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PR19: Bioresources Assets Maintenance

September 2018



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Executive summary

Driver for investment

Over AMP7 our aim is to ensure the continued sustainable management of sludge and the production of an enhanced product that will contribute to the protection of the environment and water quality and provide assurance to local food chain stakeholders and our customers as to the quality of our sludge disposed to land. The need for investment is driven by the following objectives:

- Maintaining our sludge assets to ensure a sustainable sludge product;
- Ensuring continued certification with the Biosolids Assurance Scheme (BAS). This is critical to ensure we provide assurance to food chain stakeholders and customers as to the quality of our sludge disposed of to land and consequently help protect our landbank;
- Ensuring compliance with statutory requirements;
- Increasing the resilience of our activities;
- Contributing towards the delivery of performance targets set out in our Measures of Success (MoS);
- Supporting the strategic responses identified in our strategic planning document Welsh Water 2050. (Further information can be found in the supporting document 1.4 Welsh Water 2050);
- Achieving objectives set out in our Sewage Sludge Strategy 2015-2040*ⁱ, in particular:
 - Maintaining a sustainable outlet for the disposal of sewage sludge (protecting our land bank);
 - Continuing to maximise energy generation and reducing our operational costs.

The Investment

We propose to invest £39.94 million (pre-efficiency) on our sludge management assets over AMP7. The expenditure will ensure we maintain our sludge management assets to maximise the production of an enhanced product that will contribute to the protection of the environment and water quality. A breakdown of the expenditure is included in Table 1.

Programme of work	AMP7 Capex Base	AMP7 Capex Enhancement	Total AMP7 Capital Investment
Additional Strategic Storage	-	£6.62m	£6.62 m
PCM – sludge transfer sites	£2.43m	-	£2.43 m
SLUDGE FLCM	£8.76m	-	£8.76 m
SLUDGE PCM	£8.03m	-	£8.02 m
SLUDGE RCM including CHP	£9.24m	-	£9.24 m
RCM – sludge transfer sites	£4.86m	-	£4.86 m
Total programme (pre-efficiency)	£33.32 m	£6.62m	£39.94 m
Total programme (post-efficiency)			£35.84 m

Table 1: Breakdown of Expenditure proposed in this Investment Case

Expenditure focuses on the on-going maintenance of our sludge management assets (sludge digestion plants and sludge collection sites), however, allowance has also been made for the provision of additional strategic sludge storage, to increase the resilience of our sludge management activities should there be a

temporary loss of land bank for the disposal of treated sludge. The proposed expenditure was identified following reviews of historical performance and expenditure and an analysis of risks recorded on our Investment Manager (IM) system, having regard to schemes undertaken and to be completed over AMP6.

The post efficiency capital investment identified incorporates planned capital savings resulting from on-going improvements in operational efficiency e.g. from the Maintenance and Reliability Support (MaRS) and LEAN projects, together with savings resulting from efficiencies in the delivery of schemes e.g. by our Alliance Framework.

The proposed expenditure is significantly lower than the estimated end of AMP6 outturn capital expenditure of £141.5m. However expenditure over AMP6 was exceptionally high due to the extensive programme of Advanced Anaerobic Digestion (AAD) development and sludge transfer/ collection schemes undertaken. Expenditure over AMP6 particularly focused on:

- Development of AAD plants across Wales to increase the quantity of enhanced sludge product produced, hence maximising the use of agricultural land for biosolids disposal and the protecting available land bank. By the end of AMP6, 95% of sludge produced across North and South Wales will be treated to produce an enhanced sludge product;
- Ensuring we obtained certification with BAS;
- Maximising renewable energy generation and reducing operational costs;
- Phasing out the routine use of treatments that impact adversely on land bank availability or customers; such as lime treatment that causes odour nuisance.

The capital investment proposed in this Investment Case will be supported by operational initiatives, including our Maintenance and Reliability Support (MaRS), LEAN and Sludge, Optimising, Reporting & Tracking (SORT) initiatives, which will identify and implement opportunities to make the most effective use of our resources to minimise costs.

Our Sewage Sludge Management Steering Group will monitor our performance and capital and operational expenditure over AMP7 to ensure we achieve our performance objectives and the sustainable management of sludge, having regard to identified risks and challenges.

Delivering for our customers

Our proposed investment in AMP7 will contribute to the following of our customer promises:



Safeguard our environment for future generations: Our proposed maintenance investment will ensure our sludge assets continue to produce an enhanced sludge product which will minimise risks to the environment and contribute to a circular economy.



Put things right when they go wrong: Our customers are likely to become increasingly intolerant of failure. This investment will reduce the risk of uncontrolled failure of our assets, increase resilience and avoid the unwanted customer impacts.



Fair bills for everyone: Using the latest Asset Management approaches we will maximise energy production and ensure we manage our sludge management assets in an efficient and effective way, thus reducing costs.

Delivering for the future

In Welsh Water 2050, we identified future trends. Our proposed investment will ensure that our sludge management schemes are resilient to the following future trends over AMP7:



Demographic Change: Population growth will lead to increased pressures on our wastewater assets including our sludge management facilities through the additional sludge volumes produced and hence to be treated.



Policy and Regulatory Change: Changes in policy and regulation are expected due to the UK leaving the European Union, devolution, and changing quality standards; this creates uncertainty. Improved regulatory methods and innovative policy developments could lead to more efficient delivery of services to our customers.



Protecting public health: We will have a role to play in promoting healthier and more sustainable lifestyles for our customers. The safe and sustainable management of sludge is essential for public health.

Delivering our Strategic Responses

In Welsh Water 2050, we set out to deliver 18 Strategic Responses. This investment will contribute to the following:



Strategic Response 8: Ensuring affordability of services delivered to customers: Reducing energy costs will help us ensure that our services are affordable by all customers.



Strategic Response 16 - Cleaner rivers and beaches: With increasing pressure on the natural environment from increased population, changing land use, climate change and new sources of pollution, we will improve our wastewater assets through proposed expenditure in this Investment Case, together with the Wastewater Treatment and Wastewater Network Maintenance Investment Cases and the Wastewater Network+ Enhancement Investment Case, so as to do our part to help achieve 'good' environmental status for our rivers, lakes and coastal waters.



Strategic Response 17 - Protecting our Critical Wastewater Assets: due to an increased risk of disruption, for example, from an increase in severe weather as result of climate change; and reduced customer acceptability of pollution, we will improve the resilience of our critical wastewater / sludge management assets, which have high environmental and customer impacts of failure.



Strategic Response 18: Promoting a Circular Economy and Combatting Climate Change: we will aim to become energy neutral by 2050. Maximising the renewable energy generated and gas to grid produced by our sludge digestion plants will contribute to this.

Achieving our measures of success

Over PR19, we will measure our performance against our MoS. The proposed expenditure in this Investment Case will contribute to the MoS identified in Table 2*ⁱⁱ.

Measure of Success	End of AMP6 Position	End of AMP7 Position
Ft3 Energy Self Sufficiency – Electricity generated and gas injected to grid as a percentage of all electricity and gas consumed (gas expressed as an electricity equivalent).	26%	35%
En7 Bio resources energy generation – The percentage of sludge processed through our advanced digestion facilities.	95%	97.5%
En8 Biosolids Disposal Compliance – The percentage of sludge disposed of satisfactorily.	100%	100%

Table 2: Measures of Success

1 Delivering our customer outcomes

Background

Sludge production is concentrated in the more densely populated areas of South East Wales, central South Wales and North East Wales. Investment over AMP5 and AMP6 has been focused on the implementation of Advanced Anaerobic Digestion (AAD) across Wales, which by providing an enhanced sludge product for disposal to land and increasing our production of renewable energy, has contributed to achieving identified objectives and measures of success.

By the end of AMP6, AAD will have been provided at Afan, Cog Moors and Cardiff as part of the South Wales Sludge Strategy and at Five Fords in North Wales as part of our North Wales Sludge Strategy. Conventional digestion will still be undertaken at Swansea and Hereford in the short term, however, treated sludge from these sites will be transported to Afan and Cog Moors respectively to provide the enhanced sludge product. Similarly sludge from conventional digestion at Queensferry, will be transported to the Five Fords AAD plant to provide an enhanced sludge product.

