs size band 6 works

This line Includes all onsite terminal pumping costs for size band 6 Water Recycling Centres.

Line 11: Estimated sludge costs in size band 6 works

All sludge treatment and thickening costs have been excluded from lines 1 to 10 above.

Line 12: Functional Expenditure

The total functional expenditure (excluding Atypicals for 2017/18) agrees to WWS1 (Wholesale wastewater operating expenditure) line 9 for columns sewage treatment excluding local authority rates (line 8).

The total functional expenditure for 2017/18 differs from the 2017/18 APR submission (table 4N) due to the inclusion of a recharge to other business areas for the use of shared assets recorded under sewage treatment as the principal user.

WWN2 - WHOLESALE WASTEWATER LARGE SEWAGE TREATMENT WORKS EXPLANATORY VARIABLES AND OPERATING EXPENDITURE

SECTION A: SEWAGE TREATMENT WORKS - EXPLANATORY VARIABLES

Line 1: Works name

We have included 49 large Sewage Treatment Works (STWs) in this line, as per the Ofwat definitions. We have excluded the following seven STWs populated by Ofwat in the final version of the data tables provided in June, because the calculated load for them is below the 1,500kg BOD/day threshold required for a STW to be considered as large:

1. March
2. Rayleigh East
3. Cromer
4. Harwich
5. Jaywick
6. Market Harborough
7. Rayleigh West.

Lines 3 and 9: Population equivalent of total load received and load received by STW

We have calculated the population equivalent and the loads using the same process as we have always done, which is consistent with how we used to report table 17b in the June Return. The numbers exclude imported effluents (tankering) and include non-resident population.

Lines 4 to 8: Consent standards

We have an application called PACE which summarises details of the permit limits relating to our STW discharges. These are the limits which are detailed in the Environmental Permits issued to us by the Environment Agency.

Information for these lines has therefore been taken from PACE for those STWs which fall into size band 6.

Line 5: BOD_5 consent

For a number of STWs the Urban Waste Water Treatment Directive (UWWTD) Biochemical Oxygen Demand (BOD) limit of 25 mg/l is tighter than the normal BOD limit specified in the Environmental Permit. In these situations we have therefore reported the UWWTD BOD limit as we believe this is more appropriate to use for comparative efficiency purposes. This approach is consistent with that taken when the data used to be provided as part of the June Return.

Line 10: Flow passed to full treatment

We have an application called IREM which records details of the measured flow discharged from our STWs. A report was run to determine the average daily flow passed to full treatment at the treatment works during the report year.

SECTION B: SEWAGE TREATMENT WORKS – OPERATING EXPENDITURE

Line 11: Direct Expenditure

The total direct expenditure agrees to the total direct expenditure on table WWn1 line 7 (direct costs of STWs in size band 6). Size band 6 works are individually costed where possible through our SAP costing system with allocations to remove costs relating to sludge activities where applicable. The direct costs exclude local authority rates and third party services.

Line 12: General and Support expenditure

The total general and support expenditure agrees to the total on table WWn1 line 8 (general and support costs of STWs in band size 6). Allocations to individual sites are based on the site's direct expenditure.

The general and support expenditure for 2017/18 differs from the 2017/18 APR submission (table 4O) due to the inclusion of a recharge to other business areas for the use of shared assets recorded under sewage treatment as the principal user.

Line 13: Functional Expenditure

This is the total of direct expenditure and general and support expenditure (lines 11 and 12).

Line 14: Service charges

A schedule is maintained which holds details of the annual charges which are levied by the Environment Agency for all of our permitted discharges to the environment. This was used to identify the charges paid for each of the sites included within this line.

The total service charges agrees to the total on table WWn1 line 9 (Service charges for STWs in size band 6). Allocation to STWs is based on actual cost data from the Environment Agency and includes all environmental service charges and discharge consents related to the sewage treatment site.

Line 15: Estimated terminal pumping expenditure

This line is the total estimated onsite terminal pumping costs for STWs in size band 6.

WWN3 - WHOLESALE WASTEWATER NETWORK (EXPLANATORY VARIABLES)

SECTION A: EXPLANATORY VARIABLES

Lines 1 to 2: s101A schemes

The s101A programme for AMP7 is based on applications we have received and assessed as having a duty to serve to protect the environment. It is based on an established robust 'business as usual' process. If we receive further applications during AMP7, we will assess to determine duty and where necessary we will programme investment to be delivered in AMP8. The connectable properties for AMP6 are based on the latest delivery forecast, made at the end of May 2018.

Lines 3 to 4: Capacity and number of network pumping stations

The number of pumps, rated power for each pump, location and asset status have been used where this information was held in corporate databases. The rated power of the remaining pumps, where data was not currently centrally held, was estimated through extrapolation based on site annual energy consumption and pump hours run (where available). The number of sites was calculated based on this more granular pump specific asset data. Data for subsequent years is assumed to be consistent with current year, unless impacted upon by planned investment. The planned investment data was sourced from the corporate asset management system with a provision for new PS's associated with new developments for the next two years.

A recent clarification around the PR19 definitions was received from Ofwat excluding pumping to and from inter-network storage and this resulted in a slight reduction in both number of pumping stations and rated capacity. Given this change has not been applied to the Annual Performance Report (APR) definition this has led to a slightly different number and rated capacity being reported against these lines in the PR19 when compared to the APR data tables.

Line 5: Total number of sewer blockages

This measure is consistent with the numbers reported in WWS18 line 4.

Lines 6 to 7: Total number of gravity sewer collapses and Total number of sewer rising main bursts / collapses

These forecasts are based on an average of the last five years actuals.

Line 8: Number of combined sewer overflows

An application (PACE) is maintained which records details of our permitted combined sewer overflows and this has been used to derive the number for this line. The figure includes an allowance for 130 unpermitted overflows which we are aware of. These will be investigated in due course and either closed or a permit applied for.

Line 9: Number of emergency overflows

PACE is maintained which records details of our permitted emergency overflows and this has been used to derive the number for this line.

Line 10: Number of settled storm overflows

PACE is maintained which records details of our storm tank overflows at our WRC and this has been used to derive the number for this line.

Line 11: Sewer age profile (constructed post 2001)

For years 2017/18 the best estimated year laid of every mapped sewer has been maintained. Our approach is iterative based on our corporate systems, historical development polygons, deed dates (for non-infra sites to sub-catchments) and the length weighted median year for each material.

We have restated previous years' lengths based on the latest information from our corporate GIS system. As this system is constantly being improved and maintained, this is a more accurate set of reportable numbers.

We have assumed the age profile of modelled lengths of s24 and transferred sewers. These have spread across the age bands using a weighted average method.

The projected numbers for years 2018/19 and 2019/20 are taken from historical averages based on a new and improved process that ensures that we don't double-count any transferred sewer lengths.

The projected numbers for AMP7 are built using data extracted from our corporate investment system (C55). They also include s104 length projections for AMP7.

Years 2022 to 2025 see some of the biggest increases due to a combination of schemes that deliver increased drainage capacity, new strategic sewer schemes towards the end of AMP7, and a peak in numbers of projected new s104 connections during the reporting year 2022/23.

Line 12: Volume of trade effluent

Outturn: Outturn values for the volume of Trade Effluent (TE) have been provided by the Wastewater Services team.

Forecast: Forecast values have been based upon a historic average, factored using yearly percentage changes derived from the non-household (water) volumetric demand forecast.

This non-household forecast has been based upon disaggregate non-household sector regression analysis (characterised by SIC code) and econometric forecasting based upon employment and GVA (Gross value Added) values, as appropriate. Although, not directly correlated (non-household water and wastewater volume), this has been used as an appropriate metric to evaluate potential future non-household growth.

Note that the non-household forecast indicates a marginal decline in non-household demand by approximately 1.85% by the year 2025.

Line 13: Volume of wastewater receiving treatment at sewage treatment works

Outturn volumes are derived as follows:

1. Measured flow discharged from Water Recycling centres (WRCs) serving a population greater than 250 population equivalent (PE), is recorded in the iREM application. Data is extracted from this system for the relevant reporting year
2. For smaller WRCs (serving less than 250 PE) an estimate is made of the flow discharged from each of the works. This is calculated by multiplying the PE for each site by 0.18 m3/head/day to derive a Dry Weather Flow (DWF) figure. This in turn is multiplied by a factor of 1.25 to give an average daily flow figure. The resulting daily flow is then multiplied by 365 to give a yearly figure and then divided by 1,000 to give the value in Ml/yr
3. The final number for this line is then produced by combining the separate values for the measured flows at each of our larger works with the estimated flow from each of the smaller WRC's.

The forecast volume of wastewater receiving treatment at sewage treatment works has been derived from a 90th percentile of the demand forecast (returned to the wastewater system) and an element included for infiltration based on a rolling average of the last five years calculated infiltration values. The forecast volume of returns to the wastewater system and estimated infiltration values are therefore higher than lower value recorded for 2017/18. As a consequence there is an anomaly between 2017/18 data and forecast data for 2018/19. It should be noted that the data reported in this line can be affected by the weather related infiltration.

Line 14: Length of Gravity sewer rehabilitated

The lengths of sewer rehabilitated for 2017-2020 aligns with the schemes with completion dates on Totex Delivery Workflow between 1 April 2017 - 31 March 2020. All planned named schemes for the remainder of AMP6 have been entered into Totex Delivery Workflow. An assumption has been made that length of unnamed schemes for year 5 sewer rehabilitation parcels will be based on a changed investment strategy to only complete work on grade 5 sewer and grade 4 sewer where damage due to Hydrogen Sulphide is observed. For transferred sewers an average refurbishment length of 5.86km (based on data from period 2012-2017) has been assumed for 2018-2020. The predicted lengths of existing gravity sewers replaced by developers or Anglian Water as part of s185 diversions have been included within these values. Emergency patch repair is excluded.