Need for investment

The proposed investment is required to provide assurance to local food chain stakeholders and our customers as to the quality of our sludge disposed of to land and hence maintain sustainable outlets for our treated sludge product.

To achieve this over AMP7 our proposed investment will focus on the maintenance of our sludge management assets, including our sludge digestion plants, so as to produce an enhanced sludge product and maintain / gain certification with the Biosolids Assurance Scheme (BAS). This certification will demonstrate our commitment to undertaking the sustainable management of sludge and the protection of the environment and water quality, which will consequently help protect our landbank.

There are constant concerns about being able to fully access the land that we dispose our treated

sludge to, due to sensitivities about the nature of the product. We need to maintain sufficient flexibility to continue being able to dispose of the final product.

The expenditure will focus on the following objectives:

- Ensuring continued certification with the Biosolids Assurance Scheme (BAS). This is critical to ensure we provide assurance to food chain stakeholders and customers as to the quality of our sludge disposed of to land and consequently help protect our landbank;
- Ensuring compliance with statutory requirements;
- Contributing towards the delivery of performance targets set out in our Measures of Success (MoS);
- Managing risks associated with the deterioration in the asset base that could lead to disposal of non-compliant sludge to agricultural land (we have been 100% compliant with this indicator);
- Addressing objectives set out in our Sewage Sludge Strategy 2015-2040, in particular:
 - Ensuring a sustainable outlet for the disposal of sewage sludge / protecting our land bank;
 - Continuing to maximise energy generation and reducing our operational costs;
 - Maximising renewable energy production.

The capital investment will be undertaken in conjunction with on-going improvements in operational efficiency through the Maintenance and Reliability Support (MaRS) and LEAN projects, together with more efficient sludge tankering operations through our Sludge, Optimising, Reporting and Tracking (SORT) project. Further information is included in Appendix A.

Views of our customers and stakeholders

We have engaged with our customers and stakeholders throughout AMP6 to understand their expectations and preferences, including consultations on the use of customer dividend money in AMP6 and the PR19 Business Plan^{*iii}. Our Welsh Water 2050 strategy consultation, held in the summer of 2017, engaged with 20,000 customers. We have also utilised wider industry-level research and assessed its implications for our region, our stakeholders and our future plans.

We identified our customers' priorities through our engagement, which showed strong support for investment which contributed to 'Cleaner rivers and beaches', 'Working with nature for cleaner water' and 'Better water quality for all' – topping the list for all demographic groups.

Affordability of bills

We understand the importance of balancing the need for this investment with the impact on the bills that our customer pay. To help ensure that our bills remain affordable, we have identified a range of efficiency savings within the proposed investment programme. These efficiencies will allow us to deliver the improvements that we know are important to customers, but at a lower overall cost.

Benefit for our customers

The continued maintenance of our sludge management assets together with increased resilience will support our customers' priorities for investment which contributed to 'Cleaner rivers and beaches', 'Working with nature for cleaner water' and 'Better water quality for all'.

The proposed maintenance of our assets will also:

- Ensure the continued generation of energy and the provision of gas to grid at our sludge digestion plants, thus reducing energy costs and our customer bills.
- Maintain serviceability;
- Provide assurance to food chain stakeholders and customers as to the quality of our sludge

disposed of to land through certification with BAS;

- Manage risks, costs and performance so as to deliver the benefits to our customers and the environment at an affordable cost.

We will continue to act on customer feedback throughout AMP7 by working with the Customer Challenge Group and listening to feedback from focus groups.

2 Investing now and for the long-term

In our Welsh Water 2050 strategy document, we have set out our long-term vision and our approach to achieving this, so that we can demonstrate how we will continue to meet our customer needs into the future. It considers both the direction for our own business and outlines the impact we want to have on the people, economy and natural environment of our operating area in Wales and England in the long-term.

Our Welsh Water 2050 strategy identifies significant trends (external factors) over the next 30 years and how these will impact on us and our customers. The trends related to wastewater and sludge management are set out in Figure 1.

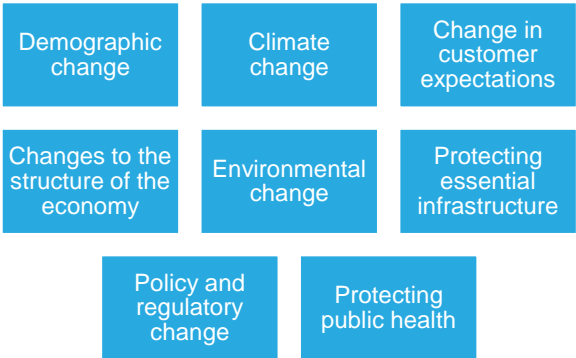


Figure 1: Trends impacting on wastewater management

Details of the trends (challenges) that are particularly relevant to this Investment Case are included below.

Future challenges

Demographic Change

Population growth will lead to increased sludge to be managed.

Policy and Regulatory Change

Changes in policy and regulation are expected due to the UK leaving the European Union, devolution and changing quality standards. This creates uncertainty, but provides the opportunity for us to

help shape future policy. Improved regulatory methods and innovative policy developments could lead to more efficient delivery of services to our customers.

Protecting public health

Our plans will reduce the risk of uncontrolled discharges to the environment and minimise any impact upon public health. We have a role to play in promoting healthier and more sustainable lifestyles for our customers.

Further information on the key risks associated with our sludge management activities is included in Appendix B.

Planning for the future

We have identified in Welsh Water 2050 the Strategic Responses that will enable us to meet the challenges and opportunities presented by these trends so that we can continue to meet our customer promises into the future. Strategic Responses particularly related to sludge management are:

- **Strategic Response 8:** Ensuring affordability of services delivered to customers;
- **Strategic Response 16:** Cleaner rivers and beaches;
- **Strategic Response 17:** Protecting our critical wastewater assets;
- **Strategic Response 18:** Promoting a circular economy and combatting climate change.

The proposed expenditure in this Investment Case will support the Strategic Responses.

Sewage Sludge Strategy 2015-2040

Our Sewage Sludge Strategy 2015-2040 was produced to ensure we maintained a sustainable means of sludge management and disposal over the AMP6 period and beyond; particularly in the face of pressures from food waste disposal, which would provide direct competition for the available landbank for sludge disposal / recycling.

Agricultural recycling is the main outlet route (>99%) for our sewage sludge and one of our primary objectives therefore was to improve the quality and reduce the quantity of sludge to land through the further development of Advanced Anaerobic Digestion (AAD) plants across all of Wales. The enhanced product would be more attractive to farmers for use on agricultural land and grassland.

The Strategy focused on:

- **Development of AAD technologies across all of Wales** – to enable us to safeguard our landbank through access to a wider range of agricultural land types, including grassland, increased acceptability of the enhanced / value added product produced by farmers and stakeholders, and, through decreased volumes of sludge produced, reduced operational costs;
- **Increased provision of strategic sludge storage** – to increase the resilience of our sludge management operations in the face of temporary reductions in landbank availability. The Strategy identifies our aim to provide 4 months emergency final product cake storage in order to mitigate any partial, short or long term loss of land bank. (e.g. due to prolonged poor weather, a catastrophic failure at one of our largest works, an outbreak of a disease such as Foot and Mouth, or as a result of additional exclusion clauses affecting the use / spreading of sludge cake on grassland or animal feed crops);
- **Adoption of volume reduction technologies to reduce transport costs** - by increasing the percentage of solids in sludge exports from satellite sites;
- **Managing risks associated with the deterioration in the asset base** - this could lead to disposal of non-compliant sludge to agricultural land (we have been 100% compliant with this indicator);
- **Increasing renewable energy production / reducing operational costs**; the further development of AAD across Wales would facilitate this;
- **Ensuring compliance with statutory requirements**;

- **Phasing out the routine use of treatments** that impact adversely on land bank availability or customers; such as lime treatment that causes odour nuisance;
- **Managing increases in sludge due to population growth and wastewater treatment improvements**; Allowance for predicted population growth would be incorporated in our schemes;
- **Protecting against land bank loss** - Producing an enhanced product through AAD treatment processes will significantly contribute to this.

A Sewage Sludge Management Steering Group is in place to ensure that capital investment is undertaken in conjunction with on-going improvements in operational efficiency, to support the implementation of the Strategy and BAS certification.

The Biosolids Assurance Scheme Standard

The Biosolids Assurance Scheme (BAS) Standard provides a transparent set of rules that combines the requirements of the numerous Biosolids and Fertiliser regulations, guidance and best practice documents into a single, transparent document. The aim of the standard is to provide better service to landowners, food safety assurances and environmental protection.

Failure to enrol in BAS could put our reputation and ability to recycle sludge to land at risk. Continued certification with BAS is critical to ensure we provide assurance to food chain stakeholders as to the quality of our sludge and consequently help protect our landbank.

Due to timeframes involved, BAS certification had not been identified within our Sewage Sludge Strategy 2015-40. It was also not a driver in the original PR14 Sewage Sludge Treatment and Disposal Investment Case and consequently in the assessment of investment needs over AMP6. Very limited investment was for example proposed across South Wales and Hereford.

The additional investment made over AMP6 and identified in this Investment Case, will contribute to our aim of achieving and maintaining BAS certification across all our assets. We are committed to maintaining certification through the

on-going maintenance and enhancement of our sludge management assets and the development of our systems, procedures and people

BAS certification is particularly important across Wales as agricultural recycling is the main outlet route (>99%) for our sewage sludge and this will continue to be the case over AMP6 and AMP7.

Managing Performance

Sludge Assets

The sludge assets covered by this Investment Case are those identified within the Ofwat document, 'RAG 2.06 – Guideline for classification of costs across the price controls'. These are identified in Appendix C.

The main sludge production is concentrated in the more densely populated areas of South East Wales, central South Wales and North East Wales. Investment over AMP5 and AMP6 has been focused on the implementation of AAD across Wales. By the end of AMP6, AAD will have been provided at Afan, Cog Moors and Cardiff as part of the South Wales Sludge Strategy and at Five Fords in North Wales. Conventional digestion will still be undertaken at Swansea and Hereford, however, treated sludge from these sites will be transported to Afan and Cog Moors respectively to provide the enhanced sludge product. Conventional digestion will also be undertaken at Queensferry over AMP7.

Managing our Sludge Management Activities.

Our sludge management and recycling operations are carried out in accordance with legislative requirements and the Sludge (Use in Agriculture) Regulations 1989. Performance is recorded based on the following activities:

- Monitoring of the critical control points for each treatment process that must be achieved to ensure compliance with the pathogen standard of the biosolids being recycled;
- Sampling and analysis of treated sludge prior to application;
- Sampling of fields (maximum 5ha) on a regular basis;

- Monitoring of soil analysis results to ensure that maximum allowable concentrations of scheduled determinants are not exceeded;
- Risk assessments to determine whether land is suitable for recycling;
- Regular auditing of soil sampling contractors;
- Feedback from farmers on the quality of the service we and the recycling contractors provide.

In order to protect our land bank and better meet the needs and aspirations of our stakeholders and customers, one of our primary measures is to ensure we maintain certification with the Biosolids Assurance Scheme across Wales. The objectives of BAS are to:

- Confirm compliance with legislative and non-legislative requirements and best practice;
- Achieve operational consistency and transparency;
- Deliver nutrient benefits to agriculture;
- Ensure the protection of the environment and hence sustainability;
- Provide information and promote public acceptance;
- Provide assurance to food chain stakeholders.

The following activities are undertaken to ensure we meet the BAS Standard:

- Risk assessments and controls are in place covering the quality and consistency of untreated sludge produced from wastewater treatment processes and any other source materials that enter the process;
- Sludge is treated to significantly reduce health hazards resulting from its use and ensure it does not cause nuisance. Hazard Analysis and Critical Control Point (HACCP) plans are in place to establish microbiological parameter process controls;
- Biosolids are regularly sampled and tested to ensure it is suitable for recycling to agricultural land and to monitor quality;

- Biosolids are transported and stored in conformance with regulations and good practice to protect the environment from diffuse pollution and odour nuisance;
- Soils are analysed prior to the application of biosolids to land to determine any constraints due to metal and nutrient loading rates, taking account of soil pH, heavy metal concentrations and nutrient status.
- Biosolids applications to agricultural land are in accordance with the requirements of the Safe Sludge Matrix (ADAS, 2001), which provides controls on the application of biosolids in advance of specific crops;
- Application to agricultural land is in conformance with relevant regulations and good practice to protect the environment from diffuse pollution and odour nuisance;
- Records are maintained of instrument calibration, sludge / biosolids and soil analyses, biosolids applications to agricultural land and complaints.

Building on progress

Sludge Management

The objectives of investment over AMPs 5 and 6 have been to:

- Maintain stable serviceability;
- Manage risks associated with the deterioration in the asset base that could lead to disposal of non-compliant sludge to agricultural land (we have been 100% compliant with this indicator);
- Produce a sludge product that was more acceptable to our stakeholders and customers;
- Increase energy production / reduce operational costs.

Early in AMP6 we also identified that one of our primary objectives was to obtain and maintain certification with the Biosolids Assurance Scheme.

Investment over AMP5 and AMP6 has therefore focused on the implementation of Advanced Anaerobic Digestion across Wales, which by providing an enhanced sludge product for disposal to land and increasing our production of renewable

energy, has contributed to achieving our objectives and meeting performance targets in our Measures of Success).

AMP5 investment focused on the construction of AAD plants at Cardiff and Afan in South Wales, together with the consolidation and rationalisation of sludge treatment centres, including decommissioning of smaller, less efficient conventional sludge digestion plants at Gowerton, Pen-y-Bont, Narberth and Aberystwyth. At the end of AMP5 a gas to grid system was also incorporated at the conventional AD plant at Five Fords.

Our original PR14 proposals for investment over AMP6 focussed on the development of AAD across North Wales and included an AAD plant at both Five Fords and Treborth. However, additional information relating to sludge loads and an enhanced knowledge of the cost and benefits of our PR14 proposals, led to the development of our North Wales Sludge Strategy, which included revised proposals as follows:

- The provision of just one Advanced Anaerobic Digestion, utilising Thermal Hydrolysis, at the Five Fords Sludge Treatment Centre (STC) and
- The decommissioning of six other STCs across North Wales and modifying these into raw cake export sites feeding the new AAD plant at Five Fords. These sites are Treborth, Chester, Ruthin, Kinnel Bay, Llangefni, and Porthmadog. The Queensferry STC would be decommissioned and modified to a raw cake export site feeding Five Fords over AMP8.

An investment of £55.4m was approved for the North Wales Sludge Strategy. The proposals would:

- Provide an additional 28 GWh/year compared to our current energy generation in North Wales;
- Remove liming processes at all sites in North Wales
- Provide robust sludge processing and treatment facilities for a 40 year design horizon.

Early in AMP6 a review was also undertaken of our objectives with respect to our sludge management activities and assets. This had regard to new challenges or challenges that had increased in priority since the production of our Sewage Sludge

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Strategy 2015-2040 and also the PR14 Sewage Sludge Treatment and Disposal Investment Case.

It was clear that these challenges would have implications on investment over AMP6. The primary challenges identified were:

- Obtaining and maintaining certification with the Biosolids Assurance Scheme; to provide an enhanced sludge product which would help protect our landbank;
- Managing impacts associated with the revised regulation of sludge treatment by Ofwat;
- Improving the reliability and resilience of sludge treatment centres;
- Reducing high operational costs and the Average Cost to Serve (ACTS) associated with our sludge management activities;
- Providing increased assurance to our food chain stakeholders through the delivery of nutrient benefits to agriculture and providing increased protection to the environment;

To respond to these challenges, it was decided to increase the production of an enhanced sludge product across Wales. Consequently to support the North Wales Strategy, it was agreed that a South Wales Sludge Strategy (including Hereford) would also be developed over AMP6, which included additional proposals to those set out in our PR14 Investment Case.