For the period April 2020 to March 2025, our forecast outputs for gravity sewers rehabilitated have been derived from our forward looking risk based models. The planned length of sewer rehabilitated for the period from 2020 has reduced when compared to 2015-2020. This reflects trends in gravity sewer collapse data, with performance against our sewer collapse serviceability measure consistently outperforming in AMP6.

Line 15: Length of rising mains replaced or structurally refurbished

The lengths of rising main replacement or refurbishment for 1 April 2017 to 31 March 2020 represent the named schemes within Totex Delivery Workflow which have completion dates in these years. All planned named schemes for the remainder of AMP6 have been entered into Totex Delivery Workflow. The predicted lengths of existing gravity sewers replaced by developers or Anglian Water as part of section 185 diversions have been included within these values. Emergency patch repair is excluded. The value for year 2017/18 is higher than other years due to the highways agency replacing a number of rising mains as part of the relocation of the A14 road.

For the period April 2020 to March 2025, our forecast outputs for rising main replacement or refurbishment have been derived from our forward looking risk based models. The planned length of rising main replacement or refurbishment for the period from 2020 has increased when compared to 2015-2020. This reflects an increased risk position identified within our risk models for this asset type.

Lines 16 to 21: Length of sewers by liquid type

We have assumed for years 2017/18 that any sewers other than Foul, Surface or Combined have been attributed to the Combined sewer lengths line. This is consistent with the approach taken in previous years.

Our modelled ex-Section 24 sewers have been included in our reported sewer lengths since JR03, therefore these have been included in these lines. Our modelled length includes an assessment of the surface water sewers and we have assumed, given the typical sewer practice at the time, the remainder are combined sewers.

Our corporate system does not have any data safeguards to prevent a combined sewer connected to a foul sewer. The general default appears to be foul rather than combined so it is less reliable to assume the liquid type connection for these sewers.

Rising mains include both pumped and Vacuum movement methods.

In line 20 this has a length of 6.325km which is for a sludge main.

The projected numbers for years 2018/19 and 2019/20 are taken from historical averages based on a new and improved process that ensures that we don't double-count any transferred sewer lengths.

The projected numbers for AMP7 are built using data extracted from our corporate investment system (C55). They also include s104 length projections for AMP7.

Years 2022 to 2025 see some of the biggest increases due to a combination of schemes that deliver increased drainage capacity, new Strategic sewer schemes towards the end of AMP7, and a peak in numbers of projected new s104 connections during the reporting year 2022/23.

Line 22: Length of formerly private sewers and lateral drains (s105A sewers)

We are reporting our total length of modelled transferred sewers. These are 26,700km of laterals and 4,500km of private drains.

WWN4 - WHOLESALE WASTEWATER SEWAGE TREATMENT (POTENTIAL EXPLANATORY VARIABLES)

Lines 1 to 7: Load received at sewage treatment works (Sections A to H)

As the requirements are similar, we have followed the same process as we used to report for tables 17c and 17d in the June Return and in line with the Information Request (IR) we provided in 2017.

The size banding of the individual Water Recycling Centres (WRCs) has been determined using the total resident population, which is comprised of domestic population, tankered waste (from septic tanks and cesspools) and trade effluent loads.

Non-resident population has not been included when determining the size banding of the works, in line with the guidance.

Forecast populations and loads have been derived using Local Authority Unitary Authority (LAUA) household projections and Office for National Statistics (ONS) trend based occupancy rates. When calculating these numbers, it has been assumed that trade effluent population equivalent (PE), tankered PE and non-resident PE remain constant through the forecast period.

The treatment types at our works is assumed to be the same as prior years, unless evidence has been provided by Operations or our Investment Programme team to the contrary.

The loads received numbers in lines 1 to 7 include non resident population, but exclude tankered imports from septic tanks and cesspools as this is consistent with our approach to reporting historically, and in line with previous Ofwat guidance.

The tables also include loads from nine additional WRCs, which are owned and operated by other Water companies, but to which our customers drain. These works are summarised in the tables below:

Population Equivalent

WRC name	Treatment type	Size band	2018	2019	2020	2021	2022	2023	2024	2025
Alkeborough STW	SB	1	502	311	311	315	320	326	332	337
Brentwood Nag Head Ln STW Tham	TB1	4	6,057	6,300	6,338	6,357	6,354	6,360	6,355	6,367
Cheveley Park STW	PRM	1	19	19	19	19	19	19	19	19
Stansted Mountfichet STW	TB1	4	2,127	2,068	2,067	2,097	2,100	2,099	2,095	2,094
Stevenage STW	TA2	3	1,432	1,385	1,392	1,404	1,412	1,422	1,422	1,419
Gt Whelnetham-Stanfld Rd STW	SB	1	6	6	6	7	7	7	7	7
Halse STW	SB	3	1,156	1,131	1,133	1,153	1,155	1,152	1,152	1,152
Severn Trent STW	SB	1	247	227	229	231	231	231	232	232
Wingrave STW	SB	4	4,966	4,843	4,910	4,998	4,977	4,971	4,965	4,949
		Total	16,512	16,290	16,407	16,580	16,575	16,587	16,578	16,575

Loads (kg/BOD5/day)

WRC name	Treatment type	Size band	2018	2019	2020	2021	2022	2023	2024	2025
Alkeborough STW	SB	1	30	19	19	19	19	20	20	20
Brentwood Nag Head Ln STW Tham	TB1	4	363	378	380	381	381	382	381	382
Cheveley Park STW	PRM	1	1	1	1	1	1	1	1	1
Stansted Mountfichet STW	TB1	4	128	124	124	126	126	126	126	126
Stevenage STW	TA2	3	86	83	84	84	85	85	85	85
Gt Whelnetham-Stanfld Rd STW	SB	1	0	0	0	0	0	0	0	0
Halse STW	SB	3	69	68	68	69	69	69	69	69
Severn Trent STW	SB	1	15	14	14	14	14	14	14	14
Wingrave STW	SB	4	298	291	295	300	299	298	298	297
		Total	991	977	984	995	994	995	995	995

Consent information is provided by an extract from our consents database (CHRIS) which is a live document and holds all of the consent limits for the works the company operate. Because we do not have the consent information for the works which are not in our control, we have not assigned these loads to any consent banding, and omitted them altogether from the Treatment works consents tables. For this reason the numbers in column N do not match the numbers in columns T, Z and AF.

We now have greater clarity over the permit limits that will apply to our WRCs in the future. The permit (consent) values for BOD5, phosphorus and ammonia included in this table now reflect the limits proposed by the EA in the latest version of their proposed quality investment programme for AMP7 (WINEP - version 3).

For lines 1 to 6 we believe the formula for this validation flag is including column O which is blank and therefore showing as an empty cell.

Lines 9 to 15: Number of sewage treatment works (Sections A to H)

The number of works includes nine additional works which belong to other Water companies but to which our customers drain. Details of these works can be found above.

As with lines 1 to 7, we have omitted these nine works from the Treatment works consents tables. For this reason the numbers in column N do not match the numbers in columns T, Z and AF.

For lines 9 to 14 we believe the formula for this validation flag is including column O which is blank and therefore showing as an empty cell.

Line 16: Current population equivalent served by STWs

The population equivalent (PE) reported in this line includes data derived from trade effluent and tankered waste. The resident population figures reported in WWS3 Line 11 do not include these components, but do include population whose wastewater is treated at other companies' works. The load figures in Lines 1 to 8 include load from non-resident population, whereas the PE reported in Line 16 does not include non-resident population. Therefore the figures in Line 16 cannot be derived directly from either WWS3 Line 11 or WWn4 Lines 1 to 8 without adjustment for these differences. They do, however, reconcile when these adjustments are made.

Lines 17 to 24: Current population equivalent served

Data has been taken from the National Environment Programme (NEP) for AMP6 for 2015-2020 and from the third release of the Water Industry NEP (WINEP3) for 2020-2025.

Population equivalent data has been taken from the 2017/18 year-end reporting where possible; for sites which have been relocated the last available population figure has been used.

Treatment type has also been taken from the 2017/18 year-end reporting.

Only schemes with a current certainty status of amber or green in WINEP 3 are considered. This is as requested by the Environment Agency that only schemes with amber and green status are included in final business plans for PR19.

There is an element of double counting in lines 17 and 20 as some discharge location schemes are also groundwater protection schemes.

For lines 18 and 19 numbers have been adjusted to allow for WRCs with multiple phosphorous obligations under one or more drivers such as WFD No Deterioration, WFD Good Ecological Status and UWWTD. At these WRCs any multiplication has been allowed for by having only one entry for each WRC in the line.

For line 23 phosphorous schemes have been excluded as these appear in lines 18 and 19.

Line 25: Population equivalent treatment capacity enhancement

We plan to provide additional capacity at our WRCs (wastewater treatment) to ensure there is no detriment to the environment as a result of increase in population equivalent in the catchment. We expect a population equivalent increase of 428,000 during the AMP7 period, this forecast aligns to our Water Resources Management Plan (WRMP) and has been derived from Local Authority Plans as detailed in the WRMP methodology.

Forecast numbers from 2020/21 are based on the planned completion dates of our names schemes, as modeled by our cost benefit assessment tool. Growth population equivalent numbers prior to 2020/21 have been extracted from the planned timeline for project completion of the current AMP6 growth programme.

Where possible we plan to meet growth requirements within current works design headroom, where this is exceeded we have undertaken detailed analysis and developed site specific projects. Allocating planned investments on the sites with the highest risk and offering the greatest value and benefits. We have allowed a small allowance in our plan for non site specific sites (contingent) where ad hoc growth will occur in our region.

WWN5 - WHOLESALE REVENUE PROJECTIONS FOR THE WASTEWATER NETWORK PLUS PRICE CONTROL

SECTION A: WHOLESALE WASTEWATER NETWORK PLUS REVENUE REQUIREMENT AGGREGATED BY BUILDING BLOCKS

Line 1: PAYG - wastewater network plus

Projected total pay as you go (PAYG) for wholesale wastewater network plus costs. Equals table WWS1 line 21 (Totex) (sewage treatment and sewage collection columns) multiplied by table WWn6 line 14 (Total PAYG rate ~ wastewater network plus).