Options for enhancing sludge facilities in South Wales and producing an enhanced sludge product were considered having regard to costs, land bank availability, environmental constraints, the provision of a more robust and resilient sludge management system, the transfer of sludge costs, sustainability and energy generation opportunities.

In October 2016, Board approved an investment of £68.4m in AMP6 for the South Wales Sludge Strategy. This would provide AAD at Cog Moors STC, capable of processing up to 27,100 tds, maintenance / resilience improvements at 12 sludge treatment satellite sites and additional strategic sludge storage at Afan.

By the end of AMP6, AAD will have been provided at Afan, Cog Moors and Cardiff, as part of the South Wales Sludge Strategy, and at Five Fords, as part of the North Wales Sludge Strategy, resulting in circa 95% of sludge produced being an enhanced sludge

product. Conventional digestion will still be undertaken at Swansea and Hereford, however, treated sludge from these sites will be transported to Afan and Cog Moors respectively to provide the enhanced sludge product. Conventional digestion will still be undertaken at Queensferry, however, a scheme is proposed as part of our PR19 submission to convert Queensferry to a sludge dewatering centre over AMP8.

Map 1 identifies the sludge assets that will be in operation at the end of AMP6.



Map 1: Sludge Assets at the end of AMP6

Strategic Sludge Storage

Our Sewage Sludge Strategy recommends that four months sludge cake storage is provided in order to mitigate any partial, short or long term loss of land bank. This could be due to prolonged poor weather, a catastrophic failure at one of our treatment centres, an outbreak of a disease such as Foot and Mouth, or as a result of additional exclusion clauses affecting the use / spreading of sludge cake on grassland or animal feed crops.

In developing proposals over AMP6, an additional four weeks of sludge storage is therefore to be provided at the Afan WwTW as part of the South Wales (and Hereford) Sludge Strategy.

Sludge Quantity Managed

The quantity of sludge produced and disposed of to land since 2011/12 through years 2016/17 is presented in Figure 2. This identifies that there has been a limited increase in quantities in sludge to be managed over the period 2011/12 to 2016/17.

Table 3 shows the sludge treatment processes utilised over 2016/17 and the percentage of sludge utilising these.

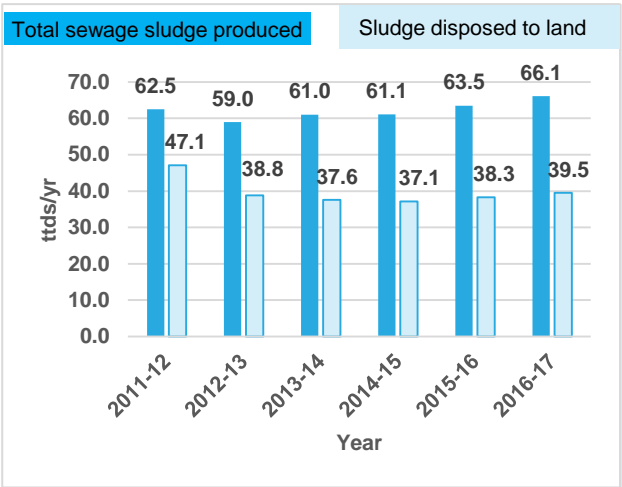


Figure 2: Annual Sewage Sludge Produced and Sludge Disposal Quantities to land

Sludge treatment process	Percentage (%)
Untreated	0
Raw sludge liming	9.8
Conventional AD	25.5
Advanced AD	64.4
Incineration of raw sludge	0.0
Incineration of digested sludge	0
Phyto-conditioning/ composting	0.3
Other	0
Total	100

Table 3: Sludge Treatment Processes

Energy Generation

We are one of the largest energy consumers in Wales using 3% of Wales’ electricity. The processes that we have to employ to treat wastewater can be very energy intensive. The rising cost of energy from our suppliers adds significant upward pressure to our operating costs and, therefore, customer bills.

During AMP5 and AMP6 we have increased our renewable energy production capacity from our sludge digestion plants. The total energy generated over AMP5/ early AMP6 and predicted to the end of AMP6 is shown in Table 4.

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Year	AMP	Energy from CHP GWh	G2G electrical equivalent GWh	Total sludge generation electrical equivalent GWh
2010/11	AMP5	19.6	0	19.6
2011/12		39.5	0	39.4
2012/13		35.3	0	35.3
2013/14		40.6	0	40.6
2014/15		42.3	0	42.3
2015/16	AMP6	40.7	2.4	43.1
2016/17		39.3	6.1	45.5
2017/18		39.3	7.2	46.5
2018/19		44.1	7.1	51.3
2019/20		44.6	17.2	61.8

Table 4: Energy generation through sludge digestion

Planning for the Future

The predicted sludge quantities to be treated is indicated in Figure 3. The quantity is expected to rise by circa 1 ttds / year. Additional loadings were

allowed for in the sludge management schemes developed over AMP5 and AMP6.

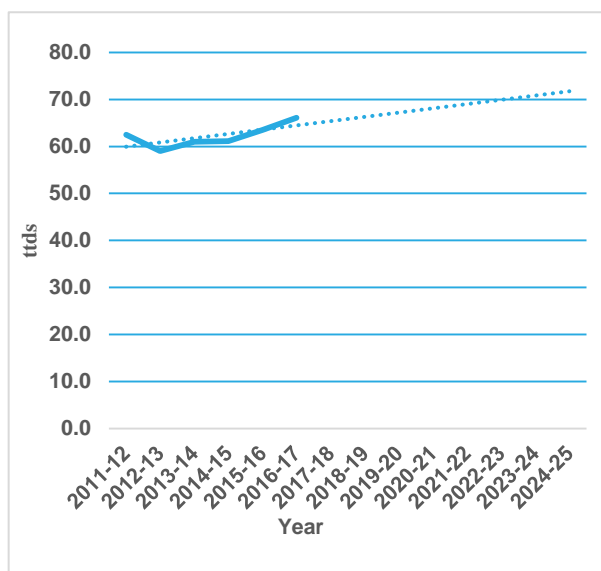


Figure 3: Total Sewage Sludge produced ttds/year

3 Options

Background

Our approach to identifying and prioritising expenditure required over AMP7 has been underpinned by our objectives to:

- Maintain our sludge assets to ensure the on-going sustainable management of sludge;
- Ensure continued certification with the Biosolids Assurance Scheme (BAS). This is critical to ensure we provide assurance to food chain stakeholders and customers as to the quality of our sludge disposed of to land and consequently help protect our landbank;
- Ensure compliance with statutory requirements;
- Sustain the recycling of treated sludge to agriculture whilst investigating other outlets, including commercial opportunities and potential innovative options;
- Review and wherever possible improve the operation of assets to increase the quantity of enhanced sludge product;
- Maximise the generation of renewable energy from sewage sludge and reduce our carbon footprint;
- Identify and implement innovation to improve performance;
- Improve the resilience of our operations; including the provision of increased strategic sludge storage;
- Meet the Ofwat KPI “Satisfactory Sludge Disposal”;
- Contribute towards the delivery of performance targets set out in our Measures of Success (MoS);
- Manage risks associated with the deterioration in the asset base that could lead to disposal of non-compliant sludge to agricultural land (we have been 100% compliant with this indicator to date);
- Address objectives set out in our Sewage Sludge Strategy 2015-2040, in particular to:

- Ensure a sustainable outlet for the disposal of sewage sludge / protecting our land bank;
- Continue to maximise energy generation and reduce our operational costs;
- Maximise renewable energy production.

Measures of Success

We will continue to monitor our performance through our “Measures of Success” (MoS). These identify targets that we need to achieve to contribute to our overall aims and objectives and meet the needs of our customers. Our proposed investment will contribute towards the MoS identified in Table 5.

Measure of Success	End of AMP6 Performance Target	End of AMP7 Performance Target
Ft3 Energy Self Sufficiency – Electricity generated and gas injected to grid as a percentage of all electricity and gas consumed (gas expressed as an electricity equivalent).	26%	35%
En7 Bio resources energy generation – The percentage of sludge processed through our advanced digestion facilities.	95%	97.5%
En8 Biosolids Disposal Compliance – The percentage of sludge disposed of satisfactorily.	100%	100%

Table 5: Measures of Success contributed to

High Level Options Appraisal

In identifying options for this investment case and to better understand the risks and opportunities

relating to our sludge management assets, we had regard to the following:

- Initiatives undertaken over AMP5 and AMP6 as part of the North and South Wales Sludge Strategies;
- Relevant risks recorded in Investment Manager;
- Feedback from stakeholders, in particular the Wastewater Assets, Operations and Energy teams;
- Recommendations in our Sewage Sludge Strategy 2015-2040;
- Assessment of reactive and forward looking capital maintenance based on consultation with stakeholders (in particular the Operations and Wastewater Assets teams) and having regard to historic expenditure;
- Proposed capital and operational expenditure in other wastewater related investment cases;
- Customer expectations.

Option 1: Reactive only

An option to review the costs and consequences of reacting to failure (fix on failure) rather than proactively reducing the risk of service failure.

The impacts of this investment decision will be an increase in the number of failures of our sludge processing assets with consequent need to frequently store sludge for potentially long periods. This will have odour impacts as well as increased risk of pollution incidents. We would also likely lose our BAS certification which would result in the loss and availability of landbank for the disposal of sludge, due to the loss of trust by landowners and our customers with respect to the quality of our sludge.

Our customer engagement identified there was a particular drive from across our customer base to reduce pollution incidents to protect our rivers and coastal waters.

As our overall objectives identified for AMP7 would not be achieved; in particular the risk associated with loss of BAS certification is not acceptable and the option is contrary to our customers' aspirations

to reduce pollution, then this option is not considered to be tenable over AMP7.

Option 2: Maintenance plus resilience

This expenditure primarily focuses on the on-going maintenance of our sludge management assets, including our sludge digestion plants, combine heat and power systems and sludge collection sites developed over AMP6. This investment will ensure we will continue to generate energy, maintain our gas to grid operations and produce an enhanced sludge product to achieve our target of 97.5% production by the end of AMP7. The investment will enable us to retain BAS certifications over AMP7, which is fundamental to the protection of our land bank.

The investment will also ensure we maintain and develop the renewable energy initiatives developed over AMP5 and AMP6 so as to:

- Maximise the renewable energy generated through improved energy efficiency;
- Reduce our carbon emissions and operating costs;
- Reduce Operational Carbon Reduction.

Investment over AMP7 is also proposed for the further provision of strategic sludge storage to increase the resilience of our activities should there be a temporary loss of land bank for sludge disposal.

Option 3: Maintenance plus additional enhancements

This option is based on Option 2 with respect to the maintenance of our assets and increased strategic sludge storage capacity, but it also includes the proposals identified in Table 6. These were based on proposals included in the South Wales (and Hereford) and North Wales Strategies, which were not implemented over AMP7.

As our MoS targets could be addressed through Option 2, then it was considered that additional funding was not required over AMP7 and hence could not be justified. It was also considered that works undertaken over AMP6 to improve and develop new sludge management assets should be embedded into our operational practice prior to

Bioresources Assets Maintenance

the further development of the South Wales (and Hereford) and North Wales Sludge Strategies.

It was therefore considered that this option could not be justified.

Option 3 – Additional Proposals	Expenditure
Decommission redundant sludge digesters / tanks or convert to sludge storage (dependent on surveys to be completed)	£2.5 m
Additional strategic Sludge Storage in North Wales - to provide increased resilience	£6.8 m
Further development of the S Wales Sludge Strategy, includes further improvements to satellite sites and additional strategic sludge storage to improve resilience	£30.0 m
N Wales Strategy - Queensferry conversion to sludge dewatering centre	£6.17 m
Conversion of the Ruthin STC	£3.2 m

Table 6: Option 3 Additional Proposals

Preferred Option

Option 2 is our preferred option.

The option will achieve our AMP7 performance targets and is considered to reflect customer and stakeholder sentiments as well as fitting in with an affordable wastewater programme. The investment in additional strategic sludge storage will also improve the overall resilience of our sludge management activities.

4 Preferred option

We consider that our proposed pre efficiency expenditure of £39.94m provides a balanced programme, developed following an analysis of the challenges, opportunities and risks, and presents the best value for money to help achieve performance targets identified in our Measures of Success at an affordable cost to customers.

Our investment plan includes key programmes of work as identified in Table 7. Although the expenditure is primarily maintenance, the strategic sludge storage is identified as enhancement, as it includes an additional asset to mitigate a key resilience risk.

Programme of work	AMP7 Capex Base	AMP7 Capex Enhancement	Total AMP7 Capital Investment
Strategic sludge storage	£0.00 m	£6.62 m	£6.62 m
PCM – sludge transfer sites	£2.43 m	£0.00 m	£2.43 m
SLUDGE FLCM	£8.76 m	£0.00 m	£8.76 m
SLUDGE PCM – sludge treatment centres	£8.03 m	£0.00 m	£8.02 m
SLUDGE RCM – sludge treatment centres including CHP	£9.24 m	£0.00 m	£9.24 m
RCM – sludge transfer sites	£4.86 m	£0.00 m	£4.86 m
Total programme (pre-efficiency)	£33.32 m	£6.62 m	£39.94 m
Total programme (post-efficiency)	£29.84 m	£6.02 m	£35.86 m

Table 7: Preferred option - Summary of proposed AMP 7 Expenditure

The following provides additional information on proposed expenditure.

- Strategic Storage £6.62m:** The provision of strategic sludge storage will increase the resilience of our sludge management activities should there be a temporary loss of land bank for the disposal of treated sludge. Proposed expenditure will provide an additional circa four weeks storage and will contribute to our aim to have four months strategic sludge storage available by the end of AMP9. Such storage would be provided by a covered barn, or multiple smaller barns, with suitable ventilation, drainage and liquor collection facilities. The costs are based on a desktop assessment.
- Planned Capital Maintenance (PCM) – Sludge Treatment Centres (£8.03m) and Sludge Transfer Sites (£2.43m):** This incorporates funding to address service risks identified over AMP7 and to manage risks associated with the deterioration in the sludge management asset base.
- Forward Looking Capital Maintenance (FLCM) £8.76 m:** FLCM will address deterioration of equipment / assets and performance risks, which would otherwise lead to potential failures.
- Reactive Capital Maintenance (RCM) – Sludge Treatment Centres (£9.24m) and Sludge Transfer Sites (£4.86m):** RCM expenditure will address asset and equipment failures and breakdowns.

The proposed Reactive Capital Maintenance (RCM) and Forward Looking Capital Maintenance (FLCM) are to include expenditure on sludge digestion plants, sludge collection and above 10% DS dewatering sites. The figures are based on a review of expenditure made over AMP6 and an assessment of requirements of new sludge assets delivered with AMP6 investment, having regard to the extent of assets identified as sludge management over AMP7 (refer to Appendix B).

Proposed expenditure was reviewed and supported by our Sewage Sludge Management Steering Group.

The post efficiency capital investment incorporates planned capital savings resulting from the more efficient delivery of schemes and improvements in operational efficiency. Further information is included in section 5.

Opportunities for innovation will be identified and developed, in particular to ensure the protection of the land bank, increase the efficiency of our operations and maximise the energy generated through our sewage sludge. Further information is included at Appendix 5.

Opex Impacts

The investment proposed over AMP7 will be focused on maintaining the equipment / assets which will be in place by the end of AMP6. There will be no impacts on operational expenditure as a result of proposals over AMP7.