Line 2: Pension deficit repair contributions - wastewater network plus

This has been set to equal table WWS1, line 22 (Pension deficit recovery payments) (sewage treatment and sewage collection columns).

Lines 3 to 11: Wholesale wastewater network plus revenue requirement

2020/21 to 2024/25 have been populated using the outputs of the populated Ofwat PR19 financial model.

Line 12: Total wholesale wastewater network plus revenue requirement

2019/20 has been populated consistent with the customer projections in WWS3 and the revenue cap. This has been split between Network Plus and Bioresources as detailed in section E.

Years 2020/21 to 2024/25 represent the sum of lines 1 to 11.

SECTION B: WHOLESALE WASTEWATER NETWORK PLUS – OTHER PRICE CONTROL INCOME

Line 13: Third party revenue - wastewater network plus

There is no wastewater other price control revenue.

SECTION C: WHOLESALE WASTEWATER NETWORK PLUS – NON-PRICE CONTROL INCOME (THIRD PARTY SERVICES)

Line 14: Bulk supplies - wastewater network plus

Wholesale revenue from bulk supplies includes new supplies to New Appointments and Variations (NAV's) and two cost sharing agreements negotiated between the parties.

The NAV supplies are all based on standard wholesale tariffs and are therefore analysed between network plus and bioresources as described in section E.

The cost sharing agreements are designed to provide an appropriate allocation of operating, capital and financing costs between the parties. The costs are allocated based either on the proportion of the capacity reserved to each party or on whether assets are separately identified and their use specific to one party or the other. The costs and therefore revenue are analysed at a service level as defined in RAG 4.07.

All revenue projections are based on a demand profile consistent with current requirements.

Line 15: Bulk supplies - contract qualifying for wastewater trading incentives (to be signed on or after 1 April 2020)

Blank line. No commentary required.

Line 16: Rechargeable works - wastewater network plus

Consistent with recent trends there is no wastewater rechargeable works revenue forecast.

Line 17: Other non-price control third party services - wastewater network plus

Consistent with recent trends there is no wastewater other non-price control revenue forecast.

SECTION D: WHOLESALE WASTEWATER NETWORK PLUS – NON-PRICE CONTROL INCOME (PRINCIPAL SERVICES)

Line 19: Wholesale wastewater network plus non-price control income (principal services)

Consistent with recent trends there is no wastewater non price control principal service revenue forecast.

SECTION E: WHOLESALE WASTEWATER NETWORK PLUS CHARGES

Lines 20 to 23: Wholesale wastewater network plus charges

The base year allocation between network plus and bioresources is based on the principles applied in the cost allocation exercise undertaken annually for our tariff setting process and the boundaries between the controls as defined in RAG 4.07.

The output of this process analyses the revenue requirement across the service chain activities (collection, treatment, sludge treatment and disposal) and by customer classes, using Activity Based Costing. This uses cost drivers to provide the link between cost data for each service activity and the measurable element of customer demand. Drivers therefore not only explain costs but also provide a measure for each customer class to explain their contribution to that cost within each service chain activity.

In assessing the revenue requirement allocations for different customer types we have, to date, allocated the Regulated Capital Value (RCV) to service activities and asset categories based on the gross Modern Equivalent Asset Value (MEAV) produced for PR09. This allocates the return on RCV (operating profit) across the service chain on a straight-line basis, with a constant percentage return per £ of the RCV.

For the revenue allocations from 1 April 2020, we have taken an estimate of the economic value of our bioresources assets at 31 March 2020, deducted this from the total wastewater RCV and then allocated the balance to the other elements of the wastewater service chain (network plus) based on their MEAV.

For the purposes of this assessment, we used the economic value including an adjustment for Renewable Obligation Certificates (ROCs) income and including shared use management and general assets.

Having established the base revenue customer class proportions we are able to forecast to 2024/25 on the basis that any changes in these proportions are driven solely by changes in the customer profile as forecast in table WWS3 and their associated demand. There is a direct correlation between customers and demand and the revenue requirement of network plus. Therefore changes in unmeasured households due to the metering programme and changes in measured households due to the metering programme and new connections result in a corresponding change in the revenue to be recovered from each customer class.

Line 24: Total wholesale wastewater network plus allowed revenue

The projected wholesale wastewater network plus allowed revenue equals the building blocks income less third party and non price control income.

It should be noted that the formula in the Ofwat data table for the period 2020-2025 has not been updated it to reflect the latest revision to the table. The correct value should be £2982.362 million.

SECTION F: GRANTS AND CONTRIBUTIONS

Lines 25 to 28: Grants and contributions for price control and non-price control - operating expenditure / capital expenditure

As per the updated data table structure issued in January 2019, we have split grants and contributions by operating and capital expenditure as well as by price control / non-price control.

Line 25: Wastewater network operating expenditure grants and contributions (price control)

This line represents the wholesale Wastewater network operational expenditure plus element of the total grants and contributions received. We are not forecasting any contributions towards operating expenditure.

Line 26: Wastewater network capital expenditure grants and contributions (price control)

This line represents the wholesale Wastewater network capital expenditure plus element of the total grants and contributions received for the wholesale Waste water service contained in App28, lines 24 to 26. This line is the sum of:

Wastewater network plus grants and contributions (price control)	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total
Infrastructure Charges (App28 line 24)	21.232	22.391	21.909	25.217	28.891	119.741
Requisitioned Sewers (s100) (App28 line 25)	0.000	0.000	0.000	0.000	0.000	0.000
Other Contributions (price control) (App28 lines 26)	4.027	4.442	4.564	4.534	4.274	21.841
Total in WWn5 line 25	25.260	26.832	26.473	29.751	33.265	141.581

The contributions in these lines have been aligned with Ofwat's requirements in the "PR19 Queries and Answers" under reference number 59. As requested, this line also includes the Inspection and supervision fees (2.5% of construction cost based on WRC 'Sewers for adoption') included in App 28, line 26.

Line 27: Wastewater network operating expenditure grants and contributions (non-price control)

This line represents the wholesale Wastewater network operating expenditure plus element of the total "other" non-price control grants and contributions received for the wholesale water service contained in lines 24 to 26. We are not forecasting any contributions towards operating expenditure.

Line 28: Wastewater network capital expenditure grants and contributions (non-price control)

This line represents the wholesale Wastewater network capital expenditure plus element of the total grants and contributions received for the wholesale Waste water service contained in App28, lines 27 to 28. We have reported the contribution from third parties towards the inspection and supervision fees for diversion work.

The below table shows App28, lines 27 and 28. It is the sum of these lines that is provided in WWn5, line 28.

Wastewater network plus grants and contributions (non-price control)	2020/21	2021/22	2022/23	2023/24	2024/25	AMP7 Total
Diversions (s185)	0.450	0.497	0.510	0.507	0.478	2.441
Other contributions (non-price control)	1.413	1.559	1.602	1.591	1.500	7.665
Total in WWn5 line 26	1.864	2.055	2.112	2.098	1.978	10.106

SECTION G: REVENUE CONTROL TOTAL – WHOLESALE WASTEWATER NETWORK PLUS

Line 29: Total revenue - wholesale wastewater network plus control

The projected wholesale wastewater network plus revenue requirement includes all revenue, including grants and contributions, covered by the plus price control.

WWN6 - COST RECOVERY FOR WASTEWATER NETWORK PLUS

Please see Annex 15a - Evidence on the natural rate of RCV run-off (Reckon) for further information on the cost recovery for wastewater network plus.

WWN7 – WEIGHTED AVERAGE COST OF CAPITAL FOR THE WASTEWATER NETWORK PLUS CONTROL

We have used Ofwat's indicative Weighted Average Cost of Capital, as set out in the PR19 final methodology.

WWN8 – WHOLESALE WASTEWATER NETWORK PLUS SPECIAL COST FACTORS

We are not submitting any Wholesale Wastewater Network Plus special cost factors.

BIO1 - WHOLESALE WASTEWATER SLUDGE (EXPLANATORY VARIABLES)

General

To inform our PR19 plan we engaged Business Modelling Associates (BMA) to build a bioresources network Decision Support Model (DST). The scope of the model covers all of our bio-resources transport, treatment and disposal operations and spans 25 years from 2020. We have used the input and output information from the model to complete the majority of the projections from 2020 as set out in the line by line commentary. It should be noted that the model scenario used to complete the data tables assumes all raw sludge produced by Network Plus is transported, treated and disposed by the Anglian Water bioresource asset base. Manual adjustments have been made to reflect an amount of raw sludge that may be treated and disposed by a third party. The model also assumes the network is operated at the optimum with raw sludge scheduled to sites to give the lowest overall cost of transport, treatment and disposal and it assumes an average Sludge Treatment Centre (STC) uptime of 90% capacity utilisation.

Historical 2017/18 numbers are the same as reported in the Annual Performance Report (APR) tables and have been derived using the same APR methodology.

Line 1: Total sewage sludge produced, treated by incumbents

For years up to 2019/20 the forecast raw produced (ttds) has been calculated as follows. A raw sludge production rate of 0.02183 ttds per head of population equivalent (PE) per annum has been used. This is the average of the 2015/16 and 2016/17 taken from table 4 for the September 2017 RCV data submission. The production rate has been multiplied by the anticipated connected PE for the given year. This data takes local authority growth data by site by year.

From 2020 the sludge production data is taken directly from the BMA DST model. The BMA DST model uses the same growth assumptions and also includes for the anticipated impact of new quality standards for wastewater treatment from the WINEP3 programme. The BMA DST model was built using historic sludge production numbers from 350 WRCs representing over 95% of the total indigenous sludge production. Growth projections for all WRCs have been captured and applied to the respective WRCs in the model. Site specific sludge yields were increased in-line with the population equivalent increase. The population (PE) increase (as modelled) from 2020 to 2025 is approximately 3.99%, the total sludge yield (PE related) for the same period is approximately 4.29%. This difference is because sludge production is dependent on the individual site conditions at sites where population growth occurs as it is specific to the type of process and existing consent standards at these WRC's.

With the release of WINEP3 a significant number of sites within the Anglian region become subject to tightening Phosphorous consents. Typical technology solutions were developed for eight different scenarios detailed in the table below based on the existing consent and treatment type (AS – activated sludge, TF – trickling filter).

Scenario	Sludge yield percentage increase
1 - New AS to 1 Mg/l or >	14%
2 - New AS to < 1 Mg/l	29%
3 - Existing AS with P Removal to 1 Mg/l or >	8%
4 - Existing AS with P Removal to < 1 Mg/l	13%
5 - New TF to 1 Mg/l or >	19%

Scenario	Sludge yield percentage increase
6 - New TF to < 1 Mg/l	37%
7 - TF with existing P Removal to 1 Mg/l or >	8%
8 - Existing TF with P Removal to < 1 Mg/l	16%

The expected yields were factored down by 25% to reflect our experience of design vs actual loads before being used to adjust the site specific yields for the impacted sites, this is consistent with the factor we apply to all our sludge production forecasts when converting from a design connected PE derived figure to sludge production treated at the STC. Where a single site had multiple drivers, only the tightest standard was considered for modelling purposes. For planning purposes, delivery of the programme was phased throughout AMP7 with the majority expected to be put into beneficial use in year 4.

The table below shows that make up of the additional sludge as a result of growth and the WINEP programme from 2020 to 2030.

Time period	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Population growth (TDS/y)	0.0	1,379.1	1,196.5	1,136.8	1,122.5	1,051.2	911.7	897.6	917.2	904.7	873.1
Quality (WINEP) related (TDS/y)	0.00	127.22	221.35	249.85	4,300.15	741.86	23.65	23.43	24.10	23.86	25.35
Year end production (TDS/y)	156,405	157,911	159,329	160,716	166,139	167,932	168,867	169,788	170,729	171,658	172,556
Total population served by WRCs	7,187,994	7,252,688	7,312,092	7,374,634	7,426,718	7,475,495	7,517,924	7,559,513	7,601,577	7,643,309	7,683,638
Population growth	0.000%	0.882%	0.758%	0.713%	1.698%	0.633%	0.543%	0.532%	0.540%	0.530%	0.509%
Quality (WINEP) related	0.000%	0.081%	0.140%	0.157%	2.676%	0.447%	0.014%	0.014%	0.014%	0.014%	0.015%

It should be noted that sludge production in 2017/18 was significantly lower than forecast and down on previous years. A number of factors, such as impacts of weather, received flows to wastewater treatment together with seasonal factors and available sludge treatment capacity, can influence the quantity received at the point of sludge treatment. Provisional data for 2018/19 indicated that the sludge production has increased and is anticipated to be within +/- 2% of the forecast figure included within Bio1, line 3.

Line 2: Total sewage sludge produced, treated by third party sludge service provider

In line with our strategy to explore and exploit viable trades of sludge with neighbouring Water and Sewerage Companies (WASCs) and third parties, we have made assumptions that a small amount of our raw sludge production will be traded from 2018/19. From discussions with other WASCs we expect this initially to be limited in nature until such time that trading out of raw cake is viable, which we anticipate will be mid AMP7.

From discussions we have had to date we anticipate that the trades will be reciprocal and therefore we have assumed trading out will balance with trading in from neighbouring WASCs.

For further information and evidence on markets and trading please refer to our IAP Response document and updated enhancement case for Bioresources.

Line 4: Total sewage sludge produced from non-appointed liquid waste treatment

Sludge arising from septic waste tankered into wastewater treatment works inlets is included in our line 1 total. The proportion calculated in 2017/18 arising from cess pit and septic tank waste is 2.3 ttds. This is calculated from received volumes (296,910 m^3) multiplied by the average measured dry solids (0.769%). For the future forecast we have assumed an average of the ttds received over 2016/17 and 2017/18 will be maintained. This was calculated at 2.1 ttds per annum.

Line 5: Percentage of sludge produced and treated at a site of STW and STC co-location

We have included the percentage of sludge produced on an STW and STC co-location only when sludge treatment is present (not raw dewatering sites). We have therefore counted our nine advanced AD sites, one conventional AD site and two lime plants. The projection from 2020 has been taken from the BMA model. The period from 2017/18 to 2019/20 has been calculated based on our strategy to reduce our STC's to ten centres by 2020 as set out in our RCV submission document.

Line 6: Total sewage sludge disposed by incumbents

The projection from 2020 has been taken from the BMA model. The period from 2017/18 to 2019/20 has been calculated based on our strategy to reduce our STC's to 10 centres by 2020 as set out in our RCV submission document.

Line 7: Total sewage sludge disposed by third party sludge service provider

Our assumption is that the majority of biosolids produced will be disposed by Anglian Water as the incumbent. However in line with the assumptions made in line 2 we have made adjustments for a nominal amount of trading with neighbouring WASC's. We are open to opportunities for trading with other WASC's and third parties and these opportunities will be explored on a case by case basis.

Line 9: Total measure of intersiting 'work' done by pipeline

We transfer sludge by underground pipeline a measured distance of 6.325 km from sludge holding tanks at Southend to centrifuge feed tanks at Rochford. This is the only pumped transfer. We have not included this in line 4 as it is a raw sludge transfer which goes elsewhere for treatment. We have plans to decommission the pipeline during the next AMP period and introduce raw dewatering at Southend. We have assumed this scheme will be delivered in 2022/23.

Line 10: Total measure of intersiting 'work' done by tanker

From 2020 the projections are taken from the BMA model. 2016/17 to 2019/20 have been derived from the average work done by tanker taken an average of the past five years. Adjustments have been made to allow for transport savings for sludge treated by third parties. The assumption is a transport saving of 20% on the proportion of sludge treated by third parties included in line 2.

Line 11: Total measure of intersiting 'work' done by truck

From 2020 the projections are taken from the BMA model. 2016/17 to 2019/20 have been derived from the average work done by tanker taken an average of the past five years. The BMA model assumes optimum operation of the network; to allow for planned STC maintenance leading to fluctuations in STC availability and seasonal changes in sludge production we have assumed a multiplier of 1.2 to uplift the model output. This has been derived from looking at historical data for where we have moved raw sludge cake to temporary stockpiles before onward transport to the STC for treatment.

Line 13: Total measure of intersiting 'work' done by tanker (by volume transported)

For the period from 2017/18 to 2019/20 the value has been calculated from line 9 divided by the average dry solids (DS). From 2020 the value has been taken from the BMA model, which assumed an average percentage dry solids of 2.47% DS.

Line 16: Total measure of 'work' done in sludge disposal operations by truck

From 2020 the values have been taken from the BMA model. Figures for the period from 2016/17 to 2019/20 have been calculated based on historical figures and taking into account our strategy to move to treat all raw sludge by our ten advanced digestion assets by 2020. The values from the model have been adjusted to account for biosolids treated and disposed by third parties as set out in line 2 and line 6. The BMA model assumes optimum operation of the network and assumes that treated biosolids cake can be delivered direct to farmland. A 1.4 multiplier to uplift the model output has been applied to allow for times where treated product is taken into storage prior to onward transport, which is common during wet weather and outside cropping seasons. This has been derived from looking at historical data for where we have moved treated biosolids cake into temporary storage before onwards transport to our farmer customers.

Line 18: Total measure of 'work' done by tanker in sludge disposal operations (by volume transported)

No sludge is disposed by tanker.

Line 19: Chemical P sludge as percentage of sludge produced at STWs

In line with the clarification received from Kevin Ridout by email on 23 May 2018 we have changed the way we have previously reported according to the PR19 (Bio 1 line 19) definition i.e. 'The total quantity of sludge produced at wastewater treatment works which includes chemical dosing for Phosphorus (P) removal expressed as a percentage of the total sludge produced at all in area wastewater treatment works'. The increase over time is mainly due to the overall increased population at the larger works removing P chemically. We have not included sludge arising from P removal at Whitlingham (Norwich) as this site is a Biological Nutrient Removal (BNR) plant removing P biologically and we do not use chemicals there. Similarly, we do not include iron salt dosing at Clacton which is for enhanced settlement. Future forecasts over AMP7 allow for increases in chemical P removal as a result of the WINEP programme.

BIO2 - WHOLESALE WASTEWATER SLUDGE TREATMENT PROCESS AND DISPOSAL ROUTES

General

By 2020 we plan to be in a position to treat all of our raw sludge production by our nine advanced anaerobic digestion facilities and one conventional anaerobic digestion plant with pasteurisation at Chelmsford. This is consistent with our strategy and the previous September 2017 RCV submission.

SECTION A: SLUDGE TREATMENT PROCESS

Line 1: % sludge - untreated

No sludge will be untreated.

Line 2: % sludge untreated process - raw sludge liming

From 2020 we do not anticipate that we will treat by lime stabilisation. As we move towards this strategic outcome we have calculated a reducing percentage by the route over the period from 2017/18 to 2019/20.

Line 3: % sludge treatment process - conventional AD

By 2020 we will only have one site in this category at Chelmsford. From 2020 the value has been taken from the BMA model. The period from 2016/17 to 2019/20 makes assumptions on the timing of closer of conventional anaerobic digesters at Caister-on-Sea.

In line with the assumptions in Bio2 line 2 we have assumed a quantity of sludge will be treated by other Water and Sewerage Companies (WASCs). Initially from 2018/19 through to 2023/24 it is assumed this will be via conventional AD technology.

Line 4: % sludge treatment process - advanced AD

Values taken fro the BMA model from 2020. Values from 2016/17 to 2019/20 derived from business planning to achieve our strategic aim of treated all of our sludge via our 10 AD sites by 2020.

In line with the assumptions in Bio1 line 2 we have assumed a quantity of sludge will be treated by other WASCs. From 2024/25 it is assumed this will be via advanced AD technology.