Similarly there will be no significant increase in the energy generated by new sludge assets as none are proposed over AMP7. However increases may occur due to innovative projects / operations.

Comparison with AMP6 Expenditure

As shown in Figure 4 the proposed investment over AMP7 is significantly lower than the estimated final expenditure over AMP6 of £141.5m. However expenditure over AMP6 was exceptionally high due to the extensive programme of AAD development and sludge transfer/ collection schemes undertaken across both North and South Wales, together with the provision of additional strategic sludge storage (refer to section 2).



Figure 4: AMP6 & AMP7 Expenditure

The Sewage Sludge Management Steering Group will support the monitoring and review of performance, risks and challenges over AMP7 to ensure we achieve our objectives.

5 Cost efficiency and innovation

Cost efficiency

We propose to deliver £4.08m of cost efficiencies over AMP7 as part of this investment programme, as shown in Table 8 below. The approach that we are proposing is consistent with the strategy that we introduced in AMP6. Our intention is to build on our AMP6 progress, and further improve the planning and delivery of our AMP7 interventions.

Programme of work	Proposed programme total budget
Additional Strategic Storage	£6.62 m
PCM – sludge transfer sites	£2.43 m
SLUDGE FLCM	£8.76 m
SLUDGE PCM	£8.02 m
SLUDGE RCM including CHP	£9.24 m
RCM – sludge transfer sites	£4.86 m
Total programme (pre-efficiency)	£39.94 m
Total programme (post-efficiency)	£35.86 m
Cost efficiency saving	£4.08 m

Table 8: Proposed Cost Efficiency

The post efficiency capital investment incorporates planned capital savings resulting from:

- Efficiencies in the delivery of schemes by our Alliance Framework e.g. through more effective delivery processes and innovative capital schemes
- On-going improvements resulting from internal business reviews and operational projects e.g. the Maintenance and Reliability Support (MaRS), Sludge, Optimising, Reporting & Tracking (SORT) and LEAN projects (refer to Appendix A). These initiatives will particularly focus on:
 - Increasing the capabilities of our personnel
 - Improving operational activities to increase efficiency and improve effectiveness;
 - Managing activities with improved data to increase sludge centre availability;
 - Improving sludge thickness at origin sites;
 - Improving the scheduling of our internal tankers;
 - Reducing the reliance on Contractor loads;
 - Improving communications and performance monitoring.

Summary of innovation

Opportunities for innovation will be identified and developed, in particular to ensure the protection of the land bank, increase the efficiency of our operations and maximise the energy generated through our sewage sludge. Initiatives being developed include:

- Anaerobic Digestion Optimisation & Innovative Strategies - Removing inhibition & improving performance and increasing gas yield by 40%;
- Orege SLG unit: conditioning & dewatering of sludge. Performance guarantee increase in dewatered sludge DS by +3%, reduction in odour and 30% reduction in polymer consumption;
- Maximising solids capture throughout the whole treatment process together with increased percentage dry solids;
- Developing better sludge products and increased efficiency: through improved dewatering, reduced use of polymer and pre-treatment initiatives;
- Ultra-waves: Sonication of Digester sludge recirculation line, will increase gas yield by 20% and improve the ammonia inhibition problems experienced.

Other initiatives include:

- Increasing resilience of sludge treatment facilities at sludge thickening / feeder sites: to consider the use of mobile mitigation kit;
- Working in partnership with other water companies to increase resilience of our activities e.g. we will continue to work with other water companies to share available AAD capacity in the event of a failure;
- Reviewing opportunities to use decommissioned tanks for sludge storage, particularly for wet sludge imported to sites (this is also a BAS driver);
- Opportunities to further improve the competencies of our personnel to provide a more flexible and skilled workforce.

Partnering and co-creation

Working closely with our partners is essential to the way we plan to work in the future. Our 2050 strategy highlights this through identifying partners for each of our programmes of future work.

We aim to undertake this work in partnership with customers and communities, the Customer Challenge Group and crucially, developers and power providers.

6 Value for money and affordability

Impact on customer bills

As part of our Customer Engagement Programme for PR19, there was a requirement to ensure a comprehensive understanding of customer views on the performance measures and the corresponding Willingness to Pay (WtP).

We understand the importance of balancing the need for investment with the affordability of our bills. We believe the investment will help to deliver the level of service our customers and regulators expect, and represents an optimal approach for sustained long term improvement.

proposed investment, we have closely considered the costs and benefits of different approaches to make sure that the investment represents long term value to our customers.

As outlined in the section 5 of this document, we will also seek to ensure value for money by identifying and developing opportunities to work more effectively, delivering schemes at a lower cost through improved processes and promoting innovation throughout delivery, by learning lessons from the work we have delivered to date, and by working closely with our partners to encourage best practice and incentivise efficiency.

Value for money

We recognise the need to demonstrate value for money in everything that we do. In arriving at the

7 Delivery

Procurement

The various projects will be managed by our Wastewater Assets team throughout AMP7 with scope and programme adjustments being made to meet current operational and other issues. We will monitor performance month by month so that we can respond quickly to emerging signs if we are not getting the benefits we have projected.

Delivery Programme

A prioritised delivery programme will be developed linked to the wider wastewater programmes and associated benefits of the interventions. This programme will be developed and optimised early in year five of AMP6

These delivery programmes of work will be continually updated following performance reviews, compliance failures, customer complaints and the identification of circumstances that lead to opportunistic interventions.

Risk mitigation and customer protection

Key risks and uncertainties with respect to current and future management of sludge are as follows:

- Non-compliance with Regulatory requirements and the Biosolids Assurance Scheme;
- Revised regulation of sludge treatment & disposal;
- Loss of landbank due to negative perceptions of public with respect to disposal of biosolids to land forming part of food chain production;

- An increase in the temporary loss of landbank over extended periods of time due to the impacts of climate change;
- Increased costs of sludge disposal due to additional distances travelled to available landbank;
- More stringent regulation / best practice requirements restricting disposal to land;
- Structural integrity of decommissioned storage and digester tanks;
- Increased complaints of odour nuisance arising from sludge handling, treatment and disposal to land;
- Impact of significant rises in future energy prices;
- Managing uncertainty e.g. unforeseen failure of a critical assets;
- Potential requirement to comply with the Industrial Emissions Directive;
- Potential concerns relating to micro-plastics in sludge to land;
- The potential impacts of phosphorus – how bound is phosphorus in sludge;
- Tightening of emissions from Digestion Plants (CHPs) in the future.

Further information on mitigation measures are included in Appendix B.

8 Assurance

Board assurance

Our current approach to asset management, including our approach to maintenance expenditure is endorsed by our executive and board.

We have a gateway approval process that all capital projects must pass through to ensure there is sufficient scrutiny and challenge from senior management.

There are six stages of the capital investment process and a gateway between each stage. The gateway defines the requirements that are to be met before a project can be approved to move to the next stage. The six gateways are as follows:

1. Commit to risk
2. Commit to feasibility
3. Commit to solution
4. Commit to delivery / start on site
5. Commit to handover.

Our Capital Programme Board (CPB) has the delegated authority to approve projects through the gateways. The approach provides strong governance for approving investment decisions and is transparent and fully auditable.

We will continue to apply these effective governance systems for our proposed AMP7 investment programme.

Cost assurance

Where we have undertaken high-level scheme investigations we have used our Unit Cost Database (UCD). Our UCD holds the historical costs associated with delivering projects in the current and previous investment programmes (AMP 4 through to and including AMP6) and has been independently benchmarked for PR19. The underlying cost models are updated annually to ensure the latest costs are applied.

Where we have budgeted for our programmes we have used our latest forecast expenditure costs (based upon actual outturn) from AMP6 to inform our plans.

Customer consultation assurance

We have taken measures to ensure that our customers can have confidence in the results of our PR19 Customer Research. We have commissioned an independent peer review of the WtP research methodology and the finding by a subject matter expert on non-market valuation. This review stated that the research has been *'expertly undertaken'* and that the *'WtP values, results, in terms of impact scores for customer preferences for improvements, appear to be accurate, and most seem to be intuitively reasonable'*.