Line 5: % sludge treatment process - incineration of raw sludge

We have no incineration.

Line 6: % sludge treatment process - phyto-conditioning / composting

We have no phyto-conditioning / composting.

Line 7: % sludge treatment process - other

In line with our strategy, we plan to cease co-composting with green waste by 2020. Our facility at Great Billing has closed and a small volume continues to be treated at Cliff Quay. We have assumed this will continue at a similar rate to 2016/17 for the period up to 2020. We co-compost sludge after digested sludge treatment. It has therefore not been included in line 7 to avoid double counting, as it has already undergone treatment.

SECTION B: (UN-INCINERATED) SLUDGE DISPOSAL ROUTE

Line 9: % sludge disposal route - landfill, raw

No raw sludge is disposed to landfill.

Lines 10, 11 and 13: % sludge disposal routes - landfill partly treated, land restoration / reclamation and other

We do not plan to dispose of any sludge via these routes in AMP7.

Line 12: % sludge disposal route: sludge recycled to farmland

We plan that all sludge continues to be disposed to farmland. Note that historically we have from time to time on a case by case adhoc basis provided some digested sludge to third parties for seeding of new assets. Whilst we do not have any plans to do this in the future we will continue consider this service on a case by case basis as and when the opportunity arises.

Where we have assumed sludge is treated and disposed by third parties we have assumed the products will be recycled to agricultural farmland.

BIO3 - WHOLESALE WASTEWATER SLUDGE OPEX

SECTION A: SLUDGE TREATMENT TYPE

Line 1: Power

This line includes power costs for sludge treatment and thickening processes (>10% ds). It Includes all imported power for sludge assets netted off with of all CHP generated power which is consumed by Anglian Water sewage treatment assets.

The reduction in power costs from 2017/18 to 2018/19 reflects an increase of power generation reducing imported power costs for the site. All generated power consumed by the site (sewage treatment and sludge treatment assets) is credited to sludge treatment generating an net power credit from 2018/19.

The total power costs (excluding Atypicals for 2017/18) agrees to WWS1 Wholesale wastewater operational expenditure line 1 for the sludge treatment columns.

Line 2: Income treated as negative expenditure

This line includes all credits received for ROCs income and externally exported power from CHP sludge assets as well as gate fee income from our composting activities.

The increase in Income from 2017/18 to 2018/19 reflects a combination of an anticipated increase power generation and an increase in ROC prices in 2018/19. The reduction the following year (2019/20) reflects a loss of gate fee income from our composting activities.

Total income treated as a negative expenditure agree to WWS1 Wholesale wastewater operational expenditure line 2 for the sludge treatment columns.

Line 3: Local authority and Cumulo rates

The total rates costs (excluding Atypicals for 2017/18) agree to WWS1 Wholesale wastewater operational expenditure line 8 for the sludge treatment columns.

Lines 4 and 5: Other direct and indirect costs

These lines include all other direct and indirect costs relating to sludge treatment.

We have included a recharge from sewage treatment to sludge treatment from 2020/21 to 2024/25 under other costs to account for the processing of return sludge liquors from the sludge treatment and dewatering assets where we have no dedicated liquor treatment plant. The recharge has all been recorded as direct and indirect other costs and represents a fully costed recharge accounting for operating costs, depreciation and financing charges. The recharge is based on return liquor flows / strength which in total represents 5.3% of total operating costs for sewage treatment plus depreciation and finance charges. The values of the liquor recharges to sludge treatment are as per below:

Return Liquors Recharge	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Other Direct Costs - Conventional IAD	-	-	-	1.464	1.519	1.502	1.535	1.571
Other Direct Costs - Advanced Digestion	-	-	-	4.742	4.918	4.863	4.970	5.087
Other Direct Costs - Total	**-**	**-**	**-**	**6.206**	**6.437**	**6.365**	**6.505**	**6.658**
Other Indirect Costs - Conventional IAD	-	-	-	2.152	2.250	2.344	2.436	2.568
Other Indirect Costs - Advanced Digestion	-	-	-	6.966	7.283	7.588	7.884	8.311
Other Indirect Costs - Total	**-**	**-**	**-**	**9.118**	**9.533**	**9.932**	**10.320**	**10.879**

The total of both direct and indirect costs (excluding Atypicals for 2017/18) agrees to WWS1 Wholesale wastewater operational expenditure line 3 to 7 for the sludge treatment columns.

The difference in 2017/18 to the reported Annual Performance Report (APR) table 4W is due to the inclusion of a recharge under 'other indirect costs' for the use of shared assets recorded within Network+ as the principle user. The value of the asset use recharge is as per below:

Shared Asset Recharge	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Other Indirect Costs - Raw Sludge Liming	0.231	0.137	-	-	-	-	-	-
Other Indirect Costs - Conventional IAD	0.024	0.028	0.027	0.028	0.023	0.029	0.020	0.023
Other Indirect Costs - Advanced Digestion	1.732	2.210	2.245	2.316	2.313	2.378	1.906	1.957
Other Indirect Costs - Total	**1.987**	**2.375**	**2.272**	**2.344**	**2.336**	**2.407**	**1.926**	**1.980**

Line 6: Total before depreciation

The total agrees to WWS1 Wholesale wastewater operational expenditure line 9 for the sludge treatment columns.

Line 7: Historical cost depreciation

The historical cost depreciation charge on sludge treatment assets increases from £34.9 million in 2017/18 to £48.4 million in 2019/20. This increase is primarily the result of accelerated depreciation on a number of conventional digestion and other assets which do not form part of our sludge treatment strategy after 1 April 2020. These assets will be depreciated to zero net book value by 31 March 2020 and decommissioned at this time.

The historical cost depreciation charge subsequently falls from £48.4 million in 2019/20 to £21.5 million in 2020/21 as a result of these assets having been decommissioned.

Line 8: Total operating costs (excluding 3rd party)

The difference in 2017/18 to the reported APR table 4W is due to the inclusion of a recharge under 'other indirect costs' for the use of shared assets recorded within Network+ as the principle user (see table above).

Raw Sludge Liming

It is anticipated that raw sludge liming will cease from 2019/20 with the sludge being processed through our advanced treatment assets respectively reducing liming costs and increasing advanced treatment costs.

SECTION B: SLUDGE DISPOSAL ROUTE

Line 9: Power

This line includes the power for sludge disposal assets.

The total power costs agrees to WWS1 Wholesale wastewater operational expenditure line 1 for the sludge disposal columns.

Line 10: Income treated as negative expenditure

This line Includes all credits received for farm sales income for final cake product to land.

The total income treated as negative expenditure agrees to WWS1 Wholesale wastewater operational expenditure line 2 for the sludge disposal columns.

Line 11: Local authority and Cumulo rates

The total rates costs (excluding Atypicals for 2017/18) agrees to WWS1 Wholesale wastewater operational expenditure line 8 for the sludge disposal columns.

Lines 12 and 13: Other direct and indirect costs

These lines include all other direct and indirect costs relating to sludge disposal.

The difference in 2017/18 to the reported APR table 4W is due to the inclusion of a recharge under 'other indirect costs' for the use of shared assets recorded within Network+ as the principle user. The shared asset recharge adjustment is as per below:

Shared Asset Recharge - Sludge Disposal	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Other Indirect Costs - Raw Sludge Liming	0.104	0.089	-	-	-	-	-	-
Other Indirect Costs - Conventional IAD	0.013	0.014	0.014	0.014	0.014	0.014	0.012	0.012
Other Indirect Costs - Advanced Digestion	0.531	0.759	0.827	0.853	0.873	0.876	0.718	0.721
Other Indirect Costs - Total	**0.648**	**0.862**	**0.841**	**0.867**	**0.887**	**0.890**	**0.730**	**0.733**

The total of both direct and indirect costs (excluding Atypicals for 2017/18) agrees to WWS1 Wholesale wastewater operational expenditure line 3 to 7 for the sludge disposal columns.

Line 14: Total before depreciation

Total agrees to WWS1 Wholesale wastewater operational expenditure line 9 for the sludge disposal columns.

Line 15: Historical cost depreciation

No commentary required.

Line 16: Total operating costs (excluding 3rd party)

The difference in 2017/18 to the reported APR table 4W is due to the inclusion of a recharge under 'other indirect costs' for the use of shared assets recorded within Network+ as the principle user (see above table).

Raw Sludge Liming

It is anticipated that raw sludge liming will cease from 2019/20 with the sludge being processed through our advanced treatment assets respectively reducing liming disposal costs and increasing advanced treatment disposal costs.

Bio4 - Wholesale Revenue Projections for the Wastewater Bioresources Price Control

Section A: Wholesale Wastewater Bioresources Revenue Requirement Aggregated by Building Blocks

Line 1: PAYG - wastewater bioresources

Projected total pay as you go (PAYG) for wholesale bioresources costs. Equals table WWS1 line 21 (Totex) (sludge transport, sludge treatment and sludge disposal columns) multiplied by table Bio5 line 19 (Total PAYG rate - bioresources).

Line 2: Pension deficit repair contributions - wastewater bioresources

This has been set to equal table WWS1 line 22 (Pension deficit recovery payments) (sludge transport, sludge treatment and sludge disposal columns).

Lines 3 to 11: Wholesale wastewater bioresources revenue requirement

2020/21 to 2024/25 been populated using the outputs of the populated Ofwat PR19 financial model.

Line 12: Total wholesale wastewater bioresources revenue requirement

2019/20 has been populated consistent with the customer projections in WWS3 and the revenue cap. This has been split between Network Plus and Bioresources.

Years 2020/21 to 2024/25 represent the sum of lines 1 to 11.

Section B: Wholesale Wastewater Bioresources - Other Price Control Income

Line 13: Third party revenue - wholesale bioresources

We have no wastewater third party revenue.

Section C: Wholesale Wastewater Bioresources - Non-Price Control Income (Third Party Services)

Line 14: Bulk supplies - wastewater bioresources

Wholesale revenue from bulk supplies includes new supplies to New Appointments and Variations (NAV's) and two cost sharing agreements negotiated between the parties.