We have also contributed to an industry-wide comparative review of the WtP results from PR19 WtP research from across the Water and Sewerage Companies to provide assurance that our WtP results are not over or understated in comparison with the rest of the industry. For the areas of WtP relevant to this investment case, the comparative review showed that our results were not outlying values and were generally towards the middle of the pack, giving us confidence that our cost benefit methodology where based upon WtP will be consistent with others in the industry.

We have also presented our approach and results from our PR19 Customer Research to our Customer Challenge Group.

Measures of success

The MoS relevant to this investment case and their targets are all commensurate with the preferences our customers' expressed in our AMP6 and PR19 engagement.

Future assurance

We have strong governance procedures for the planning and delivery of our capital investment. We will make sure that the required processes are in place to assure the successful delivery of our maintenance projects. As per PR19, we will also have strong Governance structure around PR24 to ensure that we develop and deliver affordable investment plans that have been influenced by our customers and key stakeholders.

References

*ⁱ DCWW Sewage Sludge Strategy (plus Review and Update of Proposals / Initiatives in the Wastewater Sludge Strategy – October 2015)

*ⁱⁱ PR19 Supporting documents 1.1B and 1.1F - Performance Targets - PR19 Customer Engagement: Performance targets qualitative research

PR19 Supporting Document 5.2 - Performance commitments/MOSs - PR19 Performance commitments

PR19 Supporting Document 5.3 - Performance commitment definitions - PR19 Performance commitments definitions

*ⁱⁱⁱ PR19 Supporting document 1.1 - Customer Engagement, and

PR19 Supporting document 1.2 - Stakeholder Engagement Welsh Water – Measures of Success

PR19 Supporting Document 1.4 - Welsh Water 2050

Appendix A: Operational Initiatives

There are several ongoing operational initiatives which will support capital investment proposed across our sludge management activities and improve efficiency and effectiveness of our operations.

The following recent initiatives are of relevance to this Investment Case:

A1 LEAN Strategy

LEAN is a methodology that has been devised to help us to deliver on what our customers' value most by improving our processes and removing inefficiency. Its aims are to:

- Help specify and understand value;
- Help us to get better at what we do;
- Remove the things that get in the way of us doing our job;
- Increase empowerment and ownership;
- To be an enabler to help us deliver our business goals.

It incorporates the following principles:

- Engage Colleagues – Our staff are experts in the use and application of our systems and processes and need to be involved in designing future solutions;
- Understand Customer Value – we need to know what our internal and external customers value about what we do;
- Remove Waste and Create Flow – Removing the blockers to how we do our job and deliver customer value;
- Excellence in Everything we do – Constantly trying to be the best.

The implementation of LEAN will result in:

- A proactive approach to maintenance and reduced reactive activities;
- The reduction of equipment failures through increased monitoring of equipment to identify reductions in equipment performance and potential failures more quickly;
- Improved operator engagement to include increased multiskilling and hence reduced costs e.g. enable operators to make basic mechanical and electrical adjustments, calibrations and parts replacement;
- The increased implementation of planned preventative maintenance activities, developed through the application of reliability centred maintenance and the analysis of predictive maintenance / condition monitoring.

A2 Maintenance and Reliability Support (MaRS) Project

The MaRS project aims to identify and reduce gaps in five major categories of our operations that have significant impact on plant performance and the cost of providing maintenance services. These categories form the recognised standard of performance in Maintenance and Reliability as defined by the Society for Maintenance and Reliability Professionals. These categories being:

- Business and Management;
- Process Reliability;
- Equipment Reliability;
- People Skills;
- Work Management.

The work being undertaken provides an evaluation and improved understanding of the gaps that exist between our practices and recognised industry best practices that drive physical asset reliability. As an example the work has reviewed the current processes from definition through to reconciliation for current expenditure types including Reactive Capital Maintenance (RCM), Forward Looking Capital Maintenance (FLCM) and Planned Capital Maintenance (PCM). It identified that historical organisational changes and regulatory requirements have resulted in iterative changes to processes that have never been clearly re-defined and recommended changes to align processes utilised and utilise our corporate finance system (SAP) to provide a more effective resource and management tool. Similarly initiatives to improve the categorisation and management of maintenance work, including resources and materials and time recording, have been identified to increase operational efficiency. Maintenance and materials management improvement plans will be developed to ensure an integrated and co-ordinated approach to improvements across the organisation.

A3 Sludge, Optimising, Reporting & Tracking (SORT) Project

This initiative identifies and implements opportunities to make the most effective use of our resources to minimise costs by for example:

- Managing activities with improved data to increase sludge centre availability;
- Improving sludge thickness at origin sites;
- Improving the scheduling of our tankers;
- Reducing the reliance on Contractor loads;
- Improving communications and performance monitoring.

Appendix B: Key risks and mitigation measures

Key risks and uncertainties with respect to current and future management of sludge are identified below together with mitigation measures. These include:

- **Non-compliance with Regulatory requirements and the Biosolids Assurance Scheme:** Proposed investment over AMP7 to maintain sludge assets developed over AMP5 and AMP6 will mitigate this risk;
- **Revised regulation of sludge treatment & disposal,** which will mean that investment over AMP7 will be outside of the RCV: Business changes are being made to address this;
- **Loss of landbank due to negative perceptions of public with respect to disposal of biosolids to land forming part of food chain production:** The production of an enhanced sludge product and certification through the Biosolids Assurance Scheme will mitigate this by providing increased confidence to landowners and the public regarding the quality of sludge disposed to land. Research will also be undertaken into alternative options for the disposal of sludge; including land reclamation, forestation and other commercial opportunities such as utilising sludge products to grow energy crops;
- **An increase in the temporary loss of landbank over extended periods of time due to the impacts of climate change:** It is proposed to provide additional strategic sludge storage over AMP7;
- **Increased costs of sludge disposal due to additional distances travelled to available landbank:** Opportunities to reduce sludge volumes transported will continue to be investigated and alternative options for treated sludge will be reviewed such as sludge for energy crops. The production of an enhanced product will make this far more attractive to agricultural land owners, hence reducing the risk of local land bank availability;
- **More stringent regulation / best practice requirements restricting disposal to land:** The production of an enhanced sludge product will reduce this risk and alternative options for treated sludge will be reviewed such as sludge for energy crops;
- **Structural integrity of decommissioned storage and digester tanks:** Risk will be reduced due to the investment on new AAD sites and sludge transfer sites over AMP6. Regular inspections and maintenance of the sludge assets will be undertaken and investment targeted to address structural concerns where identified;
- **Increased complaints of odour nuisance arising from sludge handling, treatment and disposal to land:** Odour monitoring and modelling will be undertaken where complaints are received and mitigation works undertaken to address identified issues to include reviews and changes where required to operational processes. Measures to cease liming of sludge and reduced quantities of treated sludge to be disposed of through our AAD plants will help mitigate concerns;
- **Impact of significant rises in future energy prices:** Initiatives will be developed to increase energy efficiency, reduce demand, increase renewable energy produced and increase storage capacity;
- **Managing uncertainty e.g. unforeseen failure of a critical assets:** Resilience plans will continue to be monitored and reviewed;
- **Potential requirement to comply with the Industrial Emissions Directive (exemption at the moment):** Discussions with the Natural Resources Wales (NRW) and Environment Agency (EA) will be undertaken to ensure this is effectively managed;
- **Potential concerns relating to micro-plastics in sludge to land:** We will contribute to research into this including UKWIR project;

- **The potential impacts of phosphorus – how bound is phosphorus in sludge:** Assessment to be undertaken to assess potential risks and if confirmed, mitigation measures will be developed;
- **Tightening on emissions from Digestion Plants (CHPs) in the future:** Alternative options to CHPs will be investigated such as the use of fuel cells.

We will manage risk through improved monitoring of our assets, processes and operations on site. Our Investment Manager system will be a critical tool to enable us to record and prioritise risks and we will utilise this, together with our analysis of performance, to help monitor, review and prioritise expenditure.