The NAV supplies are all based on standard wholesale tariffs and are therefore analysed between network plus and bioresources.

The cost sharing agreements are designed to provide an appropriate allocation of operating, capital and financing costs between the parties. The costs are allocated based either on the proportion of the capacity reserved to each party or on whether assets are separately identified and their use specific to one party or the other. The costs and therefore revenue are analysed at a service level as defined in RAG 4.07.

All revenue projections are based on a demand profile consistent with current requirements.

Line 15: Bulk supplies - contract qualifying for wastewater trading incentives (to be signed on or after 1 April 2020)

No commentary required.

Line 16: Rechargeable works - bioresources

Consistent with recent trends there is no wastewater rechargeable works revenue forecast.

Line 17: Other non-price control third party services - bioresources

Consistent with recent trends there is no wastewater other non-price control forecast.

SECTION D: WHOLESALE WASTEWATER BIORESOURCES – NON-PRICE CONTROL INCOME (PRINCIPAL SERVICES)

Line 19: Wholesale wastewater bioresources non-price control income (principal services)

We have no non-price control revenue from wastewater principal services.

SECTION E: WHOLESALE WASTEWATER BIORESOURCES CHARGES

Lines 20 to 23: Wholesale wastewater bioresources charges

The base year allocation between network plus and bioresources is based on the principles applied in the cost allocation exercise undertaken annually for our tariff setting process and the boundaries between the controls as defined in RAG 4.07.

The output of this process analyses the revenue requirement across the service chain activities (collection, treatment, sludge treatment and disposal) and by customer classes, using Activity Based Costing. This uses cost drivers to provide the link between cost data for each service activity and the measurable element of customer demand. Drivers therefore not only explain costs but also provide a measure for each customer class to explain their contribution to that cost within each service chain activity.

In assessing the revenue requirement allocations for different customer types we have, to date, allocated the Regulated Capital Value (RCV) to service activities and asset categories based on the gross Modern Equivalent Asset Value (MEAV) produced for PR09. This allocates the return on RCV (operating profit) across the service chain on a straight-line basis, with a constant percentage return per £ of the RCV.

For the revenue allocations from 1 April 2020, we have taken the estimate of the economic value of our bioresources assets at 31 March 2020, deducted this from the total wastewater RCV and then allocated the balance to the other elements of the wastewater service chain (network plus) based on their MEAV.

For the purposes of this assessment, we used the economic value including an adjustment for Renewable Obligation Certificates (ROCs) income and including shared use management and general assets.

Having established the base revenue customer class proportions we are able to forecast these up until 2024/25 on the basis that any changes in these proportions are driven solely by changes in the customer profile as forecast in table WWS3 and their associated demand. There is a direct correlation between customers and demand and the revenue requirement of bioresources. Therefore changes in unmeasured households due to the metering programme and changes in measured households due to the metering programme and new connections result in a corresponding change in the revenue to be recovered from each customer class.

Line 24: Total wholesale wastewater bioresources allowed revenue

The projected wholesale wastewater bioresources allowed revenue equals the building blocks income less third party and non price control income.

It should be noted that the table formula for the period 2020-2025 has not been updated to reflect the latest revision to the table. The total value should be £546.894 million.

SECTION F: GRANTS AND CONTRIBUTIONS

Lines 25 to 28: Grants and contributions

Blank lines. No commentary required.

SECTION G: REVENUE CONTROL TOTAL – WHOLESALE WASTEWATER BIORESOURCES

Line 29: Total revenue - wholesale wastewater bioresources control

The projected total wholesale bioresources revenue requirement includes all revenue, including projected grants and contributions, covered by the price control.

SECTION H: WHOLESALE WASTEWATER BIORESOURCES – REVENUE TO COVER BIORESOURCES COSTS

Lines 30 to 31: Wholesale wastewater bioresources revenue to cover fixed and variable costs

Ofwat action: Bioresources

Action reference: ANH.CMI.A2

The proposed split of fixed and variable revenues for the bio-resources revenue control has not been sufficiently evidenced, particularly where cost lines are partly incremental and partly fixed. We are also intervening to ensure that the bioresources revenue adjustment is set on a broadly comparable basis to avoid setting revenue controls that may distort the development of trades. We will set out our view in the draft determinations based on the updated tables bio 1,Bio3 and Bio4. We will treat the funding of the 2020 RCV (run-off, returns and tax) as fixed for these purposes, along with revenues to recover local authority rates; some fees; and a proportion of direct and indirect costs of bioresources treatment and transport.

Our response:

We believe that our proposed split of fixed and variable revenues for the bioresources revenue control has been sufficiently evidenced and is in accordance with Ofwat guidance. The information above confirms the information provided in our response to Ofwat's post submission query ANH-IAP-CMI4_001.

The allocation of revenue to recover fixed and variable costs has been calculated in accordance with the additional guidance provided from Ofwat and our historic bioresources cost data. In determining whether these costs were classified as being fixed or variable, we have assessed, by cost category, whether these costs would be likely to change driven by short term increases/reductions in sludge volumes.

Where costs were determined to vary in the short term with changes to sludge volumes, these were all categorised as variable (with all other expenditure items categorised as fixed). We have assumed that sludge volumes would only vary by relatively modest amounts and likely impact all sludge treatment centres.

A detailed breakdown of expenditure areas and the rationale for how each was classified is reported below:

	Fixed	Variable	Basis for categorisation
Sludge transport			
Liquid sludge haulage - labour		*	Liquid Haulage is carried out primarily via our internal tankering fleet with the use of additional external contracted tankering operators. This enables us to vary our overall haulage costs with modest variations in haulage quantities by maintaining the haulage volumes for our internal fleet and reducing/increasing the work given to contracted tankering operators.
Liquid sludge haulage - fuel		*	
Liquid sludge haulage - contracted		*	
Liquid sludge haulage - maintenance		*	
Liquid sludge haulage - scheduling and management	*		Primarily people costs and considered fixed with regard to modest variations in haulage quantities.
Sludge treatment			
Raw cake haulage - labour		*	Cake Haulage is carried out primarily via our internal tankering fleet with the use of additional external contracted haulage operators. This enables us to vary our overall haulage costs with modest variations in haulage quantities by maintaining the haulage volumes for our internal fleet and reducing/increasing the work given to contracted haulage operators.
Raw cake haulage - fuel		*	
Raw cake haulage - contracted		*	
Raw cake haulage - maintenance		*	
Raw cake haulage - scheduling and management	*		Primarily people costs and considered fixed with regard to modest variations in haulage quantities.
Sludge treatment - business rates	*		Business Rates - Fixed costs with modest changes to sludge volumes treated. It is assumed any variations in sludge volumes treated would be spread over all sludge treatment centres.
Sludge treatment - operational labour	*		Direct labour costs for sludge treatment sites would remain fixed with regard to modest variations in sludge volumes treated. We have small teams of dedicated sludge technicians at each site required to run the sludge assets 24hrs a day and 7 days a week. Efficient sludge treatment, maximum gas and subsequent energy generation depends upon consistent and well managed digester operations.
Sludge treatment - chemicals		*	For modest variations in sludge treatment volumes we would anticipate volume reductions/increases in chemical usage.
Sludge treatment - power		*	For modest variations in sludge treatment volumes we would anticipate volume reductions/increases in power usage and power generated via our CHP generation plant.
Sludge treatment - maintenance	*		We would not anticipate any material variations in maintenance costs for modest variations in sludge volumes treated. It is assumed any variations in sludge volumes treated would be spread over all sludge treatment centres.
Sludge treatment - CHP income		*	For modest variations in sludge treatment volumes we would anticipate volume reductions/increases in power generated impacting ROCs and power export income.

	Fixed	Variable	Basis for categorisation
Sludge liquor treatment recharge from sewage treatment	*		This is the recharge from sewage treatment assets for the processing of sludge liquors from the sludge treatment assets where no dedicated sludge liquor plant is installed. For modest variations in sludge volumes we would not anticipate this having an overall cost impact on the sewage treatment costs and subsequent recharge to Bioresources.
Sludge disposal			
Final cake haulage - labour	*		Final cake haulage to land is predominantly carried out using our internal haulage fleet. Any modest variations in final cake haulage will impact fuel and maintenance costs but not impact our labour costs which are considered fixed for haulage to land.
Final cake haulage - fuel		*	
Final cake haulage - maintenance		*	
Final cake haulage - scheduling and management	*		Primarily people costs and considered fixed with regard to modest variations in haulage quantities.
Sludge spreading to land		*	Final Cake spreading to land is completed by contractors and considered variable with reductions in sludge volumes treated and disposed of.
Sludge farm sales advisors	*		Biosolids farm sales advisors are predominantly people costs and considered fixed with regard to modest variations in sludge volumes treated and disposed of.
Sludge farm sales income		*	Biosolids farm sales income is variable with the volumes of Biosolids disposal.
General			
Business support overheads	*		These costs are the wider business support and management costs including Finance, Human Resources, Regulation, Legal, Communications and business Directors. These costs are all considered fixed with regard to modest movement in sludge volumes treated.
Recharge for shared assets recorded under principal business unit	*		The recharges for the use of shared assets is primarily IT assets and considered fixed with regard to modest movement in sludge volumes treated.
Pension deficit repair contributions	*		Pension deficit contributions are considered fixed with regard to modest movement in sludge volumes treated.
Run off and returns	*		Run offs and returns are considered fixed with regard to modest movement in sludge volumes treated.

BIO5 - COST RECOVERY FOR BIORESOURCES

Please see Annex 15a - Evidence on the natural rate of RCV run-off (Reckon) for further information on the cost recovery for bioresources.

BIO6 - WEIGHTED AVERAGE COST OF CAPITAL FOR THE BIORESOURCES CONTROL

We have used Ofwat's indicative Weighted Average Cost of Capital, as set out in the PR19 final methodology.