Appendix C: Sludge Treatment Centre / Wastewater Treatment Works Boundaries

Extracts from Ofwat RAG 4.06 – Guideline for the table definitions in the annual performance report

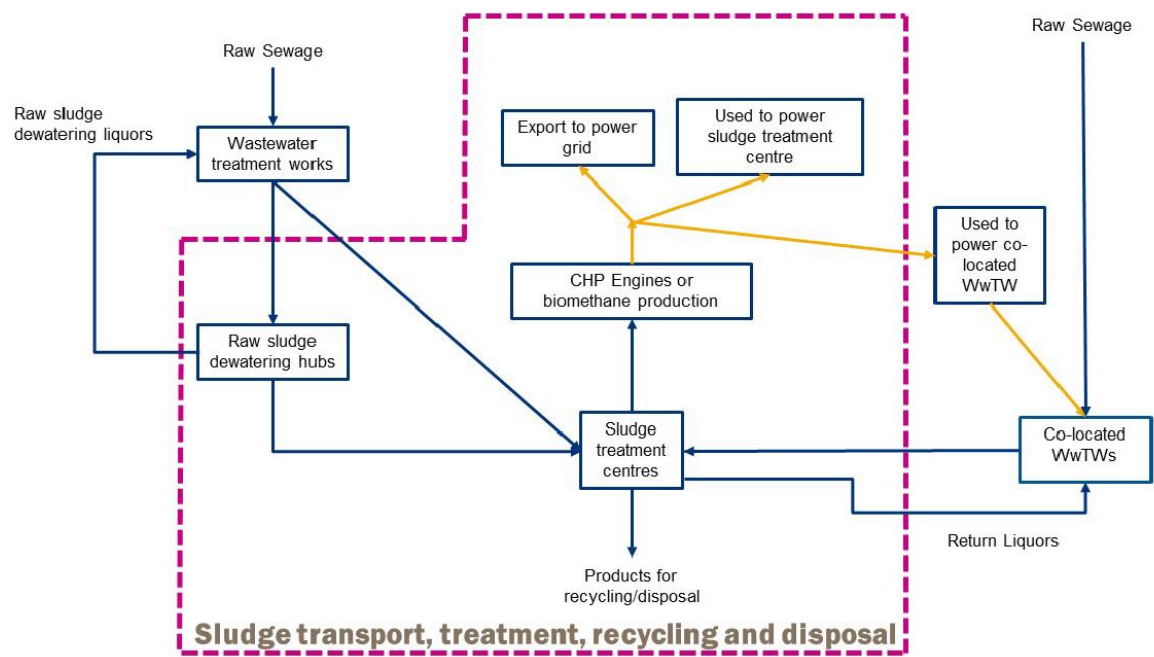


Figure 5: General Sludge Boundary

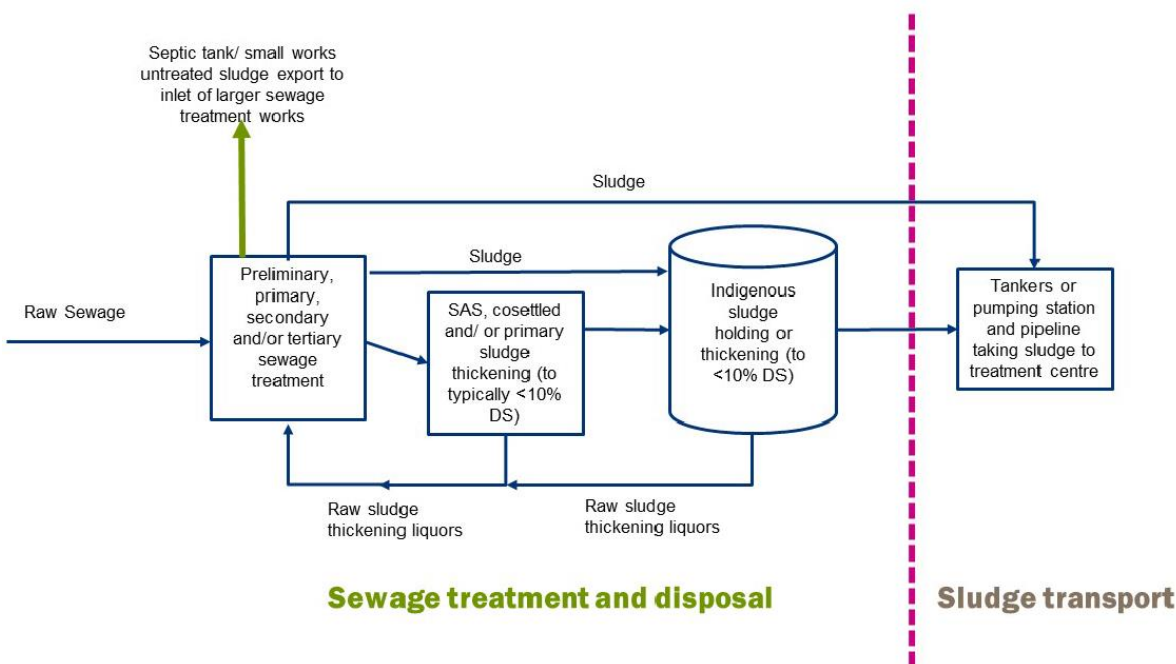


Figure 6: Sludge Boundary Detail (Wastewater Treatment Work Sites without STC's)

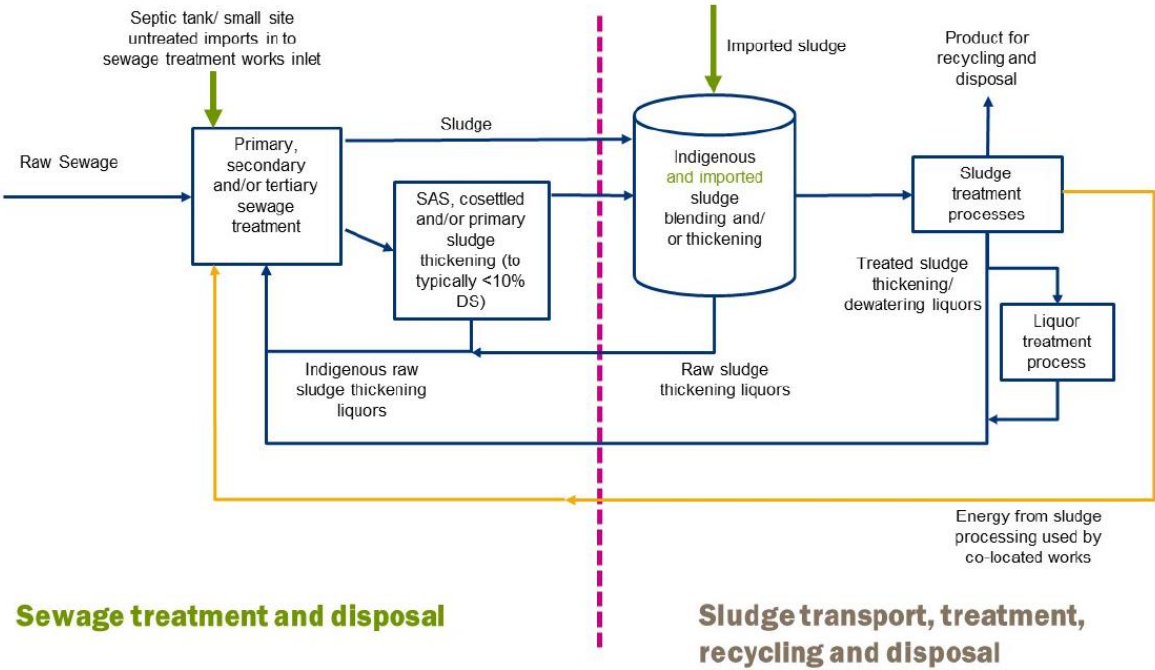


Figure 7: Sludge Boundary Detail (Co-located Site Detail) Showing Main Transfers Across the Boundary