BIO7 - WHOLESALE WASTEWATER BIORESOURCES SPECIAL COST FACTORS

We submitting one special cost factor claim in Wholesale wastewater bioresources.

SECTION A: SPECIAL COST CLAIM 1

Name of claim	Sludge Transport Claim
Name and identifier of related claim submitted in May 2018	ANH03
Business plan table lines where the totex value of this claim is reported	WWS1, Line A9 - £41.6m
Total value of claim for AMP7	£41.6m
Total opex of claim for AMP7	£41.6m
Total capex of claim for AMP7	£0m
Depreciation on capex in AMP7 (retail controls only)	N/A
Remaining capex required after 31 March 2025 to complete construction	N/A
Whole life totex of claim	£41.6m
Do you consider that part of the claim should be covered by our cost baseline? If yes, please provide an estimate	No, the claim is net of the amount provided through an efficient cost baseline, unless the method for assessing bioresources costs allows fully for the impact of sludge transport
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls	10.0% of AMP7 bioresources totex
Does the claim feature as a Direct Procurement for Customers (DPC) scheme?	No

Need for investment / expenditure

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

a Outside the control of management
b Significant and
c Long-lasting.

We recognise that sludge trading has the capacity to reduce our sludge transport costs at the margin. We are vigorously pursuing opportunities to trade sludge and have been doing so since the start of 2016. While we are disappointed that after more than two years, we have only managed to trade very small volumes of sludge, we continue to work towards a number of agreements with contiguous WaSCs. At present, the expectation is that we might be able to trade up to 10% of

sludge produced during AMP7 under the most favourable circumstances, half of which would be liquid sludge and the other half raw cake. Given the uncertainty surrounding the current negotiations, this cost adjustment claim does not take into account the potential for reduced sludge miles by virtue of sludge trading. Should we achieve this maximalist scenario, our claim would reduce by £4.2 million.

Need for adjustment

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

While there are other water companies which are:

i. Large
ii. Have low population density and
iii. Need to move sludge to Advance Anaerobic Digestion (AAD) sites.

No other WaSC has all three factors together.

Ofwat has collected two measures of work done for sludge transport as part of its cost collection exercises. The first, ttds km/year, is collected for all modes of transport. The second, m^3 km/year, is collected for tankered liquid sludge alone. We argue that for liquid tankered sludge, the correct measure is the m^3 km/year as this is measuring actual work done. The ttds measure takes no account of the physical volume of the sludge (in other words, what is actually moved), because the dry solids account for only 5% at most of the moved mass. Put otherwise – the volume of dirty water is ignored. Given that we move a disproportionate amount of liquid sludge, working on the basis of ttds km understates the problem for us. The reason why we move a higher proportion of liquid sludge is that it is not economically viable to dewater sludge at small WRCs so as to produce raw sludge cake rather than liquid.

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

Outside management control

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

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

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

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

We have implemented our sludge strategy focused on AAD over the last three AMPs. At successive price reviews, the business cases for the individual sites have been subject to detailed scrutiny by Ofwat. As such, the size and location of the existing base of AADs has (relatively) recent acceptance of their validity. It does leave open the possibility that there ought to be further STCs which would

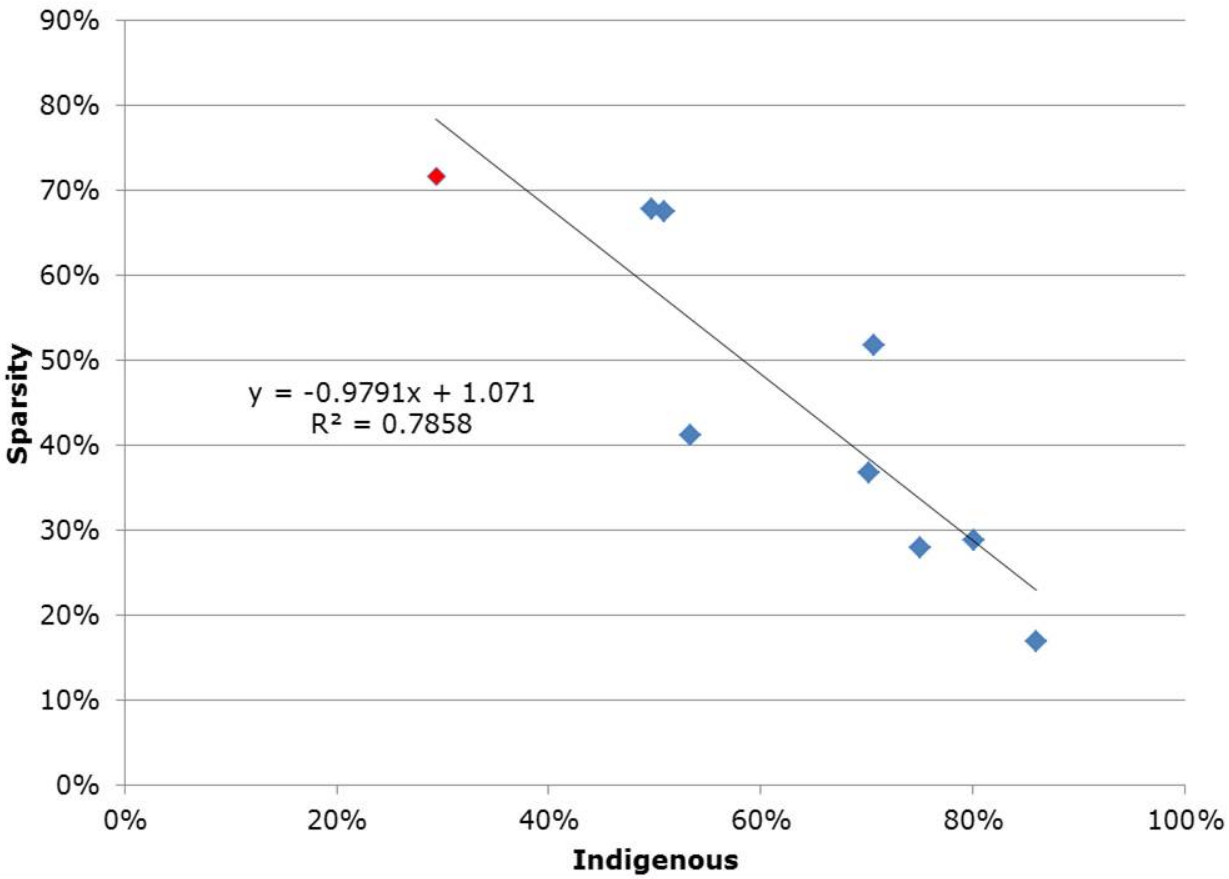
reduce the requirement for sludge transport both by virtue of the additional indigenous sludge generated and by virtue that an additional STC would allow for the reduction in aggregate sludge miles travelled. This is addressed under point iv) below.

ii. The relationship between indigenous sludge and population sparsity

The figure below demonstrates that there is a strong correlation between population sparsity (here defined as the medium level of sparsity defined by Ofwat, that is <600 persons/km2) and the proportion of sludge generated at a WRC co-located with a STC ('indigenous sludge'). The individual datum points show the respective sparsity and indigenous shares for each WaSC in the 2017 Information Request (IR17). The graph suggests that at the extreme where sparsity is close to 100%, the indigenous proportion would be close to zero. Contrariwise, if indigenous is at 100%, sparsity will be close to zero.

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

Figure 18 Relationship between indigenous sludge and sparsity (source: IR17)



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

iii. Unit cost analysis based on our 10 AAD STCs

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

iv. BMA scenarios

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

We have run scenarios on an unconstrained basis to determine the optimal size and location of STCs once existing STCs have reached the end of their planned life. The conclusion reached was that it would be beneficial overall to expand the capacity at existing sites and not to replace two STCs at the end of their lives, in the early 2030s. The additional transport costs which would be incurred as a result of going from 10 to eight STCs would more than be offset by the economies of scale realised at the remaining STCs.

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

Best option for customers

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

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

Robustness and efficiency of claim's costs

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

i. Using cost drivers alone

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

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

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

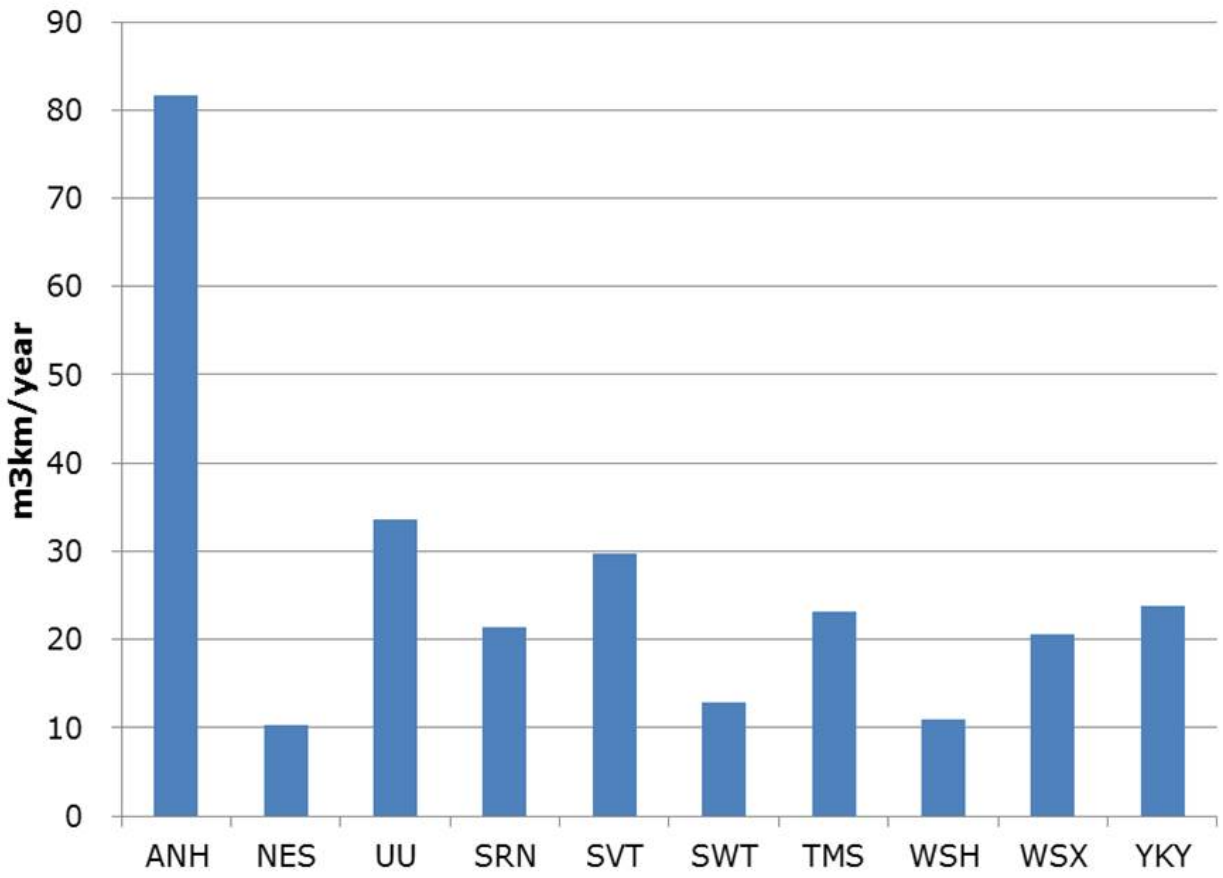
	Transport costs as % Biores	Transport share normalised	% sludge transported (1-I)	(1-I) normalised
ANH	27%	159.8%	71%	194%
NES	12%	72.5%	47%	128%
UU	11%	65.5%	25%	69%
SRN	16%	94.6%	29%	80%

	Transport costs as % Biores	Transport share normalised	% sludge transported (1-I)	(1-I) normalised
SVT	22%	131.0%	30%	82%
SWT	19%	113.4%	30%	82%
TMS	8%	49.4%	14%	39%
WSH	23%	136.9%	49%	135%
WSX	21%	125.5%	50%	138%
YKY	12%	70.8%	20%	54%
Weighted average	17%	100.0%	36%	100%

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

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

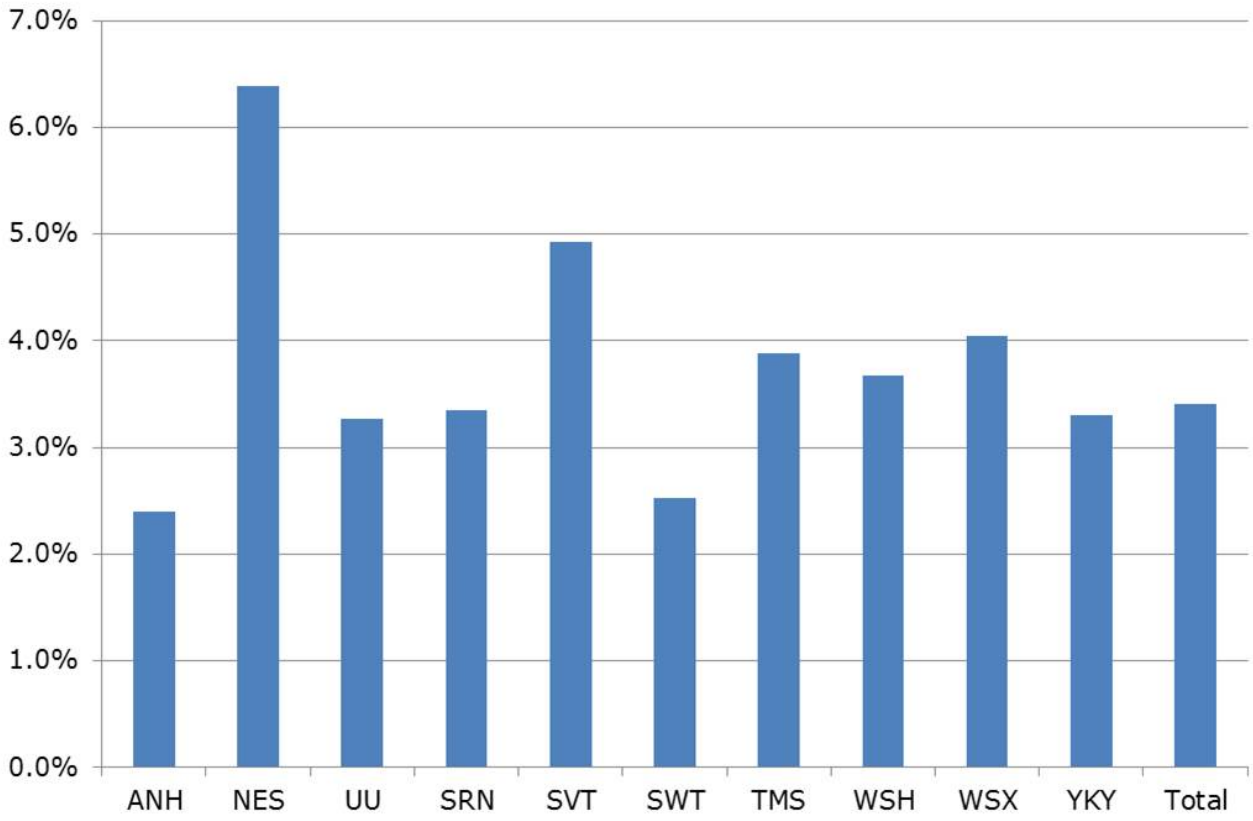
Figure 19 Tanker volume work done in 2016-17 (source: IR17)



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

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

Figure 20 Inferred Dry Solids in liquid sludge 2016-17 (sources: IR17, Anglian Water analysis)



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

Inferred and normalised DS (sources: IR17, Anglian Water analysis)

	Inferred % DS from IR17	Normalised inferred DS
ANH	2.4%	70%
NES	6.4%	187%
UU	3.3%	96%
SRN	3.4%	98%

	Inferred % DS from IR17	Normalised inferred DS
SVT	4.9%	144%
SWT	2.5%	74%
TMS	3.9%	114%
WSH	3.7%	108%
WSX	4.0%	119%
YKY	3.3%	97%
Weighted average	3.4%	100%

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

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

The question then that needs to be answered is how much does 1m^3 km cost? 1m^3 of dirty water weighs 1T, so the question is how much does it cost to move 1 tonne by 1 kilometre? Internal estimates put the figure at £0.30, implying £(0.3 x 28.5) million = £8.6 million per annum (in current prices) additional cost. This equates to £42.75 million for the five years of a price control period.

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

ii. Using botex and cost drivers

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

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

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

By comparison to the (weighted) average WaSC, the amount of work we do to move liquid sludge represents 194% of the industry average. In other words, if we matched the industry average, we would be doing only 52% (100/194) of the transport work we actually engage in. That means that the excess work we do annually as a consequence of our geographic and demographic factors is 48% of the (corrected) total. That equates to £(14.5 x 0.48)m "£7.0 million (in 2012/13 prices), or £8.1 million in 2017/18 prices. This equates to £40.4 million for AMP7.

iii. Conclusions

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

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

Sludge transport cost adjustment beneficiaries (sources: IR17, Anglian Water analysis

	AMP7 benefit		
£m 2017/18 price base	Approach 1	Approach 2	Triangulated
ANH	42.7	40.4	41.6
NES	6.3	9.9	8.1
WSH	4.5	9.6	7.1
ESX	10.1	18.3	14.2
Total	63.7	78.2	70.9

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

Sludge Transport Cost adjustment contributors (sources: IR 17, Anglian Water analysis)

	AMP7 cost		
£m 2017/18 price base	Approach 1	Approach 2	Triangulated
NWT	-10.9	-13.3	-12.1
SRN	-6.9	-8.4	-7.6
SVT	-13.5	-16.6	-15.0
SWT	-2.3	-2.8	-2.6
TMS	-22.0	-27.0	-24.5
YKY	-8.2	-10.0	-9.1
Total	-63.7	-78.2	-70.9

Customer protection

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

In 5.iii) above, we demonstrate the impact of applying the same approach to the other nine WASCs.

Affordability

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

Board assurance

Our third party assurance provider, Jacobs, has reviewed our special cost factor submissions. They concluded that we have compiled a robust claim for special costs which are unique to us as a company and are outside of management control.

Figures shown in Bio7

We have taken as our starting point, the Special Cost Factors accepted by Ofwat at PR04 and PR09 relating specifically to sludge transport. We also show the PR09 approach replicated for PR14. Finally, for AMP7, we show the approach set out above in our Cost Adjustment claim for sludge transport.

As required, the costs in AMP7 is shown in 2017/18 prices. The costs for 2004/05 to 2019/20 are shown in price of the day.

The cost for 2004/05 is taken to be the PR04 (AMP4) Special Factor claim (which was in 2002/03 prices) put into 2004/05 price base.

Similarly, the costs for each of the AMP4 years are put in price of the day from 2002/03 prices.

The costs for each of the AMP5 years are taken to be the PR09 Special Factor claim (which was in 2007/08 price base) in the price of the day.

The costs for the first two years of AMP6 follow the same approach as used at PR09 using the AMP6 data supplied in IR17, put into the price of the day.

The third year of AMP6, 2017/18, is the year on which the AMP7 cost adjustment claim was computed. This is the figure used for 2017/18 in Bio7.

The costs for the final two years of AMP6 take the 2017/18 figure and inflated by the forecast RPI inflation for 2018/19 and 2019/20, as set out in App23.

To summarise, the Special Factor / Cost Adjustments used in Bio7 are as follows:

Table Special Factor / Cost Adjustments

	# STCs	% Indigenous	Value when claimed	In 2017/18 Price Base
PR04	30	53%	£2.4m	£3.8m
PR09	34	49%	£4.9m	£6.5m
PR14	13	32%	£7.0m	£7.9m
PR19	10	29%	£8.3m	£8.3m